

March 2019

# HAZARDOUS WASTE DISPOSAL GUIDE

*FOR  
RESEARCH  
AREAS*



**DARTMOUTH**  
Environmental  
Health & Safety

Hazardous Waste  
Management Program

Phone: (603) 646-1762  
<http://www.dartmouth.edu/~ehs>

# DARTMOUTH COLLEGE EMERGENCY CONTACTS

## ENVIRONMENTAL HEALTH AND SAFETY (EHS)

<b>DARTMOUTH COLLEGE – EMERGENCY CONTACTS</b>	
Police, Fire, Medical Emergencies	911
DHMC Campus (Borwell, Rubin, Williamson)	5555
<b>Safety &amp; Security</b>	
Emergency	(603) 646-3333
Non-Emergency	(603) 646-4000
DHMC Safety (Borwell, Rubin, Williamson)	(603) 650-7896
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# RESPONSIBLE MANAGEMENT OF HAZARDOUS WASTES

## •WHAT WE ALL MUST DO TO COMPLY•

### LABEL IT, CLOSE IT, PUT IT IN SECONDARY CONTAINMENT

1. Complete the "Laboratory Safety and Hazardous Waste Training" module located at <https://dartmouth.bioraft.com/>
2. Read this document carefully and refer to it when questions arise. Help is always available from EHS by phone or email.
3. Properly label all stock chemicals and hazardous waste containers.
4. Keep waste containers closed except when adding waste.
5. Never mix incompatible wastes.
6. Store waste in sturdy, chemically resistant containers.
7. Segregate incompatible waste and chemicals at all times.
8. Use secondary containment for all hazardous liquids and liquid wastes.
9. Never dispose of hazardous wastes by evaporation, sewer or in the regular trash.
10. Notify EHS at (603) 646-1762 in the event of a significant exposure or spill.
11. Use pollution prevention techniques (Reduce, Reuse, and Recycle.)
12. Never store more than 10 gallons of hazardous waste in your lab.
13. Schedule regular waste pick-ups to minimize waste storage.
14. E-mail [ehs@dartmouth.edu](mailto:ehs@dartmouth.edu) for a waste pick-up.

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# CHEMICAL WASTE STORAGE AND DISPOSAL PROCEDURES

## INTRODUCTION:

### DEFINITION OF CHEMICAL WASTE:

Non-radioactive chemicals and solid waste contaminated with hazardous chemicals.

### Examples:

- ✓ Waste and opened surplus chemicals
- ✓ Expired or off-specification chemicals
- ✓ Carcinogens and Antineoplastic agents
- ✓ Prescription drugs and controlled substances
- ✓ Empty drums and other containers with a capacity of 10 gallons and greater
- ✓ Thermometers and other items containing mercury
- ✓ Non-returnable gas cylinders and lecture bottles or pressure containing vessels
- ✓ Residue of spill clean-up materials-contaminated rags and absorbents
- ✓ Non-radioactive lead shielding and lead scrap
- ✓ Photographic film processing solutions
- ✓ Used oil --- motor, vacuum pump, lubricating
- ✓ Pesticides
- ✓ Used solvents
- ✓ Batteries
- ✓ Paint, paint thinners, brush cleaners, linseed oil, thinner contaminated rags
- ✓ Heavy metal containing waste or products (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver)

### CHEMICAL WASTE DISPOSAL OVERVIEW:

#### 1) Collect hazardous waste in sturdy leak proof containers for disposal

- ❖ Do not dispose of hazardous chemicals via the sink, in the trash with/as biological waste or with/as radioactive waste.
- ❖ Evaporation is not an acceptable waste disposal method. Only insignificant, residual amounts of liquid associated with labware or containers can be treated in this way.
- ❖ Separate aqueous mixtures and organic solvents.



## CHEMICAL WASTE DISPOSAL OVERVIEW (CONT'D)

- ❖ Do not mix radioactive materials with chemical waste.

### 2) Hazardous Waste Collection Containers must be properly labeled and sealed at all times

- ❖ All chemicals to be discarded must have a properly completed EHS Hazardous Waste Label attached.
- ❖ On the waste label, identify major constituents by **COMPLETE** chemical name not by acronym or brand name.

### 3) Containers must be stored properly

- ❖ Containers must be sealed, in secondary containment and away from incompatibles
- ❖ Caps must be tight. No funnels or filling aids during storage.
- ❖ Process waste containers (i.e. HPLC) must have a cap with tight fitting hole for the fill tube.
- ❖ Never store flammables with oxidizers or acids with caustics.
- ❖ EHS provides bins for segregation and containment purposes.
- ❖ Flammable wastes are best stored in an FM rated cabinet with a built-in containment area.

### 4) Request a waste pick up from EHS as soon as containers are full

- ❖ E-mail: [ehs@Dartmouth.edu](mailto:ehs@Dartmouth.edu) for a pick up.
  - (See 'How to Arrange for a Waste Pick-Up')
- ❖ Do not abandon chemicals. Contact EHS immediately for proper disposal.

#### Reminders:

- ❖ Always wear eye/face protection, lab coat and gloves when working with hazardous chemicals.

Consult Safety Data Sheets (SDS) for more information on hazardous chemicals you may work with at Dartmouth College. SDS's can be found in two places:

- BioRAFT - [https://dartmouth.bioraft.com/raft/research\\_tools/SDS/](https://dartmouth.bioraft.com/raft/research_tools/SDS/)
- CEMS - <https://cems.unh.edu/dartmouth/>

#### WASTE COLLECTION AREAS:

Any location where small amounts of hazardous waste are stored temporarily prior to pick-up by EHS is called a "Satellite Accumulation Area" or SAA. This could be a

## WASTE COLLECTION AREAS (CONT'D)

room, bench top or laboratory. For laboratory spaces with fume hoods, the whole lab is designated as a Satellite Accumulation Area.

These areas must **NOT** contain *greater than 10 gallons of hazardous waste*. EHS requires that you keep your hazardous waste volumes below 10 gallons by requesting waste pick-ups routinely. If this 10 gallon limit is or will be exceeded, additional requirements such as a monthly inspection apply.

## HOW TO ARRANGE FOR A WASTE PICK-UP:

E-mail: [ehs@Dartmouth.edu](mailto:ehs@Dartmouth.edu) with the following information:

- Name of Principal Investigator
- Location of the Waste (room number and whereabouts)
- Description of Waste Contents
- Volume of Waste

## WASTE COLLECTION OPTIONS:

### WASTE COLLECTION CONTAINERS:

Waste Collection Container Requirements:

- ❖ Must be compatible with all chemicals collected.
- ❖ Must be sealable and kept sealed except when adding contents.
- ❖ Must be labeled with a EHS Hazardous Waste Label with the following essential information:
  - Chemical Contents (Full chemical name not abbreviations)
  - Percent of Each Chemical Content
  - Date that container was filled
- ❖ Must be kept in secondary containment bins (for liquids).
- ❖ Must be segregated from incompatibles.
- ❖ Must be disclosed and turned over to EHS within 3 days of the fill date.

### OPTION A. ORIGINAL CONTAINER

If a chemical is to be discarded in the original container, attach a completed EHS Hazardous Label. Contact EHS if you have old virgin products for disposal.

## WASTE COLLECTION CONTAINERS (CONT'D)

### **OPTION B. CONTAINER OTHER THAN ORIGINAL CONTAINER**

If a chemical is placed in a second container that is not the original, mark "XXX" through the waste container label and attach a completed EHS Hazardous Waste Label.

### **OPTION C. CHEMICALLY CONTAMINATED SOLID WASTE**

1. Obtain a six (6) quart plastic pail with a lid from EHS. Label the outside of the pail with a completed EHS Hazardous Waste Label.
2. Line the pail with a clear plastic bag. The lid must be on the pail except when adding contents to the bag.
3. When bag is full, tape the bag closed, attach an EHS Hazardous Waste Label to the bag and contact EHS for pick-up.

**NOTE: NEVER USE BLACK PLASTIC OR BIOHAZARD BAGS TO COLLECT CHEMICAL WASTES!**

### **OPTION D. SOLVENT WASTE**

1. Solvents must be collected in containers identical to the original.
2. Complete and attach an EHS Hazardous Waste Label. Each time you add waste to the container, make a note on the waste tag. Use a pencil as ink will smudge.
3. Fill container no further than the shoulder. DO NOT OVERFILL.
4. Once a collection container is full, it must be presented for disposal.
5. Absolutely no mercury or other heavy metals are to be mixed with solvent waste.
6. Store waste solvents away from heat or other sources of ignition.

## WASTE COLLECTION CONTAINERS (CONT'D)

### DISPOSAL OF EMPTY CHEMICAL CONTAINERS:

1. Only *trivial* amounts of the chemical may remain. Thoroughly empty all contents before rinsing. If solids or sludge remain, dispose of as hazardous waste.
2. All chemical containers must be rinsed thoroughly and air-dried. The first rinse must be collected and disposed of as hazardous waste.

NOTE: For containers of highly toxic chemicals ( $LD_{50} < 50\text{mg/kg}$ ), the first three (3) rinses must be collected and disposed of as hazardous waste.

3. Labels must be obliterated, removed or defaced thoroughly before disposal as solid waste.
4. Rinsed and dried glass bottles must be placed in the containers designated for glass disposal.

## SPECIFIC WASTE STREAMS:

### ACIDS AND BASES

1. Collect concentrated acids and bases in original containers whenever possible. This includes nitric, hydrofluoric, sulfuric, glacial acetic, hydrochloric, sodium hydroxide, ammonium hydroxide. Label with a completed EHS Hazardous Waste Label. Hydrofluoric acid etches glass and must be collected in plastic containers.
2. Dilute acid and base solutions may be disposed of down a lab sink with copious amounts of water **provided they are less than 10% (V/V) concentration with a pH between 7-9**. No solvent or metal contamination is permitted for drain disposal.

NOTE: *The use of **chromic acid** or **Chromerge®** is strongly discouraged by EHS. Contact EHS for recommendations on possible alternatives. If used, these cleaning solutions must be collected through the third rinse.*

### ACRYLAMIDE

1. Unused/unwanted acrylamide powder or opened liquid must be disposed of through EHS using Waste Collection Option A.

## **ACRYLAMIDE (CONT'D)**

2. For the collection of acrylamide gels that contain ethidium bromide, dispose of using Waste Collection Option C.

*NOTE: Only small amounts of liquid can be placed in these plastic pails. Large amounts of unpolymerized acrylamide must be treated using waste collection option B.*

## **AEROSOL CANS**

If completely empty, aerosol cans may be disposed of as non-hazardous waste. If contents or pressure remains, label with a Hazardous Waste Label and dispose through EHS.

## **BATTERIES**

There are many types of batteries on campus: automotive, lead-acid, mercury, lithium containing, household and rechargeable. Dispose of **all batteries** through EHS or Dartmouth Recycles.

## **CHEMICAL CARCINOGENS AND MUTAGENS**

If original containers are to be discarded, follow Waste Collection Option A disposal instructions. For associated contaminated disposable labware, follow Waste Collection Option C instructions. Triple rinse empty containers and collect all rinsate as hazardous waste.

## **CONTROLLED SUBSTANCES**

DEA regulated drugs must be kept under lock and key security. If you have a DEA license, you must register this number with EHS. Expired drugs or unwanted controlled substances are collected for disposal by EHS.

## **CYANIDES**

Cyanides, nitrites and sulfides are among the most toxic and rapidly acting substances found in a chemical lab. Symptoms of toxicity occur if these materials are swallowed, inhaled or absorbed through the skin. Keep stored in locked and secure locations. Always use secondary containers to help prevent breaks or spills. Use Waste Collection Option A or B for disposal.

## **DIOXANE**

Dioxane (1,4-Dioxane) is a highly flammable liquid and can form potentially explosive peroxides upon long exposure to air. Containers of dioxane must be dated when opened and tested periodically for the presence of peroxides. Dioxane must be collected using Waste Collection Option D. If old, undated dioxane is found, contact EHS immediately.

## **DRAIN DISPOSAL**

The range of substances that can be potentially hazardous is enormous. Almost any substance can be a hazardous waste if it is disposed of in large quantities or in high concentrations. Federal and state hazardous waste laws permit laboratories to dispose of small amounts of some chemicals in quantities that do not pose a hazard to human health or the environment. It is the policy of Dartmouth College to prohibit the drain disposal of all potentially hazardous chemicals and take a more conservative approach when confronted with a less defined disposal situation.

*In general, a solution or suspension that contains a substance that is not soluble should not be poured down the drain. However, if the water-insoluble material comprises less than about 2% of the mixture, drain disposal is usually acceptable because the small quantity of water-insoluble material will be well dispersed in the aqueous effluent.*

### **SUITABLE FOR DRAIN DISPOSAL**

1. Chemicals of little or no hazard in dilute aqueous solution are suitable for drain disposal. This includes most normal biological metabolites and nontoxic cellular constituents (proteins, nucleic acids, carbohydrates, soluble fats, and their precursors and catabolites.) The pH must always be between 7-9.
2. Common sugars, amino acids and non-toxic common salts (NaCl, MgCl<sub>2</sub>, etc).
3. Benign solvents such as milliliter amounts of ethanol.
4. Some dilute acids and bases (pH between 7-9). Contact EHS for assistance.
5. Biological buffers with pH between 7-9. (Phosphate buffers, saline, Tris, etc.)

### **NOT SUITABLE FOR DRAIN DISPOSAL**

1. Inherently toxic, malodorous or lachrymatory chemicals
2. Solutions containing heavy metals

## **NOT SUITABLE FOR DRAIN DISPOSAL (CONT'D)**

3. Organic solvents- methanol, acetone, hexane, chloroform
4. Poisons, carcinogens, teratogens or embryotoxins
5. Strong acids and bases (either in pH extremes/concentration)
6. Chromic/sulfuric acid cleaning solutions
7. Photographic fixer
8. Motor oil, gasoline, degreasing solutions, antifreeze or other automotive fluid
9. Paint and paint thinner
10. Pesticides
11. Toxic dyes and stains
12. Sodium Azide
13. Flammable liquids (flash point < 140°F) of any type, including solutions of ethanol (ex. 10% EtOH has a flash point of < 140°F) or solvents.

NOTE: See Appendix A for a partial listing of chemicals not suitable for drain disposal.

## **ETHER**

Ether is a highly flammable liquid and can form potentially explosive peroxides over time. Containers of ether must be dated when opened and tested periodically for the presence of peroxides. Ether must be collected using Waste Collection Option D. Ether cans have expiration dates on the label. Dispose before they expire. If old, undated ether is found, contact EHS immediately.

NOTE: See the Chemical Hygiene Plan for more information on Peroxide Formation in Chemicals.

## **ELECTROPHORESIS SOLUTIONS & GELS**

All stock solutions of electrophoresis liquid (mutagenic and non-mutagenic) must be disposed via EHS. Any solutions containing other hazardous chemicals (e.g. DMSO, ethanol, methanol, etc.) must be disposed via EHS.

## ELECTROPHORESIS SOLUTIONS & GELS (CONT'D)

### NON-MUTAGENIC DYES

(SYBR SAFE, SAFEWHITE, SAFERED, GELGREEN, GELRED, EVAGREEN, EZ VISION TWO)

1. Dilute solutions of these non-mutagenic dyes may be drain disposed.
2. Solid waste (e.g. gels and contaminated debris) of these non-mutagenic dyes may be disposed in the regular trash.

NOTE: SafeGreen contains DMSO. Solutions and solid waste need to be collected for disposal via EHS using Waste Collection Option A, B or C.

### MUTAGENIC DYES

(ETHIDIUM BROMIDE, PROPIDIUM IODIDE, SYBR GREEN, SYBR GOLD, ACRIDINE ORANGE, GELSTAR)

1. All solutions must be disposed via EHS using Waste Collection Option A or B.
  - a. Exception – Ethidium Bromide aqueous solutions of 5 micrograms/milliliter or less must be treated by using the Schleicher & Schuell Extractor device obtained from the Scientific Stockrooms. (stock #8150). This includes staining and running buffer solutions. Follow the manufacturer's instructions. After filtration, the decontaminated filtrate can be safely discarded down the drain (pH must be between 7-9). The filters are discarded by using Waste Collection Option C. Prefilter large solids first.
  - b. *Solutions of greater than 5 micrograms/milliliter* such as stock solutions and ethidium bromide mixed with cesium chloride and/or alcohol must be disposed using Waste Collection Option B.
2. All contaminated debris (e.g. gels, gloves, towels, etc.) must be collected as hazardous waste and disposed via EHS using Waste Collection Option C.

NOTE: *Never use bleach to treat EtBr wastes. This increases toxicity.*

## FORMALIN/FORMALDEHYDE/PARAFORMALDEHYDE AND GLUTARALDEHYDE

1. Unwanted or unused containers must be disposed through EHS using Waste Collection Option A.
2. Used solutions must be collected using Waste Collection Option B.
3. Contaminated solid wastes need to be collected using Waste Collection Option C.



## **FORMALIN/FORMALDEHYDE/PARAFORMALDEHYDE AND GLUTARALDEHYDE (CONT'D)**

4. If you have a large number of specimens preserved in formalin that you wish to dispose of, contact EHS at 646-1762 to discuss disposal options.

NOTE: *The use of so-called "cold sterilants" such as Cidex® or other higher M.W. aldehydes such as glutaraldehyde is strongly discouraged for both occupational and environmental reasons.*

NOTE: *If your lab uses formaldehyde/formalin, please refer to the Chemical Hygiene Plan for more information.*

## **FORMAMIDE**

Formamide must be collected using Waste Collection Option B. If radioactive, also attach an EHS Radioactive Waste Label.

## **GAS CYLINDERS**

Compressed gases are among the most problematic wastes to handle and dispose. Avoid buying gas cylinders if at all possible. Buy only what you need, use all you buy and return cylinders to the gas vendors if empty or not routinely used. Lecture bottles can be a serious disposal problem. If at all possible, return these to the manufacturer or supplier for reuse. If not, dispose of through EHS. Label integrity is essential. Ensure that the label on each cylinder is legible. Keep the valve protection cap on the cylinder when not in use. When the cylinder is in use, keep this valve cap near the cylinder so that it does not get misplaced. Attach an EHS Hazardous Waste Label when the cylinder is to be disposed.

NOTE: *Never dispose of the contents of a compressed gas cylinder by releasing outdoors or in a fume hood.*

## **MERCURY**

All mercury compounds and materials must be disposed through EHS. For mercury spills, contact EHS at 646-1762. Mercury and mercury compounds are especially hazardous. If spilled, elemental mercury in cracks of lab benches or floor tiles may pose an exposure hazard for years. Few hazardous waste facilities accept mercury. Therefore, it is essential that the use of mercury be avoided. Substitute mercury thermometers with non-mercury alternatives (available through the Scientific Stockroom) or electronic devices to measure temperature and pressure.

## OILS

Uncontaminated instrument and machine oils such as a centrifuge, diffusion pump and vacuum pump oils must be collected in plastic containers and labeled with an EHS Hazardous Waste Label. Oils found in X-Ray machines and other similar devices may contain PCB's (polychlorinated biphenyls), especially if the equipment is old. **DO NOT MIX PCB CONTAMINATED OIL WITH OTHER OILS.** Contact EHS if you suspect you have PCB oil.

NOTE: *All vacuum pumps must be emptied of oil prior to disposal. If sending them out or to the shop for service, they must be rinsed and purged with clean oil.*

## ORGANIC MERCURY (ALKYL AND ARYL) COMPOUNDS

Organic mercury compounds pose special hazards in the laboratory. Under *all* circumstances, these compounds must be handled according to the "Safe Work Practices for Particularly Hazardous Substances" in the College's Chemical Hygiene Plan. Alkyl mercury compounds require prior approval from EHS before purchase or use. Contact EHS for assistance in planning, use and disposal before using these compounds.

## OSMIUM TETROXIDE

Osmium tetroxide solutions must be disposed of using Waste Collection Option A or B. The osmium tetroxide can be converted to a less volatile (safer) form by adding corn oil to the solution and shaking. This method takes advantage of the double bonds of the unsaturated oil to form a cyclic osmic ester. The reaction may be slow as corn oil is not readily miscible in water, but it's easy and it works.

Osmium tetroxide contaminated labware must be disposed of by using Waste Collection Option C. The pail will be shipped out as hazardous waste and a new pail will be issued to the lab.

## PAINT

Paint can be a significant potential source of pollution in our landfills. Dispose of **all oil based paints** through EHS. Old, unwanted full cans of **latex paints** must be disposed of through EHS. Opened, nearly empty cans of **latex paint** can be allowed to air dry until solid then be disposed as non-hazardous waste. This must be waste generated at Dartmouth College. *You may not bring personal wastes from home for disposal through Dartmouth College.*

## PAINT THINNERS, RELATED CHEMICALS, CONTAMINATED RAGS

Chemicals associated with the use of paint thinner, brush cleaners, linseed oil, etc. must be collected for disposal by EHS. Rags and paper towels contaminated with paint thinner or related chemicals are hazardous waste. Contact EHS at 646-1762 for more information on collection options and disposal.

## PERCHLORIC ACID

Perchloric acid reacts violently with many oxidizable substances. The anhydrous (dehydrated) acid presents a serious explosion hazard. It is unstable and can decompose explosively at ordinary temperatures or in contact with many organic compounds. Amounts in labs must be limited to *1 pound or less*. Any work with perchloric acid heated above ambient temperature requires EHS approval. Special wash-down hoods may be required. Use Waste Collection Option A or B for disposal.

Many heavy metal perchlorates and organic perchlorate salts are extremely sensitive explosives; the ammonium, alkali metal and alkali earth perchlorates are somewhat less hazardous. Mixtures of perchlorates with many oxidizable substances are explosive. Cold 70% perchloric acid is a strong acid but is not considered to be a strong oxidizing agent; however more concentrated solutions are good oxidizers. Work with >85% perchloric acid requires special precautions and should be carried out only by specially trained personnel and in specially designed fume hoods.

## PEROXIDE FORMING COMPOUNDS

Certain chemicals such as diethyl ether, dioxane, 2-butanol and tetrahydrofuran can form organic peroxides if they are exposed to air, become more concentrated or age. These compounds may violently explode when combined with certain other compounds i.e. metals or by heat, shock, friction or static discharge. **Never move a container if there are solids on the bottom or if crystals have formed around the lip.**

- ❖ Clearly and explicitly label chemicals known to form peroxides.
- ❖ Always date the container when received and when opened.
- ❖ Limit the on-hand stock to a 3 month supply or less.
- ❖ To discard empty (no excess liquid) containers, air dry under the hood, flush with large amounts of water, deface the label and put containers in the trash.

## PEROXIDE FORMING COMPOUNDS (CONT'D)

- ❖ Store away from heat and light. (Use explosion-proof or explosion-safe refrigerators, as needed.)
- ❖ Protect from ignition sources, physical damage, contact with strong reducing agents or oxidizers, or other contamination.
- ❖ Ensure air-tight closures on containers, purge head space with nitrogen when possible.
- ❖ Keep a minimal working inventory.
- ❖ Never attempt to force open a rusted, stuck or scale-encrusted cap.
- ❖ Never store in a freezer.
- ❖ Never store in glass bottles with screw caps or glass stoppers.
- ❖ Never attempt to clean containers that were used to store peroxide forming compounds by scraping or rubbing, especially if an oily deposit or crusty residue is present.
- ❖ Prevention of unwanted peroxides is paramount. Stabilization and disposal can cost up to \$5000 per container.

### Immediately Contact EHS if:

- ❖ **Crusty deposits form on the material or its container, a precipitate forms or an oily, viscous layer appears.**
- ❖ **Rusted, damaged, undated or suspicious looking containers of peroxide forming materials are found.**

NOTE: See the *Chemical Hygiene Plan for more information on Peroxide Formation in Chemicals.*

## PESTICIDES

Dartmouth College has an Integrated Pest Management Program. Therefore, pesticides should never be used in the workplace. If you have a pest problem, please contact FOM at 646-2485. If old pesticides are found, please contact EHS at 646-1762.

## PHENOL/CHLOROFORM

1. Collect liquid mixtures using Waste Collection Option D. The percentages of each must be known.
2. Phenol/Chloroform contaminated labware such as pipette tips and eppendorf tubes with small volumes of liquid must be collected using Waste Collection Option C. (Miniprep tubes can be included in this wastestream and do not need to be emptied of contents prior to disposing into the bag as long as they are capped). **It is not acceptable to throw this type of waste into general trash containers or autoclave in biohazard bags.**

## PHOTOGRAPHIC SOLUTIONS

**All darkrooms must be registered through Environmental Health & Safety.**

**Used Fixer** (Black & White, Color, Bleach, Microfilm, X-ray):

Fixers pick up unexposed silver during photo processing. Due to this, used fixer solutions are classified as a hazardous waste and are prohibited from drain disposal. Used Fixer must be collected using Waste Collection Option A or B.

**Stabilizers and Activators:** Some activators and stabilizers pick up unexposed silver during photo processing. Use Waste Collection Option A or B for these.

**Indicator Stop Bath or Acetic Acid:** If Indicator Stop Bath has changed color, the solution is neutral and can be drain disposed. If Stop Bath does not have an indicator, check the pH. Stop Bath solutions with pH greater than 2 and less than 7 should have their pH adjusted to between 7-9 before drain disposal. Used Indicator Stop Bath or acetic acid solutions that do not meet either of these conditions must be collected using Waste Collection Option A or B.

**Developers - Black & White:** In general, these solutions can be drain disposed. Identify the chemical constituents from the product's SDS and call EHS for disposal information.

**Developers - Color:** Some color developers contain hazardous constituents and others have a pH that prohibits them from being drain disposed. Identify the chemical constituents from the product's SDS and call EHS for disposal information and assistance.

**Hypo Clearing Agent:** These solutions can be drain disposed.

**Mixtures:** Certain photo processing operations do not allow for the collection of fixer separate from other photochemicals. These mixtures **cannot** be discharged to the sewer. All silver bearing solutions **MUST** be collected using Waste Collection Option A or B.

## PHOTOGRAPHIC SOLUTIONS (CONT'D)

NOTE: *All silver recovery systems must be approved and registered with Environmental Health & Safety. All automated film processors must be equipped with silver recovery systems and registered with Environmental Health & Safety.*

## REACTIVES

Chemicals that are considered reactive can react violently with air, water or other substances and also have the potential to explode. These chemicals include picric acid, sodium cyanide and sodium azide. Notify EHS of your intent to use these materials.

- ❖ Segregate oxidizers from flammable and combustible materials, organic material and reducers.
- ❖ Pyrophoric chemicals ignite spontaneously on contact with air. Store breakable glass bottles inside a plastic bottle carrier. Keep these chemicals in a cabinet below eye level.
- ❖ Shock-sensitive and/or explosive materials (benzoyl peroxide) can spontaneously release large amounts of energy when struck, vibrated, dropped or agitated. Some chemicals become increasingly shock sensitive with age. Inspect these regularly for degradation and dispose of promptly. Consult the Material Safety Data Sheet (SDS) before working with reactives.
- ❖ Never contaminate reactive chemicals with heavy metals or incompatibles.

## “SHARPS” (CHEMICALLY CONTAMINATED)

- ❖ Needles, syringes, razor blades and any glass object capable of puncturing skin that are chemically contaminated must be placed in a WHITE needle (SHARPS) box. (***WHITE sharps boxes are sold in the Burke Laboratory Resource Center only.***)
- ❖ Label with a completed hazardous waste label. Indicate the chemical contaminate on the label.
- ❖ When full, contact EHS for a waste pick-up.

## SODIUM AZIDE

Sodium azide is commonly used in low concentrations as a microbiocide to preserve samples. Curiously, it has also been used as rocket propellants or explosives and is very toxic. Avoid exposure to the pure material. Avoid weighing the solid by adding solvent to the material and diluting to working concentrations.

## **SODIUM AZIDE (CONT'D)**

Take care not to contaminate pure sodium azide with metals or foreign materials as this can lead to the formation of explosive metal azides. Azide solutions can also form explosive metal azides in drain pipes. Collect solutions and pure material for disposal through EHS.

## **SOLVENTS**

All solvents must be collected using Waste Collection Option D (e.g. methanol, methylene chloride, acetone, xylene). Please list **all** chemical constituents on the waste label. This includes any metals. The pH also is very important to note on the waste label. Halogenated and non-halogenated solvents may be mixed together. NO excess solids or debris is allowed. For laboratories using large volumes of certain solvents, it may be possible to distill or purify these solvents for reuse. Please contact EHS for more information on solvent recycling.

## **STAINING SOLUTIONS**

Staining solutions such as Wright's, eosin, iodine and methylene blue stains must be disposed of using Waste Collection Option A or B. You must list the solvent used on the waste label (e.g. water, glacial acetic acid, methanol).

## **SCIENTIFIC EQUIPMENT- SURPLUS, REPAIR OR DISPOSAL**

All pieces of scientific equipment must be carefully surveyed and decontaminated when they may have potentially been in contact with biological, chemical or radioactive materials. It is the responsibility of researchers to do this. All equipment that may have contained radioactivity must be cleared by the Radiation Safety Officer prior to being surplused, sent out for repair or disposed. This includes refrigerators, freezers, incubators, centrifuges and counters (beta scintillation and gamma counters). Vacuum pumps must have oil removed prior to disposal and rinsed with clean oil if sent out for repair. A completed *Certification that Property is Free from Hazards* tag must be attached after the piece of equipment has been surveyed and decontaminated if needed. ([http://www.dartmouth.edu/~ehs/essential-info/hazard\\_clearance.html](http://www.dartmouth.edu/~ehs/essential-info/hazard_clearance.html))

## **UNIVERSAL WASTES**

Universal waste is "universally generated". It is defined as a hazardous waste but has low risk relative to other hazardous wastes. Types of universal wastes in the State of New Hampshire are batteries, fluorescent light bulbs, mercury containing devices, used automotive antifreeze, certain pesticides and color cathode ray tubes. Due to the large volume, Dartmouth College collects and recycles

## UNIVERSAL WASTES (CONT'D)

batteries, bulbs and cathode ray tubes through the Dartmouth Recycles Program. Please contact them at 646-2485 for more information on general recycling. If you have mercury containing devices, pesticides and antifreeze, please contact EHS. This must be waste generated at Dartmouth College. *You may not bring personal wastes from home for disposal through Dartmouth College.*

## UNKNOWNNS

**Analysis and disposal of material for which the identity is not known can be expensive, from \$300 to \$1500 per unknown.** If unknowns are found, consult with coworkers who may have an idea as to the identity of the material. Even a general chemical classification (e.g. "aromatic sulfur compound") can be very helpful. Contacting a colleague who has left will pay for itself several times over.

To prevent unknowns, remember to label all your containers regardless of size. Labeling of stock solutions is essential. All labels must include the commonly accepted name (**NO CHEMICAL FORMULAS**), hazard warnings, special instructions, individual responsible and the date made. When scientists plan to leave the college, contact EHS to help you clean out the laboratory so that unknowns can be identified.

## WASTE MINIMIZATION:

Waste minimization is any action that:

- ❖ Decreases the amount of hazardous waste generated.
- ❖ Reduces the toxicity of the waste generated.

The cost associated with the proper disposal of chemical wastes and the safe storage of chemicals in the research laboratory are inextricably linked. Researchers are encouraged to limit the amount of chemicals purchased. It is easier to order additional chemicals than to dispose of unwanted or unused surplus chemicals. **REMEMBER: On average, the cost of disposal is at least 10 times higher than the cost of the chemical.** In some cases, there are no acceptable waste disposal options.

Controlling the increasing costs of proper chemical waste disposal and the inherent hazards of storing and working with hazardous chemicals requires re-thinking many of the ways that we purchase, handle and store chemicals.



## WASTE MINIMIZATION (CONT'D)

Waste minimization benefits you, the college and the environment by:

- ❖ Lowering costs
- ❖ Reducing potential health hazards
- ❖ Reducing potential long-term liabilities for disposal
- ❖ Promoting environmental ethics
- ❖ Preventing pollution

### **SOURCE REDUCTION AND WASTE MINIMIZATION TIPS**

Maintain good housekeeping in your laboratory or work location.

Clearly mark the contents of all chemical containers.

Keep an up-to-date inventory of all hazardous materials used in your lab.

Examine all wastes generated and ask if they could be minimized and how.

Substitute less hazardous chemicals whenever possible.

Ask others in your department if they could use your unwanted chemicals.

Reduce the scale of processes so that less waste is generated.

Treat or destroy hazardous by-products as the last step in experiments.

Include waste minimization when planning experiments or demonstrations.

When in doubt, call Environmental Health & Safety for assistance.

## STORAGE OF HAZARDOUS CHEMICALS:

The use of chemicals is an essential part of modern research and teaching labs. Fortunately, most of the chemicals commonly used in the laboratory are not especially hazardous - but there are clearly exceptions.

In the laboratory, hazardous chemicals can be divided into four general categories - corrosives, flammables, reactivities and toxics. In most cases, it is the immediate or obvious hazard that determines which category a particular chemical is classified. "Toxics" typically refer to chemicals with defined acute or chronic effects.

## GENERAL PRINCIPLES FOR MANAGING LABORATORY CHEMICALS

- ❖ Only purchase what you can reasonably expect to use during the next six months.
- ❖ *Less is better....* Purchase containers in the smallest practical size. Whereas the per unit cost may be greater -- significant savings are realized in reduced disposal costs and safer storage.
- ❖ When possible, buy what you specifically need. It is often possible to buy pre-made molar and normal solutions, thereby reducing the likelihood of waste.
- ❖ Glass breaks. When available, purchase chemicals in plastic containers. If this is not possible, purchase shatter resistant plastic coated bottles.
- ❖ Read labels. Most of what you will need to know on how to handle and store the chemical is found on the manufacturers' label.
- ❖ Rotate your chemical inventory. **Indicate the date received and the date opened.** Pay particular attention to expiration dates.
- ❖ Chemicals should be disposed of if not used within a year -- especially peroxide forming compounds.
- ❖ Keep all chemical containers off floors, carts and electrical equipment.

## GENERAL PRINCIPLES FOR MANAGING LABORATORY CHEMICALS (CONT'D)

- ❖ Physically segregate your chemicals into their respective hazard categories - -corrosive, flammable, reactive and toxic.
- ❖ Label the secondary storage containers or areas in which particularly hazardous chemicals may be used. These substances must be kept in a designated area.
- ❖ Relocate corrosive, flammable and reactive chemicals to locations **below** eye level. This simple task greatly reduces the likelihood of something falling from above and breaking.
- ❖ Cabinets with doors are safer location than open shelves for chemicals.
- ❖ For safely transporting any chemical, place in secondary containment.
- ❖ Avoid placing any chemical container in direct sunlight, underneath a sink or near heat sources.
- ❖ Never store volatile or flammable chemicals in standard refrigerators.
- ❖ DO NOT STORE HAZARDOUS CHEMICALS IN COLD ROOMS.
- ❖ Be especially careful with reactive chemicals. Obtain and read the SDS for each reactive chemical that you may have or may work near.
- ❖ The identification and disposal of unlabeled chemical containers is very expensive. Please label all containers in the laboratory with the following information. This includes any stock or working solutions.

**Name of chemical or stock solution**

**Date made**

**Your initials**

**Hazard warning (i.e. flammable, toxic, corrosive, reactive)**

- ❖ Use and manage your chemical fume hood wisely. Too many chemical containers or equipment can occlude the air slots and compromise the hood.
- ❖ Store all flammable chemicals in an approved flammable storage cabinet. If you do not already have a flammable storage cabinet, call EHS for assistance. Flammable storage cabinets come in all sizes and represent a modest investment.
- ❖ Follow all waste disposal guidelines provided by EHS.

## STORAGE OF FLAMMABLE LIQUIDS

- ❖ Limit the amount of flammable liquids in use to the smallest practical volume. Work with flammable liquids inside a chemical fume hood. At the end of the day, return all flammable liquids to an approved flammable storage cabinet.
- ❖ All flammables liquids must be stored in a UL approved flammable storage cabinet. The doors to these cabinets must close securely. Self-closing doors are best. Contact EHS for assistance in ordering flammable storage cabinets.
- ❖ The maximum quantity of flammable and combustible liquids that can be stored in any laboratory **without** an approved flammable storage cabinet is **6 gallons**.
- ❖ The maximum quantity of flammable and combustible liquids that can be stored in any laboratory **with** an approved flammable storage cabinet is **20 gallons**.
- ❖ The purchase of 5 gallon containers of flammable liquids is strongly discouraged. All transfers of flammable liquids from containers of 5 gallons or more must be made inside a fume hood. These containers also must be kept in a flammable storage cabinet.
- ❖ Segregate flammables from oxidizers and oxidizing acids.
- ❖ Most refrigerators/freezers purchased by the labs are designed for non-hazardous materials. Therefore, all of these refrigerators must be labeled with a warning label stating that these units are not suitable for the storage of explosives, corrosives and flammable material. These labels are available through EHS. This also applies to cold rooms.

## STORAGE OF GAS CYLINDERS

### Number of Cylinders

- ❖ In general, only keep cylinders in your lab that are in current use or waiting for immediate use.
- ❖ As a rule, no more than 2 flammable gas and/or oxygen cylinders per lab. Exceptions must be approved through Environmental Health & Safety.
- ❖ No more than 1 liquefied flammable gas (acetylene) cylinder per lab.

## STORAGE OF GAS CYLINDERS (CONT'D)

### Securing of cylinders

- ❖ All cylinders **not** attached to a regulator must have a valve protection cap installed.
- ❖ For vertical storage, cylinders must be secured (at a minimum) in their upper third by a tight fitting chain or belt secured to the wall or non-movable casework. This applies to all cylinders.
- ❖ One cylinder per chain or web belt.
- ❖ Horizontal storage of cylinders is only allowed in racks designed for the purpose. Cylinders must be chained to the rack.
- ❖ Cylinders must not be kept in corridors, hallways, stairways or cold rooms (or any other area with limited ventilation). Exceptions to this must be approved by EHS.

### CRYOGENIC LIQUIDS

- ❖ Cryogenic liquids, such as liquid nitrogen, must be handled only in containers designed for that purpose.
- ❖ Full face protection including safety glasses and goggles as well as insulated gloves must be worn when handling cryogenic liquids.
- ❖ When transferring liquid from one container to another, the receiving container must be cooled gradually.

# RADIOACTIVE WASTE DISPOSAL PROCEDURES

## DEFINITION OF A RADIOACTIVE WASTE:

Any waste that contains or is contaminated with a radioactive material.

## EXAMPLES OF RADIOACTIVE WASTE:

- ✓ Radioactive source vials
- ✓ Contaminated pipette tips
- ✓ Contaminated labware
- ✓ Liquid scintillation counting fluids and vials
- ✓ Aqueous liquids (hybridization and waste buffers)
- ✓ Experimental or clean-up material contaminated with radioactive material
- ✓ Animal carcasses and excreta

## GENERAL INSTRUCTIONS:

- ✓ Plan ahead to reduce radioactive waste.
- ✓ Distinguish between contaminated and non-contaminated items.
- ✓ **All waste must be in an EHS provided container and a clear plastic bag.**
- ✓ Segregate according to half-life using categories established by EHS.
- ✓ Separate liquid waste from dry waste.
- ✓ Dry radioactive waste must be dry---with only slight associated moisture.
- ✓ Ensure that all radioactive waste containers are clearly labeled with a Radioactive Waste tag.
- ✓ Segregate aqueous solutions from solvents.
- ✓ Aqueous **pH must be between 7-9 (+/- 0.5).**
- ✓ Never leave radioactive waste unattended or unsecured in an unlocked lab.
- ✓ Avoid mixing radioactivity with biohazards or hazardous chemicals.
- ✓ Non-contaminated/non-hazardous wastes are disposed of as general lab trash.
- ✓ **Remove or clearly deface all radioactive warning stickers on non-contaminated wastes before their disposal into a lab trash can.**
- ✓ Dispose of your waste on a regular basis.
- ✓ “Do it yourself” decay in storage programs are forbidden and subject to citation by the Radiation Safety Officer.

## HOW TO ARRANGE FOR WASTE PICK-UP:

Go to: <https://dartmouth.bioraft.com/> to submit your radioactive waste pick-up. Click on the “waste pick-up request” tab. Complete the form and submit. Please make sure all your waste is sealed, labeled and ready for pick-up.

## SPECIFIC WASTE STREAMS:

### ANIMAL CARCASSES

Animal carcasses containing **radioactivity** will be handled on a case by case basis through EHS. Contact EHS prior to beginning any experiment that may generate this.

Animal bedding contaminated with radioactivity will be handled on a case by case basis through EHS. Contact EHS prior to beginning any experiment that may generate this.

### AQUEOUS LIQUID WASTE

(Water based solutions, buffered wash solutions, etc.)

1. All radioactive liquids must be disposed to EHS.
2. No in-lab drain disposal is allowed.
3. DO NOT mix radionuclides. Use a separate waste bottle for each.
4. Collect the initial probe or reaction mix. Shield waste containers to below 2 mR/hour.
5. **Collect the first three (3) washings after decanting the probe or reaction mix.**
6. Radioactive aqueous liquid must be placed in 1 gallon plastic containers available from EHS. Other, smaller containers may be used for high activity wastes such as Cr-51. Secondary containment must be used to prevent contamination of bench tops or other surfaces.
7. **The pH must be adjusted to between 7 and 9 (+/- 0.5).** Use litmus paper to check the approximate pH. Avoid contaminating pH meters and probes.
8. Attach a completed Radioactive Waste Tag to the container.

## **DRY ACTIVE WASTE (DAW) OR SOLID WASTE**

Dry radioactive waste must be segregated into categories according to half-life.

<b>Categories</b>	<b>Isotope(s)</b>	<b>Half-Life</b>
<b>1</b>	<b>P-32, P-33</b>	<b>15-25 days</b>
<b>2</b>	<b>Cr-51</b>	<b>28 days</b>
<b>3</b>	<b>S-35, I-125</b>	<b>60-87 days</b>
<b>4</b>	<b>H-3, C-14</b>	<b>&gt; 90 days</b>

**NEVER ADD OTHER RADIONUCLIDES TO ESTABLISHED WASTE CONTAINERS.**

### **DAW/SOLID WASTE COLLECTION**

1. For H-3, C-14, P-32, or S-35 waste, obtain a 5 gallon yellow pail and lid lined with a clear plastic bag from EHS. For Cr-51 or high levels of I-125, a metal pail with lead lining may be issued. This pail will be designated by radionuclide.
2. "Beta Plates" from plate readers are placed in clear plastic bags and labeled with a radioactive waste tag. These are treated as solid waste as minimal liquid remains.
3. When full, seal bag with tape and attach a completed Radioactive Waste Tag.

### **FORBIDDEN ITEMS IN DRY ACTIVE WASTE (DAW)**

- ❖ **Commingled long and short-lived isotopes**
- ❖ "Sharps"--hypodermic needles, razor blades, broken glass, Pasteur pipettes
- ❖ Infectious/potentially infectious agents
- ❖ Biological materials or materials perceived to be biological in nature
- ❖ Autoclave bags or labels with the biohazard symbol
- ❖ Lead pigs or sheets
- ❖ No excessive liquid
- ❖ **Sealed sources**
- ❖ Food containers or food wrappers
- ❖ **Hazardous chemicals**
- ❖ **Scintillation fluid/vials**



## LEAD PIGS

- ❖ Remove the source vial and obliterate/remove all radioactive labels and warnings from the pig before disposal.
- ❖ Survey for surface contamination with a Geiger counter or by swab testing, as appropriate.
- ❖ Place in a small, sturdy cardboard box and dispose to EHS. This lead can be recycled.

## “MIXED” WASTE OR MULTI-HAZARD WASTE

“Mixed” waste is defined as any radioactive waste comingled with hazardous waste or potentially infectious material. Creating this waste stream must be avoided. Contact EHS when planning an experiment that involves the generation of this type of waste. **PROPER LABELING IS ESSENTIAL.**

- ❖ **For potentially infectious material combined with radionuclides**, please refer to the Biological Waste procedure.
- ❖ **For radioactive multi-hazard waste containing chemical**, such as trichloroacetic acid, chloroform, phenol, alcohols, contact EHS prior to generating it. When using 3-H or any other long half-life radionuclide with acids or bases, the resultant solution must be neutralized as part of the experiment prior to disposal to EHS.

## PLASTIC SECONDARY CONTAINERS (WITH OR WITHOUT LEAD)

- Remove the source vial and obliterate/remove all radioactive labels and warnings from the container before disposal.
- Survey for surface contamination with a Geiger counter or by swab testing, as appropriate.
- Place in a small, sturdy cardboard box and dispose through EHS.

## SCINTILLATION VIALS

- ❖ Tightly secure all caps
- ❖ Segregate vials according to radionuclide
- ❖ Place capped vials in original shipping trays or box
- ❖ Attach a completed Radioactive Waste Tag. The amount of radioactivity must be calculated as closely as possible
- ❖ Only non-flammable scintillation fluid is allowed. It must have a flash point of greater than 140 degrees F to be considered “non-flammable”
- ❖ **Drain disposal of scintillation fluid is not allowed.** Even if the product claims that it is “environmentally safe”, it still is not suitable for drain disposal

## SEALED SOURCES

All sealed sources must be registered with EHS. Periodic leak testing is required depending on the radionuclide. Contact the RSO immediately if there are any problems with sealed sources or for disposal.

## “SHARPS”

(NEEDLES , SYRINGES, PASTEUR PIPETTES, RAZOR BLADES, ETC.)

- ❖ Needles, syringes or any glass object capable of puncturing skin that are contaminated with radioactivity must be placed in a red needle (SHARPS) box. Use “CAUTION Radioactive Material” warning tape to label the container.
- ❖ **Segregate according to radionuclide. Do not add NON-radioactive sharps to the container.**
- ❖ Contact the RSO if your research involves the use of needles and syringes contaminated with long half-life radioisotopes (half-life greater than 90 days). Every effort must be made to avoid generating this type of waste.
- ❖ When full, close and tape shut and attach a completed Radioactive Waste Tag to the box.

## SHIPPING BOXES AND ASSOCIATED PACKAGING

- ❖ Survey all packing material associated with a radioisotope shipment to determine if it is contaminated.
- ❖ If NOT: Using a “Sharpie” or other marker pen, thoroughly cover/deface all warning labels, statements or suggestions of its use. Do not reuse. Dispose of as regular trash.
- ❖ IF CONTAMINATION IS FOUND, bag the contaminated material, label with a completed Radioactive Waste tag and dispose to EHS.

## STOCK VIALS

- ❖ Place into DAW waste containers according to nuclide.
- ❖ **Turn in tracking sheet when vial is disposed to EHS.**
- ❖ Document in your log book, the date the vial was disposed.

## WASTE MINIMIZATION TECHNIQUES:

Two important things to remember are:

1. Segregate waste by EHS established radionuclide categories.
2. Minimize the total volumes of waste created.

## KEY CONCEPTS IN A RADIOACTIVE WASTE MINIMIZATION PROGRAM

- ❖ Attempt--to the extent possible--to centrally locate your work. Consider foot traffic, incidental radiation exposure, access to equipment, potential for tracking contamination, etc., when planning your workspace.
- ❖ Limit the size and number of your radiation work locations.
- ❖ Protect house vacuum systems with in-line vacuum filters. (Available through Procurement.)
- ❖ Use aerosol-resistant pipette tips to prevent contamination of your pipette devices. (Available through Procurement.)
- ❖ Arrange your materials and disposal containers to minimize clutter and avoid unnecessary contamination of work surfaces, equipment and you.

**FOR HIGH ENERGY RADIONUCLIDES SUCH AS P-32, P-33, CR-51 AND I-125  
(GREATER THAN 1 MICROCURIE):**

- ❖ Distinguish between contaminated and non-contaminated items by diligently surveying your work area with a radiation monitor.
- ❖ Isolate contaminated items. For a small spill, mark or outline the perimeter of contaminated bench paper. Cut away the contaminated area and dispose of as radioactive waste. Dispose of the rest as non-contaminated, non-hazardous waste.
- ❖ Avoid the tendency to treat everything as being contaminated. Monitor your gloves before disposal.

**FOR LOW ENERGY RADIONUCLIDES SUCH AS H-3, C-14, S-35, AND I-125  
(LESS THAN 1 MICROCURIE):**

- ❖ Limit your work area by using a fiberglass tray. (These can be obtained from EHS.) Swab test the tray after use to ensure no contamination has occurred. If counts are found, the tray can be decontaminated by using a commercially available decontamination solution. (A tray is considered contaminated when counts are greater than 220 dpm per 100 centimeter squared.) After decontamination, re-swab to ensure counts are below 220 dpm per 100 centimeter squared in keeping with the ALARA concept.
- ❖ Set up your waste containers before beginning work. Use the plastic containers for empty source vials, higher activity, lower volume items, "HOT" tips and other small items. For safety, gloves can be considered contaminated in the absence of an easy way to monitor.
- ❖ Practice vigilance by limiting the work area and routinely monitoring surfaces and equipment. When in doubt, swab first before classifying it as a "radioactive" waste. A little extra time set aside to monitor for contamination will repay itself many times over in saved disposal costs.

<b>HALF-LIVES OF COMMON RADIOISOTOPES</b>	
Isotope	Half-Life
<b>H-3<sup>1</sup></b>	<b>12.3 years</b>
<b>C-14<sup>1</sup></b>	<b>5730 years</b>
<b>Na-22<sup>1</sup></b>	<b>2.6 years</b>
P-32	14 days
P-33	25 days
S-35	87 days
<b>Ca-45<sup>1</sup></b>	<b>163 days</b>
Cr-51	28 days
I-125	60 days
<b>Cd-109<sup>1</sup></b>	<b>453 days</b>
<b>Fe-55<sup>1</sup></b>	<b>2.6 years</b>
Fe-59	45 days
<b><sup>1</sup>Indicates radionuclides not eligible for Decay-In-Storage</b>	

# BIOLOGICAL WASTE DISPOSAL PROCEDURES (BIOHAZARDOUS & ANATOMICAL WASTES)

## DEFINITION OF BIOLOGICAL WASTE:

Biohazardous waste is any waste generated from working in biological or biomedical laboratories that may contain infectious or potentially infectious substance, or any agents or substances that are an environmental release risk (e.g., recombinant DNA). This includes materials that may present an actual or perceived biological risk to others on site.

## EXAMPLES OF BIOHAZARDOUS WASTE:

- Microbiological cultures or stocks (including bacterial, viral, parasitic, fungal, etc)
- Recombinant or synthetic nucleic acid molecules (including viral vectors)
- Organisms that contain recombinant or synthetic nucleic acid molecules
- Cell/tissue cultures
- Anatomical or pathological waste (organs and tissue from **humans** or **animals**)
- Human clinical specimens (feces, blood, urine or any other body fluid)
- Contaminated animal bedding
- Disposable personal protective equipment (PPE)
- Labware potentially contaminated with biohazardous agents (flasks, plates, pipets, tubing, etc)
- Sharps: scalpels, razor blades, Pasteur pipettes, needles, syringes

***NOTE: COLLECT ALL ANIMAL CARCASSES ANATOMICAL PARTS OF ANY SORT (HUMAN OR ANIMAL) FOR DISPOSAL BY THE CCMR OR EHS. THESE MATERIALS REQUIRE SPECIAL HANDLING AND DISPOSAL—NO EXCEPTIONS!***

## UNIVERSAL PRECAUTIONS:

Applying a universal precautions approach (e.g., managing all research biological materials as if they are an infectious disease or environmental release risk) in working with biohazardous materials is a prudent standard. The Dartmouth College Institutional Biosafety Committee (IBC) recommends that unregulated research lab biological wastes be managed as biohazardous waste. This action will assure that all biological research materials are inactivated or managed in a manner that isolates the exposure risk for the general public and the environment.

## REGULATIONS:

Unlike hazardous chemical or radioactive waste, there is no one federal agency that clearly defines and regulates biohazardous waste. Several agencies, some associated with research funding, have unique waste disposal requirements. Therefore, it is the researcher's responsibility to have a general knowledge of biosafety regulations and guidelines and how they apply to their work and the waste that is generated through the research process. Please review the regulatory/agency information in the following table.

**Table 1. Federal Guidelines or Regulations on Biohazardous Waste**

<b>Regulation</b>	<b>Activities covered by this standard</b>	<b>Biohazardous waste</b>
OSHA's Bloodborne Pathogens Standard	Work with human-derived materials including clinical and unfixed anatomical specimens, human cells and cell lines.	Those wastes that are contaminated to the extent where fluids may drip or flake off of waste; liquid wastes; fresh (unfixed) tissues; sharps.
NIH Guidelines for Research Involving Recombinant or Synthetic DNA Molecules	Work with molecules that are constructed outside living cells by joining natural or synthetic DNA molecules that can replicate in a living cell, or molecules that result from the replication of those therefrom. All recombinant DNA work is to be carried out at BSL1 containment practices and procedures at a minimum.	All contaminated solid and liquid wastes including sharps.
CDC/NIH "Biosafety in Microbiological and Biomedical Laboratories" (BMBL)	Lab and animal studies involving work with microorganisms that cause disease in humans and/or in animals; diagnostic lab operations involving human or animal clinical specimens.	All cultures, stocks, and items contaminated with these materials; in some cases, animal bedding and carcasses and sharps.
USDA APHIS Permits	Work with any animal or plant-derived materials or pathogens that require an APHIS permit to receive or retain the material.	Permits will outline specific waste treatment requirements for the material in question. This usually involves segregation and inactivation of the material prior to disposal.

## GENERAL INSTRUCTIONS:

- Never place non-hazardous items such as soda cans, paper, cardboard, bottles, etc. in biohazard bags. Remember, once combined they cannot be separated.
- Chemical hazards or radioactive waste must never go into a biohazard bag. This includes labware associated with microfuge amounts of hazardous chemicals. When in doubt, please call EHS first.

*Example: Phenol waste associated with a DNA extraction is no longer a biohazard, it should be disposed of in the hazardous chemical phenol waste.*

- Hallways, equipment rooms or areas with public access are not appropriate places to leave biohazardous waste unattended.
- Never place autoclave bags directly on the floor. Place bags in a secondary container/tray before and after autoclaving. This prevents biohazardous spills/leaks.
- Clean spills from leaking autoclave bags immediately with a suitable disinfectant (fresh 1:10 dilution of bleach). This should be performed for spills from biohazard bags pre and post-autoclaving.
- Chemically decontaminate liquids with bleach (final 1:10 concentration) or 0.5% Wescodyne ® for 30 minutes before pouring the solution down the drain with a 10 fold excess of water. Chemical decontamination saves time.
- Do not autoclave liquid blood or other body fluids as they tend to congeal and make a mess—chemically decontaminate instead.

*NOTE: Clotted blood must always be autoclaved (60 minutes at 121 degrees centigrade, slow exhaust) in lieu of chemical disinfection. Clotted blood is known to clog drains.*

- All aspiration traps must utilize an in-line HEPA filter to protect the building vacuum system.
- Using appropriate collection (autoclave bags in plastic pails) and decontamination methods (chemical disinfection, autoclaving) labs can render biological waste (biohazardous waste) non-hazardous before collection and removal.



## SPECIFIC WASTE STREAMS:

### SOLID WASTE – (AUTOCLAVED)

- Solid biohazardous waste (PPE, culture vessels, labware, etc), except for dense materials (e.g., body parts, animal carcasses or tightly packed material) can be autoclaved and then disposed of as general waste. Autoclave bags must always be orange emblazoned with the word “biohazard” and the international biohazard emblem. NEVER USE RED BAGS!
- EHS provides 5 gallon plastic pails with covers designed for the collection of biohazardous lab debris for autoclaving.
- Use the metal trays provided by EHS as a secondary container for autoclaving and transport. Avoid the use of Nalgene® since it is a poor conductor of heat and certain polymers are not autoclave safe.
- Do not rely on autoclave tape as an adequate indicator of decontamination. Autoclave tape will discolor the moment steam comes in contact—it does not indicate adequate process time.

### Autoclave procedure:

5. Add 250 milliliters of water to orange Biohazard Bag before closing. This step is imperative to ensure proper sterilization.
  - i. *Use proportionately less water for smaller bags*
6. Place in pan suitable for transporting and autoclaving
7. Process for 60 minutes if using a metal pan and 75 minutes if using an autoclavable Nalgene® pan at 121°C (15 psi)
8. Cool, then discard autoclaved bag as general waste in the heavy clear plastic bags in the bins provided in the autoclave area. Housekeeping will remove the autoclaved bags ONLY if they have been properly autoclaved and placed into the clear bags. They will not remove any bags left on the floor or in the autoclave.

## LIQUID WASTE

### BLOOD AND BODILY FLUIDS

- Blood and bodily fluids must be deactivated before drain disposal

#### Procedure:

1. For each 100 milliliters of blood or body fluid, use either 10 milliliters of sodium hypochlorite (bleach) or 0.5 milliliters of Wescodyne® (povidone iodine with detergent).
2. **Mix and let stand 30 minutes.**
3. Pour the mixture down a lab sink followed by a ten-fold excess of water.
4. Dispose of any associated labware into an autoclave bag for steam sterilization.

### CELL CULTURE MEDIA - (e.g. Growth media for eukaryotic cells, bacteria, etc.)

Cell culture media **must** always be decontaminated before disposal. This may be done by adding disinfectant directly to the vessel or treating pooled spent media.

#### Procedure:

1. For each 100 milliliters of media, use either 10 milliliters of sodium hypochlorite (bleach) or 0.5 milliliters of Wescodyne® (povidone iodine with detergent).
2. **Mix and let stand for 30 minutes.**
3. Pour the mixture down a lab sink followed by a ten-fold excess of water.
4. Dispose of cell culture vessel (flask, multi-well plate, tissue culture plate, Falcon® tube, etc.) into an autoclave bag for steam sterilization.

## NEEDLES, SYRINGES, RAZOR BLADES, GLASS PIPETTES

### Procedure:

1. Place these materials in puncture resistant containers obtained from the Scientific Stockroom. (For Vail/Remsen: **Stock # 6920 or 6921**. For Borwell/Rubin: **Stock #8191**)
2. Do **not** recap, bend, remove or clip needles.
3. When 3/4 full, snap lid closed and tape to securely shut.
4. Do **not** put fingers into sharps containers

*NOTE: In situations where large numbers of Pasteur pipettes are used, researchers are encouraged--when necessary--to use alternative collection procedures. In all cases where alternative collection is used, the objective is to ensure personnel protection from protruding glass. Call EHS, if questions still exist.*

### For Borwell/Rubin/Williamson:

All sharps must be placed in pink plastic containers found in the Borwell Scientific Stockroom. When 3/4 full, close and tape shut with masking tape. Place them next to the regular trash receptacles for disposal by DHMC housekeeping staff. Overfilled containers or untaped containers will not be picked up. **If radioactive**, dispose of through the Environmental Health & Safety Office.

### All other areas of Dartmouth College:

To arrange for disposal, e-mail [ehs@dartmouth.edu](mailto:ehs@dartmouth.edu) for a pick-up.

## OTHER WASTES

### ANATOMICAL WASTE, TISSUES

1. Fresh or Frozen Specimens
  - a. Unfixed, unpreserved samples should be double bagged in **black** plastic or autoclave bags, then frozen. Do not autoclave. Contact EHS for disposal.

## **OTHER WASTES (CONT'D): ANATOMICAL, TISSUE**

### 2. Fixed or Preserved Specimens

- a. For the disposal of fixed or preserved specimens, double bag and attach a Hazardous Waste Label. Indicate on the label the preservative used. Call EHS for disposal. If you have large volumes of specimens for disposal, contact EHS to discuss the method of collection and labeling.

## **ANIMAL CARCASSES/TISSUES/BEDDING**

### 1. Animal carcasses, tissue and/or hair from animals

- a. Animal carcasses, tissues and hair/fur must be double bagged in **black** plastic bags (Stock # 6491 or #6980) and stored in refrigeration or frozen until collected for commercial incineration.

#### **In Borwell/Rubin/Williamson:**

Place in the gray bin in the refrigerator located in Borwell Room #382002 of the CCMR.

#### **In Vail/Remsen:**

Place in a plastic bin in the refrigerator located in Vail B01 of the CCMR.

#### **In Moore:**

Contact CCMR staff.

### 2. Animal bedding contaminated with chemical hazards or biohazards

- a. Disposal of animal bedding containing either chemical hazards (e.g., chemotherapeutics, toxins, etc), or biohazards (e.g., pathogens, viral vectors, etc.) must be disposed of according to the "CCMR Hazard SOP #510".
- b. Bedding containing chemical hazards will be collected for incineration based on a risk assessment by the PI, IACUC, and EHS. Bedding/cages containing biological hazards will be autoclaved based on a risk assessment by the PI, IACUC, and EHS.

## **OTHER WASTES (CONT'D): ANIMAL CARCASSES/TISSUES/BEDDING**

3. Animal carcasses/bedding containing radioactivity
  - a. These materials will be handled on a case by case basis through EHS. Contact EHS prior to beginning any experiment that may generate this.

*NOTE: Non-contaminated animal bedding is disposed of by the CCMR staff into the DMS compactor located at the Borwell or Vail loading docks.*

## **OTHER WASTES:**

### **POTENTIALLY INFECTIOUS MATERIAL COMBINED WITH RADIOISOTOPES**

NOTE: *Contact EHS at 646-1762 prior to performing these procedures.*

1. Liquids must be decontaminated by adding a suitable disinfectant to the container. Note the infectious agent and disinfectant on a Hazardous Waste Label. Also, attach a completed Radioactive Waste Tag to the container. Dispose of liquid through EHS.
2. Solid material such as pipette tips and culture flasks must be soaked in a suitable disinfectant. Rinse and check for residual radioactivity in liquid. Dispose of liquids and labware through EHS.
3. Questions--call Environmental Health and Safety at 646-1762.

## APPENDIX A

### CHEMICALS NOT SUITABLE FOR DRAIN DISPOSAL

These chemicals may not be drain disposed in any amount:

*Listed are examples, this is not an all-inclusive list*

#### ORGANIC CHEMICALS

All alkanes and water-insoluble hydrocarbons		All chlorinated and brominated hydrocarbons
Hexane	Phenolic compounds	Methyl Bromide
Benzene	Xylene	Heptachlor
Cyclohexene	Toluene	Ethidium Bromide
Ethyl ether		Bromoform
Pentane		
Heptane		
<b>Chlorinated hydrocarbons</b>		
Chloroform		Tetrachloroethylene
Carbon tetrachloride		Trichloroethane
Methylene chloride		Trichloroethylene
PCBs		
<b>Chlorofluorocarbons (freons, halons)</b>		
<b>EPA Priority Pollutants (See below)</b>		

#### INORGANIC CHEMICALS

CHEMICALS CONTAINING THE FOLLOWING METALS AND COMPOUNDS	
Antimony	Lead
Arsenic (+ Arsenate and Arsenite)	Mercury
Beryllium	Nickel
Cadmium	Selenium
Chromium (+ Chromate and Dichromate)	Silver (+ Photographic Fixer)
Copper	Thallium
Cyanides, Cyanates, and Thiocyanates	Zinc
<b>SPECIFIC COMMONLY USED INORGANIC CHEMICALS</b>	
Sodium azide	Sodium cyanide
Chromium glassware cleaners: Chromerge®, chromium trioxide/sulfuric acid solution	

## APPENDIX A (CON'T): CHEMICALS NOT SUITABLE FOR DRAIN DISPOSAL

EPA Priority Pollutants (40CFR Part 122 Appendix D, Tables II and III)

### Table II - Organic Toxic Pollutants

#### VOLATILES

acrolein	acrylonitrile
benzene	bromoform
carbon tetrachloride	chlorobenzene
chlorodibromomethane	chloroethane
2-chloroethylvinyl ether	chloroform
dichlorobromoethane	1,1-dichloroethane
1,2-dichloroethane	1,1-dichloroethylene
1,2-dichloropropane	1,3-dichloropropylene
ethylbenzene	methyl bromide
methyl chloride	methylene chloride
1,1,2-tetrachloroethane	tetrachloroethylene
toluene	1,2-trans-dichloroethylene
1,1,1-trichloroethane	1,1,2-trichloroethane
trichlorethylene	vinyl chloride

#### ACID COMPOUNDS

2-chlorophenol	2,4-dichlorophenol
2,4-dimethylphenol	4,6-dinitro-o-cresol
2,4-dinitrophenol	2-nitrophenol
4-nitrophenol	p-chloro-m-cresol
pentachlorophenol	phenol
2,4,6-trichlorophenol	

#### PESTICIDES

aldrin	alpha-BHC
beta-BHC	gamma-BHC
delta-BHC	chlordane
4,4'-DDT	4,4'DDE
4,4'-DDD	dieldrin
alpha-endosulfan	beta-endosulfan
endosulfan sulfate	endrin
endrin aldehyde	heptachlor
heptachlor epoxide	PCB-1242
PCB-1254	PCB-1221
PCB-1232	PCB-1248
PCB-1260	PCB-1016
toxaphene	

## APPENDIX A (CON'T) CHEMICALS NOT SUITABLE FOR DRAIN DISPOSAL

### Table II-Organic Toxic Pollutants (Con't)

#### BASE/NEUTRAL

acenaphthene	acenaphthylene
benzidine	benzo(a)anthracene
benzo(a)pyrene	3,4-benzofluoranthene
benzo(ghi)perylene	benzo(k)fluoranthene
bis(2-chloroethoxyl)methane	bis(2-chloroethyl)ether
bis(2-chloroisopropyl)ether	bis(2-ethylhexyl)phthalate
4-bromophenyl phenyl ether	butylbenzyl phthalate
2-chloronaphthalene	4-chlorophenyl phenyl ether
chrysene	dibenzo(a,h)anthracene
1,2-dichlorobenzene	1,3-dichlorobenzene
1,4-dichlorobenzene	3,3'-dichlorobenzidine
diethyl phthalate	dimethyl phthalate
di-n-butyl phthalate	2,4-dinitrotoluene
2,6-dinitrotoluene	di-n-octyl phthalate
1,2-diphenylhydrazine (as azobenzene)	fluoroanthene
fluorene	hexachlorobenzene
hexachlorobutadiene	hexachlorocyclopentadiene
hexachloroethane	indeno(1,2,3-cd)pyrene
isophorone	naphthalene
nitrobenzene	N-nitrosodimethylamine
N-nitrosodi-n-propylamine	N-nitrosodiphenylamine
phenanthrene	pyrene
1,2,4-trichlorobenzene	

#### ADDITIONAL MATERIALS

dioxins-2,3,7,8 tetrachloro-dibenzo-p-dioxin (TCDD)  
asbestos

### TABLE III- Other Toxic Pollutants (Metals and Cyanide) and Total Phenols

Antimony, Total	Nickel, Total
Arsenic, Total	Selenium, Total
Beryllium, Total	Silver, Total
Cadmium, Total	Thallium, Total
Chromium, Total	Zinc, Total
Copper, Total	Cyanide, Total
Lead, Total	Phenols, Total
Mercury, Total	