



Environmental Analysis Program

Pomona College
Biogeochemistry Laboratory

SOP-L106

Refrigerators and Freezers

Standard Operating Procedure

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1. Purpose

This procedure describes the proper use, sample storage protocols, and inventory management for the laboratory refrigerator (4 °C), freezer (approximately –30 °C), and ultra-low freezer (approximately –80 °C). Proper cold storage is essential for preserving sample integrity for chemical, biological, and molecular analyses (APHA et al., 2012).

2. Scope

- **Applies to:** All use of the laboratory refrigerator (4 °C), freezer (–30 °C), and ultra-low freezer (–80 °C) for sample preservation and reagent storage
- **Does not apply to:** Food storage (prohibited), field coolers, or cryogenic storage (liquid nitrogen)
- **Location:** EA Program laboratory, SGM 133

3. Definitions

- **Cold chain:** The unbroken sequence of refrigerated storage and transport that maintains samples at the required temperature from collection through analysis; a break in the cold chain may compromise sample integrity.
- **Cryogenic storage:** Storage at temperatures below –80 °C, achieved with ultra-low freezers or liquid nitrogen dewars; required for DNA, RNA, enzymes, and some biological samples.
- **Freezer burn:** Dehydration and oxidation of samples stored improperly in a freezer, caused by sublimation of ice crystals; prevented by airtight sealing of containers.
- **Holding temperature:** The target storage temperature specified by the analytical method or regulatory protocol for a given sample type (e.g., 4 °C for water samples, –20 °C for soil extracts, –80 °C for nucleic acids).
- **Temperature excursion:** An event in which the storage temperature falls outside the acceptable range; must be documented and the potential impact on sample integrity evaluated.
- **Ultra-low freezer (–80 °C):** A mechanical freezer capable of maintaining temperatures between –70 °C and –86 °C; used for long-term storage of DNA, RNA, microbial cultures, and enzyme preparations.

4. Responsibilities

Role	Responsibility
Lab PI	Approve storage assignments, ensure training compliance
Lab Manager	Monitor temperatures, coordinate power outage response
Trained Personnel	Store and retrieve samples following this SOP, maintain inventory records
New Students	Complete training before independent use

4.1. Acknowledgements

We thank Aparna Chintapalli for setting up the –80 C ultra-freezer map and inventory system.

5. Safety and Hazards

Hazards

- **Physical:** The –80 C freezer poses a risk of cold burns (frostbite) upon contact with surfaces or samples. Heavy drawers and racks can cause crush injuries if dropped.
- **Chemical:** No flammable materials may be stored in the laboratory refrigerator or freezers. These units are not explosion-proof and can generate significant static electricity, which can cause an explosion in the presence of flammable fumes.
- **Electrical:** Power outages can compromise stored samples (see Section 7).

Important

No food or beverages shall be stored in the laboratory refrigerator or freezers under any circumstances.

5.1. Required PPE

- ☐ Insulated cryogenic mittens or gloves (required for –80 C freezer)
- ☐ Lab coat
- ☐ Safety glasses (when handling chemical reagents from cold storage)
- ☐ Closed-toed shoes

5.2. Emergency Procedures

For cold burns, warm the affected area gradually with lukewarm water; do not rub. Seek medical attention if blistering occurs. Refer to [SOP-L002 Laboratory Safety](#).

6. Equipment and Materials

6.1. Equipment

Item	Location	Notes
Laboratory refrigerator	Lab, SGM 133	Set to 4 C
Laboratory freezer	Lab, SGM 133	Set to approximately –30 C
Ultra-low freezer (–80 C)	Lab, SGM 133	<i>TBD – confirm manufacturer and model number</i>
Thermometer / temperature logger	Inside each unit	For monitoring; check daily

6.2. Consumables

Item	Notes
Cryoboxes (cardboard or plastic)	For organizing samples in the -80°C freezer
Cryogenic labels / markers	Must withstand -80°C without peeling
Sample tubes (cryovials, microcentrifuge tubes)	Must be rated for the target storage temperature

7. Procedure

7.1. Refrigerator (4°C)

1. Store samples that require short-term cold storage (soil extracts, water samples awaiting analysis, reagents with refrigeration requirements)
2. Label all containers with: sample ID, date, researcher name, and project
3. Do not overcrowd the refrigerator; allow air circulation around samples
4. Remove expired samples and reagents during monthly cleanouts
5. *TBD – define shelf assignment system for the refrigerator*

7.2. Freezer (-30°C)

1. Store samples requiring medium-term frozen storage (archived soil samples, tissue samples, reagents requiring -20°C or colder)
2. Label all containers with: sample ID, date, researcher name, and project
3. Organize samples by project; do not mix projects within the same shelf area
4. *TBD – define shelf assignment and inventory system for the -30°C freezer*

7.3. Ultra-Low Freezer (-80°C)

The -80°C freezer is organized using a hierarchical location system. Every sample must be documented in the [Freezer Inventory Google Sheet](#) and in your laboratory notebook.

7.3.1. Loading Protocol

1. When loading the freezer for the first time or after defrosting, install a few drawers at a time from top to bottom, allowing the freezer to stabilize between additions
2. Only open the freezer when you are ready to place or remove samples. Minimize the time the door is open.
3. Wear insulated cryogenic mittens and a lab coat when accessing the freezer

7.3.2. Location Hierarchy

The freezer inventory uses the following hierarchy:

- **Shelf:** Each shelf is contained behind an inner door, numbered from top to bottom. (Note: Shelf 1 is currently empty.)
- **Divider:** Each divider is a column of drawers within the shelf, labeled A through E from left to right
- **Drawer:** Drawers are numbered sequentially from top to bottom within each divider
- **Box:** Each drawer contains five boxes, labeled 1 through 5 from front to back
- **Box position:** Each box is divided into 100 positions. Numbering runs from front-left (position 1) to back-right (position 100), counting along rows from left to right

7.3.3. Required Inventory Fields

Record the following in the [Google Sheet](#) and in your lab notebook each time you store or remove a sample:

Field	Description
Shelf	Shelf number (top to bottom)
Divider	Column letter (A–E, left to right)
Drawer	Drawer number (top to bottom)
Box	Box number (1–5, front to back)
Box position	Position number (1–100)
Project	Project name or code
Date collected	Date sample was collected in the field
Sample ID	Unique sample identifier
Sample description	Description including any relevant analytical results (e.g., NanoDrop concentration)

Tip

Before opening the freezer, identify the exact shelf, divider, drawer, box, and position you need. Have all your samples labeled and ready to go. This minimizes the time the door is open and protects the integrity of all stored samples.

8. Quality Control and Acceptance Criteria

8.1. Temperature Monitoring

- Check and record the temperature of each unit daily (or use a continuous temperature logger)
- Acceptable ranges: refrigerator 2–6 °C; freezer –25 to –35 °C; ultra-low freezer –75 to –85 °C
- If temperature is outside the acceptable range, investigate immediately (door left ajar, power outage, compressor failure)
- *TBD – establish an alarm system or temperature logging protocol with automatic notifications*

8.2. Power Outage Protocol

! Power Outage Response

If the power goes out, it is imperative that valuable samples in either freezer be moved to a location where power is currently available to maintain freezing conditions. The laboratory generators do not provide sufficient power to keep any of the refrigerators or freezers at their appropriate temperatures.

1. Contact the lab manager and PI immediately
2. Do not open freezer doors unless moving samples to a backup location
3. A closed –80 C freezer can maintain temperature for approximately 24 hours if the door remains shut
4. If power is not expected to be restored within 4 hours, arrange to transfer critical samples to a backup freezer on campus
5. *TBD – identify backup freezer locations on campus and establish agreements for emergency sample transfer*

8.3. Inventory Maintenance

- Conduct a full inventory audit of the –80 C freezer at least once per semester
- Remove samples from completed or abandoned projects promptly
- Ensure the Google Sheet is current; discrepancies between the sheet and actual contents must be resolved immediately

9. Waste Disposal

Waste Type	Disposal Method
Expired or abandoned samples	Dispose per the relevant SOP for the sample type (e.g., biohazard, chemical waste, standard trash)
Broken cryovials	Sweep up carefully; treat as sharps if broken glass
Used cryoboxes	Standard trash (if uncontaminated)

10. References

APHA, AWWA, & WEF. (2012). *Standard methods for the examination of water and wastewater* (22nd ed., p. 1360). American Public Health Association.

11. Training Record

Before using the laboratory cold storage independently, personnel must:

1. Read this SOP and [SOP-L002 Laboratory Safety](#) in full
2. Demonstrate proper use of cryogenic PPE
3. Demonstrate the ability to locate a sample using the freezer hierarchy and Google Sheet
4. Successfully store and retrieve a sample under supervision, updating the inventory in both the Google Sheet and lab notebook
5. Be signed off by the PI or lab manager