

TIPS TO ACHIEVE LABORATORY SUSTAINABILITY

How to Be Sustainable in the Laboratory

By Paige Garland | Spotlight Solutions

Abstract

Now more than ever, it is important to be conscious of your environmental impact, especially in the laboratory. Sustainable lab practices are not only good for the environment, but there are proven economic benefits too. These simple tools can help you apply sustainable lab practices to your laboratory. This resource guide will give you tips and resources for lighting, water, energy, recycling, and more!

Lab Recycling Programs

GreenLabs Recycling

contact@greenlabsrecycling.com

Green Labs Recycling is a recycling company for sustainable science in the Greater Boston area. This includes Boston, Cambridge, Waltham, Natick, Watertown, and more.

GreenLabs does not offer mailing recycling options, they help find local recyclers to reduce greenhouse gas emissions and further promote sustainability. Their recycling program has no minimum volume for pickup. They are also in the process of making reusable bags for recycled pipette tip boxes. GreenLabs works with brewing companies to promote sustainable recycling programs as well.

GreenLabs Recycling **accepts**: pipette tip boxes, refillable wafers, media bottles, conical tube racks, and clean #1 (polyethylene terephthalate) and #5 plastics (polypropylene lab material)

GreenLabs Recycling **rejects**: pipette tips, nitrile gloves, packaging material, and plastic resin #2,3,4,6,7

The infographic features the GreenLabs Recycling logo at the top left, which consists of a green circular arrow and the text 'GreenLabs RECYCLING'. To the right is a QR code. Below the logo, the text 'Accepted Items' is displayed. Underneath, three items are shown: a stack of pipette tip boxes, a clear media bottle, and a conical tube rack with a green arrow pointing down to it. Below these images, the text reads: 'pipette tip boxes, media bottles, conical tube wafers, and lids (triple rinsed and dried) racks only'. The section 'Not Accepted' is in red text. Below it, three items are shown: a pipette tip, a pair of blue nitrile gloves, and a piece of film plastic. Below these images, the text reads: 'pipette tips • nitrile gloves • film plastics • plastic resin #2, 3, 4, 6, 7 •'. At the bottom, the text says 'email us! contact@greenlabsrecycling.com'.

No plastics or recycled material needs to be autoclaved, the only requirement is that for any bottles holding liquid, they be triple rinsed, and cap left off before disposal. It is also helpful to sterilize lab materials and ensure that the recycled material is clean.

Service Options:

- Standard Service: personnel from the lab facility pre-stage the plastic in their loading dock to facilitate a streamlined pickup.
- White Glove Service: Collection staff will enter the facility and collect the plastic directly from its point of use within labs.

TerraCycle

TerraCycle [Zero Waste Boxes](#) help ensure that you can recycle your lab materials without creating unnecessary waste. These include pipet tip boxes and 5 gallon sharps boxes. TerraCycle uses the recycled plastics from pipet tip boxes to make park benches and other eco-friendly products. For the 5 gallon sharps system recycling, all items in container are run through industrial autoclaves for sterilization, any blood residue, trace medications, etc. are destroyed in the autoclave, syringes are shredded mechanically, and metals, plastics and glass are separated for recycling. EasyPak is another zero waste system that recycles PPE like disposable masks and gloves. They also have a bulk recycling program that handles electronic and [PPE recycling](#).

Examples of available Products:

- Zero Waste Pipet Tip Boxes
- Zero Waste 5 Gallon Sharps System
- EasyPak Safety Equipment and Protective Gear Recycling Box
- EasyPak Disposable Masks Recycling Box
- EasyPak Disposable Gloves Recycling Box
- EasyPak Disposable Masks Large Recycling Box

Cytiva x TerraCycle

Cytiva has partnered with TerraCycle to find a solution to the landfill waste accumulated by laboratory plastic syringe filters. Together they created a recycling box for Cytiva's Whatman syringe filters. Each box can recycle 10,000 filters and sent to TerraCycle to be recycled and turned into industrial materials like decking and pallets.

Corning Recycles

If you purchase lab equipment from Corning, Falcon, or Axygen, then you are eligible for Corning's packaging recycle program! Packaging such as pipet tip racks, centrifuge tube plastic bags, Styrofoam racks, shrink wrap, wrappers, and any plastic bags used from cell culture dishes can be sent back in a box for proper recycling. They do not accept packaging from other manufacturers, cardboard, or any biologically coated products. All you have to do is mail your items to Corning and you have done your part!

Kimberly-Clark RightCycle

Kimberly-Clark Professionals RightCycle program allows you to recycle your PPE, nitrile gloves, and safety glasses. The recycled items must be Kimberly-Clark products. This program keeps waste out of landfills and turns these products into new consumer goods. All you have to do is collect your used or discarded nitrile gloves in a box and collect your protective clothing and safety glasses in another. Once the boxes are full and loaded onto a pallet, you can ship the items out to be recycled and processed into new material.

Voluntary Lab Recycling

If your laboratory does not have any lab recycling programs in place, create your own! Find a recycler who will sell or lend you large bins for lab waste. Some materials you can recycle on your own from the laboratory include cardboard, printer paper, packaging materials, pipette tip trays, #1 and #2 plastic containers (uncontaminated), metal cans, and plastic bottles. You can also set aside batteries and electronics to be discarded in e-waste bins.



Eco-friendly Freezers

Nuaire

[The Blizzard HC VIP NU-99338J](#): This freezer is considered eco-friendly because it uses hydrocarbon, which produces lower emissions while still maximizing storage and maintaining ideal performance. The Blizzard is an upright freezer that is most commonly used for storing cancer cells, T-cells, stem cells, and organ/tissue samples.

[The Blizzard HC VIP NU-99420J](#): The ergonomic chest Blizzard HC also uses hydrocarbon refrigerants which reduces cost and energy consumption. The freezer also includes a self-checking diagnostics system and strong and reliable insulation.

Thermo Fisher Scientific

[Fisherbrand Isotemp Ultra-Low Temperature Freezers](#): The Fisherbrand freezer uses hydrocarbon energy that can reduce energy consumption by as much as 25%. There is also a vacuum panel insulation which helps limit negative environmental impact. Not only are they a reliable freezer choice but they were manufactured in a zero-waste facility to further promote the importance of sustainability.

Avoid purchasing a new freezer if possible. However, when making a new purchase, chest freezers typically use less energy than vertical freezers. Not only is it important to purchase a freezer that is eco-friendly but also to maintain and regularly defrost freezers to prolong their life and decrease energy usage. Some freezers come with automatic manual defrosters, but many will

need to be done manually. Defrosting is necessary to prevent ice build-up from moisture because it limits airflow and cooling capabilities. Defrosting and regularly maintaining your freezer is sustainable because this increases the freezers lifespan.

A few other tips to save energy include discarding unneeded samples, creating sample inventories, cleaning the door seal, chilling up temperatures (ex. changing from -80°C to -70°C), dusting the coils behind freezers, and using high density storing methods. Chilling up your freezer can save up to 1000 kW of power and over \$100 in energy costs. Most samples are still safe to store at -70°C but is important that if you are chilling up your freezer that you are mindful of temperature swings and regularly watch the temperature. The -70°C shift for freezers work best when it is full, so share freezer space with a neighboring lab if needed.

Fume Hoods

Sash Height and Closing the Sash

The standard sash height for operating in a fume hood should be between 12 and 18 inches. Fume hoods require a lot of energy. It is important to keep the sash low to protect yourself from fumes and splashes, but also to reduce energy consumption. Closing the sash whenever possible is an easy way to reduce a fume hoods energy consumption because it reduces airflow. Many fume hoods use variable air volume (VAV), meaning that the sash height controls the amount of airflow. Therefore, keeping the sash low when in use and closed whenever possible will reduce the energy consumption of fume hoods.

Harvard Universities “Shut the Sash” program which encouraged campus labs to close their fume hood sashes, saved an estimated \$200,000 a year and reduced greenhouse gas emissions by 300 metric tons of CO₂. So not only will you save energy, but the reduction of energy will also save money and reduce gases released into the atmosphere. Other efforts to reduce your fume hoods energy consumption include implementing a sash management program and ensuring your lab employees are educated on the importance of closing sashes whenever possible. In addition to this, like any other piece of lab equipment, properly using and maintaining your fume hood to prolong its lifespan is a great sustainable practice for the laboratory.

Ventilation Management

Lab ventilation and the proper ventilation of fume hoods is important to keep the work environment clean and safe from fumes and toxic chemicals. Ensuring that the fume hood is only generating a high airflow when the fume hood is open or in use is also important to reduce energy consumption. Closing the sash of a fume hood whenever possible limits the airflow and ventilation from the fume hood, resulting in saving energy. Many fume hoods use VAV to controls the amount of airflow. The chart below from Cornell’s Environmental Health and Safety department outlines the control banding of laboratory ventilation.

Laboratory Ventilation Controls Bands

Control Bands	General Ventilation Rate
Highly ventilated	8 ACH occupied / 4 ACH unoccupied
Moderately ventilated	6 ACH occupied / 3 ACH unoccupied
Low laboratory ventilation provided	single pass air required, but ventilation rate is determined by specific operating schedules or other management practices
Specialized ventilation required	to be determined by engineering analysis

Source: Cornell University Environment, Health and Safety

Sustainable Purchasing

There are many simple purchasing changes you can make to add to your lab's sustainability. Making these small changes in your labs can have a larger impact than you realize. The first solution to sustainable purchasing is using stackable pipette tip boxes and refilling old ones. Keep waste minimization top of mind by avoiding unnecessary bulk chemical ordering. Another tip is to use glassware whenever possible and avoid plastics if you can. Glassware that is autoclavable is the best solution to minimize lab waste. Purchasing a de-icing kits for your lab freezers will make it easy to defrost them (you already know the benefits of defrosting!). Other great purchasing tips for sustainable labs include buying reusable and autoclavable reagent reservoirs, using the right size plates, buying conical tubes from recycled plastic, and ordering dry oligos.

Other Sustainable Lab Products

[Grenova](#)

Grenova creates products with a goal to repurpose used laboratory waste. Their Tipnovus bench top machine is a washer for pipette tips, allowing you to reuse materials in an environmental effort to reduce waste. Grenova has other products with similar capabilities including a mini version of the pipette tip cleaner, a storage cabinet made for drying materials in a clean HEPA-filtered environment, and an oxidizing reactant for denaturing biological contaminants.

[Imrali Inventions Slide Cleaner](#)

The "iWash Slide Cleaner" washes and recycles cell counter slides that are designed to replace disposable slides and eliminate lab waste. The minimum amount each slide can be cleaned is 20 times! Not only that, but cell counting will also become much more affordable, and you will reduce your biohazardous plastic waste and carbon emissions in the process.

Water

In the laboratory, washing your hands is a crucial step in entering and exiting. This means that every person who goes in the lab washes their hands at least twice. Managing your laboratory water usage is very important. One way to do so, is by using low-flow faucet aerators for installation on dedicated handwashing lab sinks. There are many benefits to installing an aerator including that it acts as a debris filter. One common misunderstanding about low-flow faucets is the pressure. Low flow does not mean that the pressure of the water changes. Aerators are extremely affordable and easy to install, simply added to the end of a faucet. Any aerator that is running at 2 gallons per minute can easily be reduced to a 0.5 gpm aerator. This can reduce your handwashing water usage by 30-50% per use of a sink, which is a great way to be sustainable in the laboratory.



Another great solution to save water in the laboratory is by using foot operated sinks for water flow. This is also beneficial from a sanitary standpoint because you will not need to touch a handle after handling potentially hazardous chemicals in the laboratory. Other good practices to be mindful of include reporting leaks, turning off faucets when not in use, promoting water conservation, and even adding dual flush systems to bathrooms.

Water energy can be saved in more ways than adjusting sinks and faucets. Minimizing the water usage when cooling and rinsing lab equipment is another sustainable lab practice. The single-pass cooling system uses the most water for cooling methods in the lab. The best way to minimize water usage in this process is to use a cooling loop or reusing single-pass discharge water for things like irrigation or initial rinses. By separating lab water from domestic, irrigation, or other cooling water, water quality can be better monitored and regulated by facility managers across the entire facility. Rinsing equipment using counter-current rinsing is the most efficient way to rinse and save water. This means that the flow of water is opposite to the workflow and the cleanest water is used last. Batch rinsing also saves water because multiple pieces of equipment are washed using the same water and cleaned all together.

Energy/Electricity

Researchers at Harvard University are innovating ways to save energy and electricity in the laboratory. Like many other labs, they face issues with leaving machines on and having to frequently return to the laboratory to turn things off. Their solution to this problem is to create a web-based switch to turn things on and off, as well as a temperature monitor. These switches could be used to conserve energy and limit the negative effects of machines being left on by accident. Harvard is in the process of developing the wifi-connected hardware and cloud-based software that will serve as a ‘control center’ for devices.

Another solution to save energy and turn off lab equipment when it is not in use, is to set timers on equipment. This allows you to not worry about if you have already turned on/off your machine and it will not interfere with any of your research. Examples of machinery that you can use timers on include heating blocks, centrifuges, printers, and PCR machines.

Lighting

Incandescent lightbulbs use only 10% of the energy that they consume to produce light. The other 90% of that energy is given off as heat from the bulb. This is extremely inefficient and unsustainable. Switching to an alternative lighting system such as LED lights or compact fluorescent bulbs use more of their consumed energy. They use roughly 75% less energy than incandescent bulbs and are known to last longer. A common myth about LED lights is that they produce a “white light” versus the normal yellow light we are accustomed to from incandescent bulbs. LED lights come in all different color temperatures, including a “yellow” bulb so you can replace your lights without noticing any difference. An additional benefit to using LED lights is the ability to recycle them in green electronic waste bins.

Maximizing daylight and natural brightness is the easiest solution to save energy. Opening windows and allowing daylight to illuminate a laboratory (if bright and safe enough) is a very energy efficient alternative. This can be achieved by working at benches near windows or natural light sources and turning off overhead lights. Another way to save energy in the labs is using fixture configuration. The best strategy for this is to use direct-indirect ambient lighting parallel to the benchtop of use. It is best to have a ratio of direct and indirect light because too much direct light can create glares but too much indirect light could potentially be too dark. The ratio used by International Institute of Sustainable Laboratories suggests a direct light ratio of about 20-40 percent.

Not all laboratory tasks require the same amount of lighting. If applicable, using task lighting such as overhead desk lamps instead of overhead lights can save energy as well. It is a cost effective way to reduce energy by using less ambient light. However, it is essential that task lights are shut off or unplugged when not in use, to avoid unnecessary light and energy. Lighting controls can also be used to program the lights in the laboratory based on daylight and time of day. This energy efficient solution allows you to maximize and minimize lighting as necessary. Using a system like this can also help lightbulbs last longer and work more efficiently to fit the labs lighting needs.

Additional Helpful Articles on Lab Sustainability

[5 Ways to Make Your Laboratory More Sustainably - BioSistemika](#)

[12 Principles of Green Chemistry - ACS](#)

[Greening Up The Lab: Sustainable Research Practices - Princeton University EHS](#)

[Saving Energy in Labs Looks Like This - NC State University](#)

[Best Practices - I²SL International Institute for Sustainable Labs](#)

[Green Lab Supplies and Lab Equipment Guide](#)

Thank you

If you have any questions, please feel free to reach out to our team at info@spotlightsolutions.com.