Beginner's Guide to Green Labs

Penn's *Climate and Sustainability Action Plan 3.0*, launched October 2019, serves as our roadmap for campus sustainability and builds upon the previous ten years of environmental leadership. Labs are large consumers of energy on campus, contributing to 37% of Penn's total carbon emissions, and serve as an important opportunity to lessen the campus' overall environmental footprint. Green Labs programs supports the University's goal of reducing carbon emissions 100% by 2042.

Labs on Penn's campus represent a huge opportunity for energy savings and improved waste diversion and lab staff and students should have access to use Penn's resources to reduce your lab's environmental impact. This guide provides some basic tips and resources to implement in the lab space and improve your lab sustainability performance.

The four main areas of focus for Green Labs surround the topics of energy conservation, water conservation, lab waste, and green chemistry. In addition to this Beginners Guide and the more comprehensive Green Labs Guide and Commitment, Penn Sustainability also offers other resources such as the Green Labs Working Group Meetings and Green Labs Executive Committee, where you can get more involved with lab sustainability on campus!

Spread the word about lab sustainability and let your lab neighbors know about your engagement by becoming Green Labs Committed. Below are some daily actions you can do to make your lab more sustainable.

Waste Reduction

Recycle

- Make reducing waste easier by making sure that recycling and trash bins are clearly labeled. If you need additional recycling bins, talk to your Building Administrator.
- Triple-rinsed chemical plastic and glass containers, non-hazardous Falcon tubes, clean media bottles, pipette tip boxes, and most product packaging can be recycled in traditional recycling streams.
- Visit the Penn Procurement Services website for more information on Special Recycling and Reuse Programs such as electronics, ink and toner cartridges, masks and gloves, etc.

Know Your Specific Waste Disposal Protocols

Safe disposal of hazardous waste is critical for a healthy environment. Make sure non-hazardous waste is diverted to the appropriate waste streams, as hazardous waste disposal is expensive.

Visit the EHRS website for specific information about the proper disposal of chemical waste, radioactive waste, biohazardous waste, sharps, glassware, and more.

Share Supplies

Use Ben's Attic, the University of Pennsylvania's surplus property exchange website, to search for and share excess supplies. Communicate with neighboring labs about sharing excess equipment and supplies before making new purchases. You can email sustainability@upenn.edu to get added to the Green Labs listserv to share surplus supplies opportunities.

Reuse Consumables and Switch to Glass

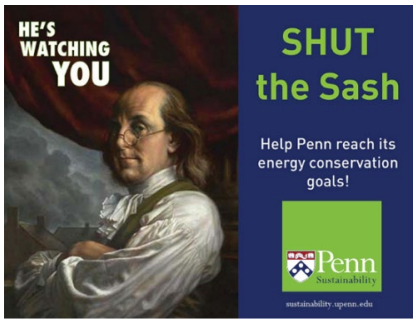
Reduce single-use waste by switching to reusable Petri dishes, conical tubes, pipets, and other glassware where possible. Some plastic consumables can be safely autoclaved and reused. Ensure the proper decontamination method for your specific equipment.

Energy Reduction

Turn Off Lights and Inactive Equipment

- Use daylight or task lights instead of overhead lights when possible.
- Install LED bulbs in desk lamps.
- Check with coworkers and Building Administrators when modifying any lighting and inquire with your Building Administrator about options to automate lighting controls.
- Use stickers on equipment to remind people to shut down equipment when not in use.
- Use outlet timers to schedule equipment to automatically turn off at night and on in the morning. Water baths and heating blocks can be set to the correct temperature when the first person arrives in the lab without keeping it on all night. Most ovens, gas chromatography machines, and centrifuges reach operating standards in as little as 20-40 minutes. Keep centrifuge rotors refrigerated so they are ready.

Close Fume Hood Sashes



Fume hoods are one of the largest energy consumers in the lab. A single fume hood can use as much energy as 3.5 households every day. Close the sash when not in operation to save energy and to also protect you from hazardous materials in the hood.

Turn Off Biosafety Cabinets When Not in Use

Shut down biosafety cabinets when not in use. Biosafety cabinets can consume as much as energy as 0.5 households every day. Unducted BSCs (Class 1, Class 2, Type A1/A2) may be safely turned off. To maintain a safe lab environment, allow Biosafety cabinet fans to run for 10-15 minutes unobstructed before and after use. Always follow EHRS best practices for safety. EHRS does not recommend the use of UV light for disinfection, so save a little energy and leave it off. For more information, please see the Biosafety Cabinet section of the EHRS website.

Vendor Take-Back and Procurement

Make Sustainable Purchasing Decisions

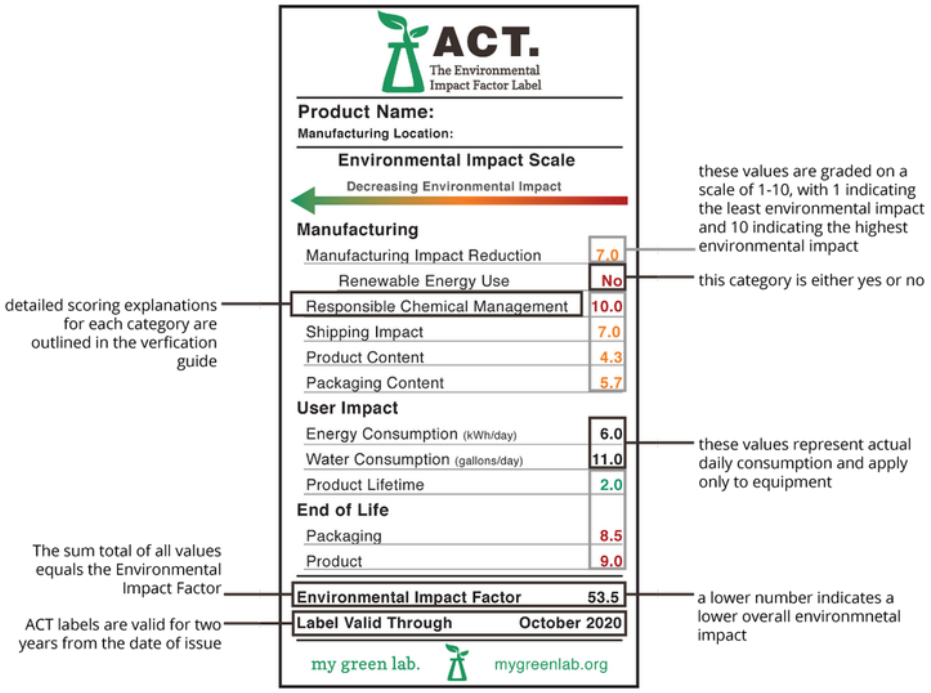
Purchase products that conserve energy, have reduced packaging, are made with recycled content or with reduced toxic or hazardous chemicals, and are designed with sustainability in mind. Look for companies that have sustainability labels in their product catalog.

MilliporeSigma products with a Greener Alternative Product icon are re-engineered to improve their environmental footprint, align with one of the 12 Green Chemistry Principles, or are Designed for Sustainability.

Thermo Fisher products with a green leaf use less waste, fewer resources, sustainable packaging, sustainable disposal, or is more energy efficient.

VWR (Avantor) products with an Environmentally Preferable Product label are more energy or water efficient, have recyclable or reduced waste packaging or content, are manufactured with low CO_2 impact, or are safer to human and environmental health.

The ACT Environmental Impact Factor Label was designed to evaluate the environmental impact of a product. Look for products with label or search the ACT database.



Styrofoam Take-Back

New England Biolabs, Sigma-Aldrich, and Qiagen EPS (Styrofoam) shipping boxes can be sent back by using the pre-paid postages on the container for reuse and recycling. Large boxes can be sent to Project Meow for winter cat shelters.

Reusable Sharps Container Program

Reusable sharps containers lower costs while increasing safety by requiring fewer people to handle the sharps. Visit the Business Services website for more information on the Reusable Sharps Program.

Green Chemistry

Use Green Chemistry Alternatives

Choose to use "greener" chemicals and solvents. Green chemistry aims to maximize efficiency and minimize hazardous effects on the human health and environment through 12 principles. This Fact Sheet offers suggestions for selection of common solvents for use in chemical reactions, extractions, and purifications in chemical research labs. Using less hazardous materials helps improve safety as well as reduce the energy required to dispose of hazardous waste and reduce the amount of time under fume hoods. Visit the American Chemical Society website for more sustainable chemistry information and tools.

Preferred	Usable	Undesirable
1-Butanol	2-MethylTHF	Benzene
1-Propanol	Acetic Acid	Carbon tetrachloride
2-Propanol	Acetonitrile	Chloroform
Acetone	Cyclohexane	Di-isopropyl ether
Ethanol	Dimethyl Sulfoxide	Dichloroethane
Ethyl acetate	Ethylene glycol	Dichloromethane
Isopropyl acetate	Heptane	Diethyl ether
Methanol	Isoctane	Dimethoxyethane
Methyl ethyl ketone	Methyl t-butyl ether	Dimethyl acetate
t-Butanol	Methylcyclohexane	Dimethyl formamide
Water	Tetrahydrofuran	Dioxane
	Toluene	Hexane(s)
	Xylenes	N-Methylpyrrolidinone
		Pentane
		Pyridine

Date Chemicals

Date new chemicals and adhere to a first-in, first-out policy. An organized chemical inventory will help prevent accumulation of chemicals in storage and avoid unnecessary new purchases.

Water Reduction

Use the Lowest Grade Water

Use the lowest grade water appropriate, ensuring that high quality water is available when required. Consider soaking rather than continuous flushing to conserve water. Instead of water stills, use reverse osmosis or ion exchange methods, when possible, to conserve energy.

Establish Efficient Labware Washing Practices

Make sure items really need to be autoclaved. Reduce the frequency at which individual items are autoclaved and increase efficiency by creating a sign-up or schedule to coordinate use.

Eliminate Single-Pass Cooling

It is easy to forget to turn off water, even when filling a jug or rinsing glassware, but these simple tools can help reduce water consumption! Consider running a recirculating loop through a cold-water bath as an alternative to running water down the drain. Ensure water baths are turned off each evening or consider investing in a waterless bead bath.

Monthly Actions

Keep an Updated Inventory

Chemical inventory is mandatory for all labs. Visit the EHRS website for more information about Penn's inventory system. Maintain your lab's chemical inventory so you don't order excess chemicals. Fill out the Chemical Surplus or Borrow Request form to request an EHRS search of campus inventory for chemicals before purchasing new orders.

Set Minimum Purchase Order Amounts

Set a minimum office or equipment purchase orders of $100-$200 and manage purchasing to reduce the number of purchase orders. This will help to reduce shipping charges, packaging, and delivery fuel consumption.

Report Leaking Faucets

Contact your Building Administrator or submit a Facilities work ticket on the FRES website to report a drip or leak whenever you see one.

Schedule Regular Equipment Maintenance

Maintain a laboratory equipment checklist and perform preventative maintenance practices.

- Clear ice build-up on ULT freezers with a soft cloth or rubber mallet, if necessary, on evaporator coils, seals, and gaskets every month. Check and clean the condenser coils and filters every two to three months. Check behind your freezer to remove any dust or grime from the radiator periodically. Schedule freezer defrosts one or two times a year. Check out NuAire's preventative maintenance checklist for more tips.
- Visually inspect the fume hoods every use to ensure the exhaust fans and air filters are working, the airflow is within the proper range, and avoid storing chemicals in the fume hood that can obstruct air flow. Other periodic inspections and preventative maintenance practices are provided by RDM.

Additional Resources

Visit the Penn Sustainability Green Labs page to find more resources, including more guides, signage, and information on how you can get more involved.

For a fun, interactive exercise, share and check out Labconscious' Green Labs tips module for more green tips in specific lab locations!