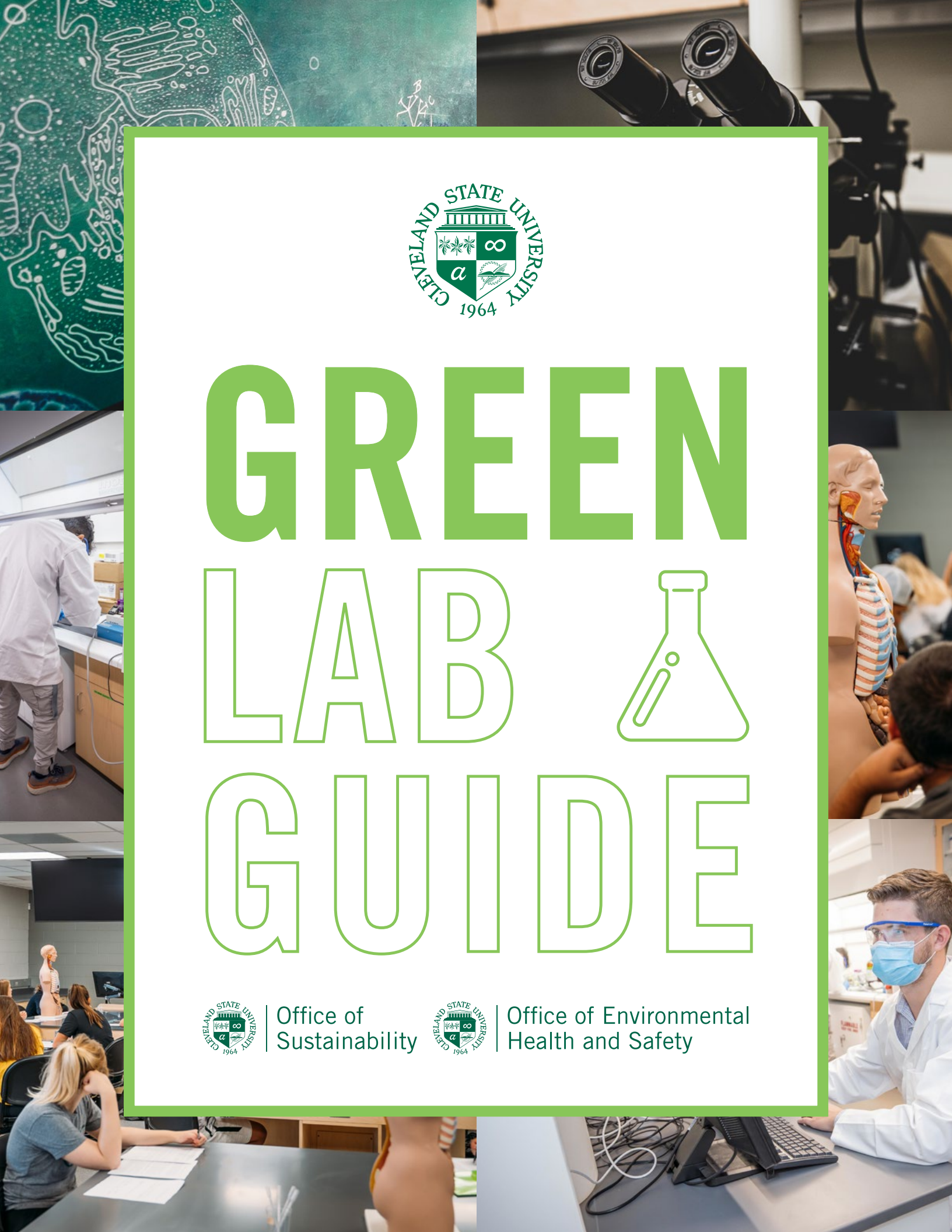

GREEN LAB GUIDE

Office of Sustainability | Office of Environmental Health and Safety

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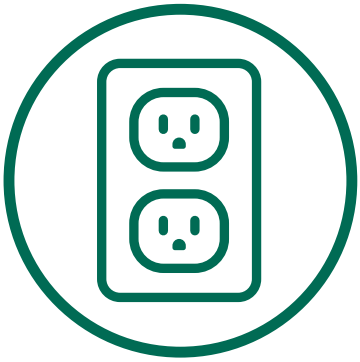
The framework for the CSU Green Lab Guide was developed by a biology student intern with the CSU Office of Sustainability. The guide was based on interviews with CSU faculty and analysis of best practice green lab procedures at peer universities. Support was provided by the Office of Sustainability, the Office of Environmental Health and Safety and CSU Facilities Services.

Please direct any comments or questions on the Green Lab Guide to the Office of Sustainability at sustainability@csuohio.edu.

EXECUTIVE SUMMARY

Laboratories at Cleveland State University are an important part of research, innovation and education.

Labs are also resource-intensive and consume significant amounts of energy and water. Compared to a standard office, a single laboratory can use 10 times as much energy and four times as much water[1]. It's been estimated that labs produce 5.5 million tons of plastic waste annually[2].



10X

More energy than offices

4X

More water than offices

5.5

Metric tons of plastic waste

While some increased resource usage can be attributed to the nature of laboratories, a portion of it could be reduced by simple adjustments to a few daily habits. The CSU Green Lab Guide is meant to serve as a reference for lab personnel with the aim of implementing sustainable practices and technologies that increase efficiency and conserve resources.

Guidelines are offered in four key areas:

1) Energy Conservation

2) Water Conservation

3) Sustainable Purchasing

4) Waste Reduction

A checklist for each of these areas is included on page 6.

All the suggestions in this guide are designed to reduce consumption and cut costs in labs without impacting productivity. Thanks for your efforts to minimize the environmental impact of labs at CSU!

ENERGY CONSERVATION

Shut the sash!

Laboratory ventilation systems can account for nearly half of all energy used in a lab and a single fume hood can consume as much energy as 3.5 homes[3].

Fume hoods consume so much energy because labs require more air exchanges than other spaces on campus. When the sash is left open, air that has been heated or cooled is exhausted straight to the outdoors through the fume hood and cannot be recirculated. Conditioning the air and running large fans for ventilation consumes a lot of energy.

The fume hood sash should only be open when directly manipulating substances within the hood and only to the level necessary to perform the experiment. Close it fully when not in use.

Keep yourself safe, avoid chemical exposure and reduce campus energy use by shutting the sash!

Increase ventilation only in emergencies

The red emergency button is only to be used in the event of an emergency. Pressing the red emergency button, often labeled "Ventilation Start," increases the air exchange rates to their maximum capacity while simultaneously maintaining negative lab pressurization. While effective in an emergency, this feature is extremely energy- and cost-intensive and should never be used unnecessarily. Pull the red button out to deactivate emergency ventilation.

Use properly sized appliances

Choose the right size incubator, autoclave, freezer or oven to store and treat samples. Using an oversized autoclave consumes significantly more energy than a sufficiently sized countertop version. Consider sharing appliances and space within the lab or between labs to achieve the most efficient use of resources. Whenever possible, design experiments to minimize electricity usage.

Turn off equipment when not in use

Unplugging unnecessary equipment when not in use saves energy and reduces utility costs.

Chilled centrifuges, ovens and heating blocks all require a certain temperature to be maintained. Equipment that must maintain a set temperature, whether hot or cold, requires a lot of energy. Turning off these types of equipment when not in use can save up to 10 kWh/day.

Turning off unused equipment is best, but utilizing energy-saving or stand-by modes also makes it possible to save energy when the equipment is not in use.

Audit, defrost and clean freezers

Assess freezer inventory regularly and remove unnecessary or unusable reagents or samples on a regular basis to decrease freezer load and make room for new supplies. Keeping freezers organized will also limit the time that doors need to stand open.

Defrosting freezers prevents ice buildup that reduces freezer space and decreases efficiency. Dust build-up on the outside coils forces the freezer to work harder to maintain the temperature. Defrosting freezers and vacuuming the coils twice per year reduces energy consumption and increases equipment performance and lifespan.

Raise freezer temperatures

Chilling up an ultra-low temperature freezer can result in significant energy savings. An adjustment from -80C to -70C can result in a 30%-40% energy savings[4]. Set refrigerator and freezer temperatures at appropriate levels instead of the lowest possible temperature to increase the life of the freezer and save energy.

Turn off lights and computers

Switch off lights when the last person leaves the lab. Enable power management settings on computers and put them into sleep mode after 20 minutes of inactivity. Consider plugging computers and electronic devices into power strips that are easily accessible and can be turned off at the end of the day.

WATER CONSERVATION

Reduce single-pass cooling

Single-pass cooling wastes a lot of water. Consider running a recirculating loop through a cold-water bath. Eliminating single-pass cooling from your workflow can save thousands of gallons of water each year and prevent the risk of flooding. Learn more about retrofit and replacement options for single-pass cooling.

Avoid water aspiration when possible

Water aspiration requires a continuous flow of water from the tap. Moderate daily use wastes an estimated 50,000 gallons of water per year. A vacuum pump provides greater control over the vacuum and avoids water waste entirely.[5]

Limit use of deionized water

It takes three gallons of water to make one gallon of deionized (DI) water. Use water purification only when necessary and match the process to the actual quality of water required.

Use autoclaves efficiently

Autoclaves can use as much as 60 gallons of water per cycle. And if your autoclave is more than 10 years old, chances are it uses up to 90 gallons per cycle[6] . Consolidate loads when possible and don't run an autoclave to sterilize a single box of pipette tips. Use the right size autoclave for the job.

Establish efficient lab practices

Establish efficient labware washing practices. Run dishwashers, autoclaves and cage washers only when they are full, and turn off these pieces of equipment or put them into standby mode when not in use. Turn off water when not being directly used. Design experiments to minimize water usage. Post signage with reminders to turn off the water.

Report leaks promptly

Report all leaks to the FAST Coordination Center at 216-687-2500 as soon as possible. A dripping faucet can waste over 600 gallons of water per year and a constantly running toilet can waste over 130,000 gallons per year.

SUSTAINABLE PURCHASING

Purchase smart and consolidate orders

Consolidating orders and eliminating small orders reduces packaging as well as the emissions and energy associated with transport of materials.

Buy tubes and pipettes in bags and refill racks rather than buying pre-filled racks.

Participate in vendor take-back programs whenever possible.

Maintain an up-to-date inventory

Maintain an up-to-date inventory of lab supplies, chemicals and equipment. Audit chemical supplies annually and purchase only what is necessary.

Only buy in bulk if you know the supplies or chemicals will be used. Check supplies before ordering to prevent over-purchasing and waste of resources.

Purchase ENERGY STAR® equipment

ENERGY STAR® certified products provide the same level of equipment functionality while decreasing environmental impact and operational costs. If ENERGY STAR is not an option, seek out efficient features, such as timers on autoclaves or ovens.

Learn more about ENERGY STAR-rated laboratory grade freezers and refrigerators here.

Order the least hazardous product

Identify alternative chemicals and processes for your lab and order products that can replace the hazardous materials needed for experiments. This fact sheet offers suggestions for selection of solvents and greener alternatives. My Green Lab has developed Green Chemistry, a useful guide for choosing green chemical alternatives.

WASTE REDUCTION

Minimize volume of materials purchased

Try to substitute disposable products with reusable products whenever possible.

Buy chemicals at the pace you need them, not in bulk. Buying in bulk creates a surplus of unused chemicals or reagents. Use the oldest chemicals first to ensure that they are fully utilized.

Label, store and dispose of hazardous chemicals according to EHS guidelines

Adhering to EHS guidelines not only improves lab safety, but helps to maintain accurate chemical inventories and reduce the volume of hazardous waste.

Follow campus recycling procedures

Divert waste from landfill through the following CSU recycling programs:

- **Paper:** Clean mixed papers can be put in the blue recycling bins, including copy paper and its packaging, newspapers, magazines, envelopes, junk mail, greeting cards, paperboard boxes (cereal, crackers, etc.) and phone books.
- **Plastic and cans:** Recycling bins for plastic and cans are gray with green lids. You can put plastic bottles, jugs and containers in this bin along with metal cans.
- **Cardboard:** Flatten clean cardboard boxes and leave by recycling bins for custodians to collect.
- **Styrofoam:** Reuse Styrofoam boxes and coolers when possible. Clean Styrofoam blocks can be placed next to recycling bins.
- **Batteries:** Recycle batteries in recycling bins located throughout campus and in select labs.
- **E-waste:** Recycle electronic equipment through Property Control.

Practice green chemistry to reduce quantities of hazardous chemicals

Green Chemistry utilizes chemical pathways that result in little to no generation of hazardous substances. Whenever possible, select non-hazardous chemical alternatives for experiments. To learn more, visit the American Chemical Society's 12 Principles of Green Chemistry or Beyond Benign for resources to implement green chemistry in undergraduate courses and labs.

GREEN LAB CHECKLISTS

Green lab practices can greatly reduce waste and energy consumption in labs without sacrificing the integrity or accuracy of scientific results. Thanks for your efforts to minimize the environmental impact of labs at CSU!

Energy Conservation Checklist

- ☐ Shut the sash!
- ☐ Increase ventilation only in emergencies
- ☐ Use properly sized appliances
- ☐ Turn off equipment when not in use
- ☐ Audit, defrost and clean freezers
- ☐ Raise freezer temperatures
- ☐ Turn off lights and computers

Sustainable Purchasing Checklist

- ☐ Purchase smart and consolidate orders
- ☐ Maintain an up-to-date inventory
- ☐ Purchase ENERGY STAR® equipment
- ☐ Order the least hazardous product

Waste Reduction Checklist

- ☐ Minimize volume of materials purchased
- ☐ Label, store and dispose of hazardous chemicals according to EHS guidelines
- ☐ Follow campus recycling procedures
- ☐ Practice green chemistry to reduce quantities of hazardous chemicals

Water Conservation Checklist

- ☐ Reduce single-pass cooling
- ☐ Avoid water aspiration when possible
- ☐ Limit use of de-ionized water
- ☐ Use autoclaves efficiently
- ☐ Establish efficient lab practices
- ☐ Report leaks promptly

ADDITIONAL RESOURCES

CSU Green Lab Program: csuohio.edu/sustainability/green-lab

CSU Office of Sustainability: csuohio.edu/sustainability

CSU Office of Environmental Health and Safety: csuohio.edu/ehs

- EHS Chemical Storage: Practices for Proper Chemical Storage
- EHS Laboratory Safety: csuohio.edu/ehs/laboratory-safety-0

CSU Facilities Services: csuohio.edu/fast

CSU Recycling: csuohio.edu/sustainability/waste-and-recycling

To report leaks or request building maintenance, call the FAST Coordination Center a**t 216-687-2500.**

REFERENCES

[1]mygreenlab.org/about.html

[2]Urbina, M., Watts, A. & Reardon, E. Labs should cut plastic waste too. Nature 528, 479 (2015). https://doi.org/10.1038/528479c

[3]Wesolowski, D. et al. The use of feedback in lab energy conservation: Fume hoods at MIT. Int. J. Sustain. High. Educ. 11, 217–235 (2010).

[4]etcc-ca.com/reports/ultra-low-temperature-freezers-opening-door-energy-savings-laboratories

mygreenlab.org/-70-is-the-new--80.html

[5]labmanager.com/product-focus/vacuum-pumps-to-replace-your-water-aspirator-4162

[6]mygreenlab.org/water.html

CLEVELAND STATE UNIVERSITY
1964

BE GREEN

CSU SUSTAINABILITY MOVEMENT

csuohio.edu/sustainability/green-lab