Five Steps to a Greener Lab:

A roadmap to environmental action

The laboratory is a place of inspiration, curiosity, ingenuity, and often altruism. Researchers are, by and large, a thoughtful and deeply invested group, but the environmental and ecological consequences of life science research are not typically at the forefront of researchers' minds when planning their investigations. Is it possible to minimize your environmental impact when working in the laboratory?

I. START THE DISCUSSION

The first step towards raising awareness about greener lab practices is to start the discussion with your coworkers. Share your concerns, brainstorm ideas together, and perhaps provide a list of green-labs-themed websites they can review. Several sites have sprung up in the past few years, including **www.mygreenlab.org**, the Labs21 Wiki, **www.green.harvard.edu/labs** and **www.labconscious.com**. Labconscious® began as a community of concerned life scientists, seeking to crowdsource solutions to the field's pervasive environmental challenges (see feature 1). "We've been really energized by the engagement we've seen with our blog and social network accounts," said Josh Resnikoff, contributing editor of Labconscious. "Life scientists are starting to take a critical look at the resources that their research demands, and they're starting to find smarter alternatives for a number of wasteful processes."

Next, speak to your environmental health and safety officer to ensure that your lab is taking full advantage of the green programs available. While some institutes and universities have realized the value of pro-environmental policies for the life sciences, others have been slower to adopt new processes. For instance, most universities offer basic recycling services, which collect paper products, beverage bottles and cans, but there are a number of specialized recycling methods that can address the various new streams of recyclables that are commonly used in life science research, such as polystyrene, polyethylene and polypropylene.

Be aware that laboratory safety policies frequently dictate how certain types of laboratory waste must be treated, whether it's incineration, sterilization or neutralization. Each of these methods is associated with its own environmental concerns; when possible, choose methods and chemicals that don't require regulated disposal. When regulated disposal is required, as for certain chemicals, consider secondary treatment methods that can minimize the amount or volatility of disposable materials, like distillation.

Once you've identified a few tactics for cutting your lab's environmental footprint, share your ideas with a larger group: present your findings at the next lab meeting, prepare a list for inclusion in your departmental newsletter, or hold a departmental seminar. You may be surprised by how receptive your coworkers are to your suggestions.

II. RECYCLE PLASTICS

Lab consumables are commonly made from plastics, as they are lightweight and extremely stable. Unfortunately, plastic decomposes slowly, if at all. Therefore, recycling is the most responsible way of disposing of the copious amounts of plastic generated in the lab. Small things, such as using refillable tip boxes or storage boxes, can help reduce the amount of plastic used. Items such as empty media bottles can also be recycled. Nucleic acid purification, in particular, is notorious for generating large amounts of plastic waste in the laboratory.

Labconscious is an open community for researchers to share ideas, protocols and best practices that help reduce the environmental footprint of bench science. Sponsored by New England Biolabs, it is our hope that Labconscious will become an educational platform and resource repository that will connect companies and brands with end users, and be used to identify greener processes and products. Together, we can try to make a better world with better labs.

Start the discussion at **labconscious.com**. Subscribe to the blog, follow the social channels and submit your ideas, stories and photos that relate to sustainability.

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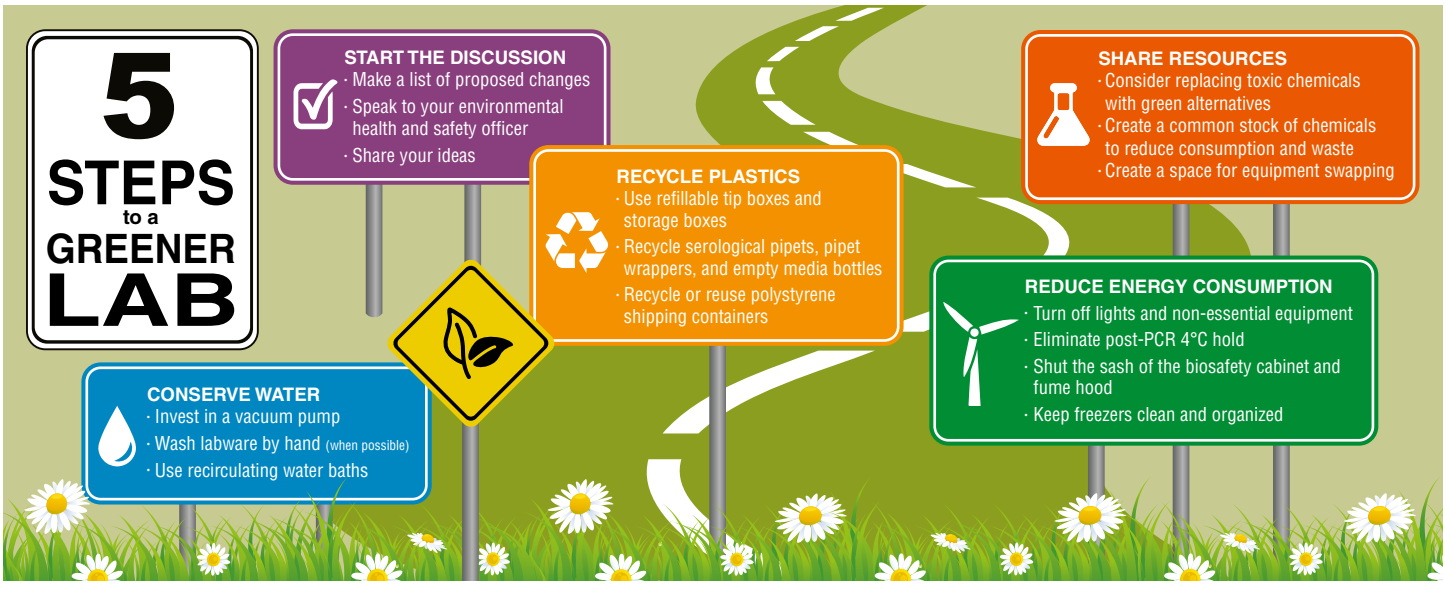

NEB'S SHIPPING BOX RECYCLING PROGRAM

NEB established the first shipping box recycling program over thirty-five years ago. Still in practice today in the U.S. and in some locations internationally, the program diverts polystyrene from landfills. Customers are provided with a return address label, and simply seal the box with the label and return via their local mail provider. It couldn't be more simple!

Many life science reagents require controlled temperature shipping, and expanded polystyrene (EPS) is the material of choice for protecting and insulating temperature-sensitive products. EPS is extremely stable, taking upwards of one million years to decompose in a landfill. EPS recycling is available in a few locations, but an EPS reuse program, like NEB's shipping box recycling program (see feature 2) and Andrew Markley's Styrofoam® box recycling program at the University of Wisconsin are even greener alternatives. Andrew received one of NEB's Passion in Science Awards™ in 2014, and has since worked to spread his box reuse program to other universities (see feature 3). The same material, polystyrene, is used in the fabrication of disposable serological pipettes, commonly used in sterile cell culture techniques. Recycling of serological pipettes may be available near you, but be sure to investigate BioSafety Level (BSL) restrictions for their applications.

If your institution's recycling program is limited, a good first step is to speak with your local environmental health and safety officer. Learning what provisions are available for new recycling programs, or what chemical safety rules must be adhered to, will help to guide your search for next steps.

III. CONSERVE WATER

Water consumption in life science research (and manufacturing) is extremely intensive. Things such as buffer production, cleaning of glassware, sterilization and incubation in water baths can all utilize large amounts of water.

There are several ways to conserve water in the lab. When making buffers or other aqueous solutions, follow an SOP; dumping out batches of incorrectly made buffers wastes both time and resources. Washing glassware by hand can be highly water efficient, but isn't a realistic option for certain labs; newer dishwashers can be connected to deionized and filtered water supplies, allowing for multiple rinses of important glassware. If your lab uses a water flow vacuum system, consider investing in a small vacuum pump; you can choose a size that fits your lab's particular needs and available space. Choose recirculating water baths, when possible. Consider installing aerators or water misers to minimize the amount of water that pours out of the faucet. While some of these improvements may be out of your hands, suggestions can always be passed on to your environmental health and safety officer or facilities manager.

AN NEB CUSTOMER WITH A PASSION FOR RECYCLING

Expanded polystyrene (EPS, also known as Styrofoam) has a low consumer-recycling rate due to its high transportation costs. In 2012, Andrew had the idea of collecting EPS boxes on campus and reusing them locally. Together, with the University of Wisconsin (UW) Office of Sustainability, they applied for and received over $100,000 in EPA funding for an undergraduate team to set up this system. In a year, UW went from no campus EPS recycling to collection sites in 26 buildings, reusing or recycling close to a semi-truck load monthly. Now, the university resells EPS boxes (as well as packing peanuts) through the campus surplus store, and provides boxes to local biotech companies for reshipment. The rest is delivered to a local EPS recycler. The hope is to use funds received by selling boxes to make campus EPS collection financially self-sustainable. Success with the UW program has led to Andrew replicating this program at two other universities.

AN INNOVATIVE METHOD FOR WASTEWATER TREATMENT

When NEB designed its facility in Ipswich, MA, one of the goals was to be more environmentally sound. As such, NEB chose to implement a Solar Aquatics® System on its campus to treat wastewater. Housed in a beautiful greenhouse filled with tropical plants, the system utilizes and accelerates the processes found in streams and wetlands to purify the water according to tertiary standards. While visitors may stop at the greenhouse to marvel at the beauty inside, many do not know it is treating the entire campus' wastewater for groundwater recharge.

To learn more about the water treatment process, visit **www.neb.com/aboutNEB**.

NEB's pledge to protect the environment extends to its local watershed; as such NEB has a unique solution for treating its wastewater and returning it to the ground (see feature 4).

IV. REDUCE ENERGY CONSUMPTION

Who hasn't unlocked the lab door, after a long weekend, to find that the lights had been on the whole time? Some laboratories are equipped with "smart" lights, activated by motion sensors; but if your lab is not, be mindful about turning the lights off. Furthermore, much of the climate control is determined by your facilities department. Still, there are several ways that every researcher can help save energy in the lab; it will just take some small adjustments to your established routines.

One of the major, researcher-related energy costs in the lab can be the easiest to avoid – skip the post-PCR hold. Plan your PCR to finish before you leave for the day or ask a labmate to move your tubes to the refrigerator, because your 4°C-hold step wastes significant energy.

Another simple, yet effective way to save energy is to shut the biosafety cabinet (tissue culture hood) sash. By shutting the sash, you stop the laminar-flow fan from running when it's not needed. Save even more energy by shutting the sash of the fume hood. In 2008, the Office for Sustainability at Harvard University initiated a shut the sash program, and has demonstrated significant energy savings as a result (For more information, visit **www.green.harvard.edu/programs/green-labs/shut-sash-program**).

Learn more about sustainability in the laboratory in the latest episode of NEB TV

www.neb.com/NEBtv

You can also visit #shutthesash to see how other labs have adopted this philosophy.

Freezers are also known to consume large amounts of energy in the lab. Eliminate cold air loss by periodically scraping down the gasket that seals the freezer to remove any ice that has accumulated. Also, by keeping the coils on the rear of the freezer unit free from dust and debris, you can prevent the freezer from working harder to achieve and maintain temperature. Lastly, by simply organizing the freezer contents and creating a map to post on the freezer door, open times will be shorter and less frequent.

V. SHARE RESOURCES

Chemicals

Always review your experimental protocol; in some cases, greener chemicals can replace toxic chemicals. For example, one could consider replacing ethidium bromide, which is commonly used for staining DNA in agarose and acrylamide gels, with a safer stain such as GelRed™ or SYBR® safe. When safer options are not available, consider buying the smallest amount that will serve your purpose, or try to source your chemicals from a "shared" source. Find out if your institution has a shared chemical repository, and if not, work to set one up.

References:
www.LabConscious.com
www.labs21century.gov

Equipment

Perhaps you have changed your research focus and have equipment on your bench that you no longer need. Rather than disposing it, designate a place in the building for equipment reuse. There is probably another researcher in the building that can use it, and you may find something you were looking for as well! For example, in 2013, the Harvard University Office for Sustainability piloted a "Reuse Room" where researchers can deposit specific items for recycling and reuse, including equipment, glassware, NEB Styrofoam coolers and gel packs. This program has been very successful for them. To learn more, visit **www.laboratoryequipment.com/articles/2014/04/collaborative-sustainability**.

SUMMARY

You've already taken the first step; you've educated yourself about a number of greener actions you can get started with. The next step is up to you, but we'd like to suggest that you keep learning – learn what your institution and local governance can do for you. Learn what's recyclable, what can be reused, and how to reduce your lab's waste profile. Then, help to raise awareness amongst your coworkers. Work together to come up with a plan, tailor that plan specific to your department and then work to get leadership support.

At NEB, we're committed to reducing our own environmental footprint (see feature 5) and we are always open to suggestions as to how we can do better. We encourage you to share your ideas at **labconscious.com** or **labconscious@neb.com**, so that we can all benefit from each other's ideas, big or small.

Bringing your eco-mindedness into the laboratory can be easy; all it takes is a bit of research into your institution's policies, and a commitment to making life science research greener. Start small, question convention, and know that you can make a difference!

WHAT IS LEED® CERTIFICATION?

Leadership in Energy and Environmental Design (LEED) certification is a distinction awarded based on a suite of environmentally focused standards. These include site sustainability, water efficiency, energy conservation and atmospheric protection, choice of building materials and resources, indoor environmental quality, innovation and building design. LEED certification can be awarded at the laboratory level, or for entire buildings.

NEB commissioned the building of a LEED-certified laboratory facility in Ipswich, MA. Many choices were made to optimize energy usage, choose responsibly-sourced building materials and conserve resources through building design. For a list of examples, visit **www.neb.com/about-neb/environmental-commitment**.

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