

Taking a LEAF out of the green lab book

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Do you want to make your research more efficient and reliable? Have you wondered whether science could be environmentally sustainable and what you can do to help bring this about?

With climate and environmental change a global concern, people and governments have looked to scientists to find ways to reduce carbon emissions and to live a more sustainable existence. In this context, scientific research does not only need to be reproducible and reliable, it must also itself be done sustainably. Both industrial research and academic research have huge carbon footprints: they need large capital equipment with high energy inputs, and day-to-day work in laboratories generates vast amounts of waste. For those working at the lab bench, the task of reducing the environmental impact of their work can appear daunting. But by setting data-driven objectives to reduce energy use and waste, and providing practical and realistic goals, we can carry out lab-based research more sustainably. Recently, the Biochemical Society hosted a webinar, titled 'Environmental Sustainability in Biomedical Laboratories' (Figure 1), outlining some of these sustainable labs initiatives, with an introduction to LEAF from Martin Farley. In this article, we hear from those working to implement lab sustainability programmes at the University of Oxford.

Implementing local infrastructure for sustainable labs

Laboratory buildings are responsible for over 60% of Oxford University's total energy consumption and carbon emissions, and the Sustainable Labs programme was started in September 2018 to reduce this demand. It supports the university's target of reaching net-zero carbon emissions by 2035, as set out in its recent Environmental Sustainability strategy.

A successful Sustainable Labs programme depends on strong engagement from laboratory staff and students across the university. Our dedicated Microsoft Teams group, monthly newsletters and termly workshops and seminars help to increase engagement with the programme. By increasing the regularity of such opportunities, we hope to improve the continuity of sustainable science. Continuity is vital, particularly with the turnover that can be

experienced. We also provide resources for laboratory staff. These include best practice guides for fume cupboards and ULT (ultra-low temperature) freezers, which together account for 10% of the university's energy consumption; an A-Z of recycling; and a guide to reducing single-use plastic within laboratories. Such guidance is crucial, as knowing where and how to act can be challenging in laboratory settings. Finally, we also have the support of the carbon management plan, which contributes towards the replacement of old, inefficient laboratory equipment.

Along with these resources, the Sustainable Labs programme encourages laboratories to gain certification through LEAF (the Laboratory Efficiency Assessment Framework). The LEAF pilot programme showed that participating labs, on average, save £3700 and 2.9T of CO₂e per year. The LEAF programme at the University of Oxford was introduced in 2020, with four labs becoming accredited. In 2021, this rose to 23 laboratories, and more than 50 have signed up this year's programme, inspired by earlier successes. The university organizes peer-to-peer audits of the LEAF submissions, to increase idea sharing between labs. LEAF teams are supported in a variety of ways, including by providing items such as timer switches for equipment, a range of stickers for recycling bins, and reminder to shut fume cupboard sashes and to turn off equipment at the end of the day



Figure 1. Screenshot from the related webinar recording

(Figure 2). As LEAF is a user-led initiative, we look forward to working with the wider sustainable science community to ensure the contents continue to drive improvements.

Sustainable initiatives in action

The Raff lab at the Sir William Dunn School of Pathology, University of Oxford, has been tackling the issue of laboratory plastic consumption and waste for the past two and a half years. We have done this by implementing a range of sustainable processes (Figure 3). These include decontaminating, washing and reusing plastic consumables such as *Drosophila* embryo collection plates and 15/50 ml tubes; reusing plastic packaging and DNA extraction columns; exploring plastic alternatives such as glass beads or glass spreaders for use with agar plates; and using wooden toothpicks to pick bacterial colonies. Science has grown largely reliant on single-use items, and mitigating this consumption is key to reducing overall emissions. This has been evidenced by early research efforts, such as a study from Martin Farley and Benoit Nicolet in Biorxiv, examining reusable consumables compared to single use. Such work showed that reuse

not only reduced carbon emissions significantly, but also saved on the overall costs, and of course consumable prices are always rising.

Alternatives such as glass or wood can be reused multiple times after decontamination and washing, greatly reducing the plastic waste produced and, as shown in the study mentioned earlier, reducing overall energy and water use too. Currently, our lab is also piloting the washing and reuse of plastic fly food vials, bottles and cotton plugs. In the near future, we will start decontaminating and reusing microcentrifuge tubes and pipette tips too and our lab will no longer generate significant amounts of plastic waste.

This has taken time to implement, with these lab green initiatives being absorbed into the lab one at a time without pressuring lab members and allowing them to step back if needed. Washing and regenerating plastic and glassware for reuse in the laboratory are very time consuming as well.

However, pandemic-related restrictions have enabled lab members to (a) gather information (at virtual seminars, meetings and workshops); (b) reduce all kinds of waste; (c) optimize protocols for washing and reusing different consumables; and (d) organize fridges, freezers, desk and bench spaces to clear



Figure 2. 'Switch-off' stickers available to groups in the University of Oxford



Figure 3. Process of washing, reusing and recycling laboratory consumables

unwanted samples to make space for new samples, rather than buying new fridges and freezers that would require more energy and would contribute to increased carbon emissions. The Raff lab Silver LEAF accreditation in September 2020 and subsequent Gold LEAF award in October 2021 are a testament to the work carried out to embed sustainability in the day-to-day running of the lab.

With the creation of the Dunn green group in January 2020 and the assistance of the University of Oxford sustainability team, there was momentum to increase the sustainability of research-related work in the department. The Dunn School green group comprises like-minded people from different areas including principal investigators (PIs), admin and support staff, students, post-docs, facility staff and lab managers. We meet frequently to discuss and voluntarily implement environmental sustainability initiatives within the department. In addition, this group advises departmental committees and the head of the department on how to make departmental operation more sustainable.

Indeed, setting up environmentally friendly initiatives requires support and encouragement from the very top. When PIs and heads of departments give the support to conduct science in an environmentally sustainable way and to investigate climate-friendly initiatives in the lab, this filters down to the rest of the department. Green group initiatives introduced

include regular bike doctor sessions, creating recycling posters, sticking on/off stickers around the Dunn School, 100% recycled printer paper, food/compost bins, glove and masks recycling box, 15/50 ml tube washing and reusing, and commonly used buffer to be made by washing up facility. In addition, the green group continuously improves the information that people in the department receive on how to dispose or recycle different laboratory materials or waste by email, Green group notice board, social media, climate awareness weeks and in-person conversation with people. In October 2021, 13 labs at the Dunn School obtained LEAF accreditation out of a total of 23 labs within the Oxford University that were recognized. In February 2022, the Dunn School green group was presented with Oxfordshire High Sheriff Climate Action Heroes award. The award recognizes efforts to embed sustainable environmental practices across the Dunn School.

Doing science is usually easier and more fun than washing lab consumables, and it can sometimes be less time consuming too. But with the right support from departments, universities and suppliers, sustainable science is now a real goal that can be reached using the objectives set out in sustainable lab programmes, such as LEAF. Encouraging lab leadership and teamwork in sustainable practices in this rewarding manner is already having a positive impact, both on the environment and on the people doing the work. ■

Further Reading and Viewing

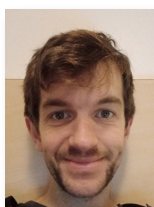
- We need to talk about sustainability. Marta Rodriguez-Martinez, (2022) *The Biologist*.
- Re-use of labware reduces CO₂ equivalent footprint and running costs in laboratories. Farley M. & Nicolet B. P., (2022) *Biorxiv*.
- Environmental Sustainability in Biomedical Laboratories, Biochemical Society Webinar November 2021 (<https://www.biochemistry.org/past-webinars/>).
- What is LEAF? (<https://www.ucl.ac.uk/sustainable/staff/leaf>).
- University of Oxford Environmental Sustainability Strategy (<https://sustainability.admin.ox.ac.uk/environmental-sustainability-strategy>).
- A case report: insights into reducing plastic waste in a microbiology laboratory. Joana Alves et al., (2020) *Access Microbiology*.
- Regeneration of commercial nucleic acid extraction columns without risk of carryover contamination. Siddappa NB et al., (2018) *Biotechniques*.
- Under the white coat is a green heart (<https://www.path.ox.ac.uk/news/under-white-coat-green-heart>).
- LEAF uptake at the University of Oxford (<https://sustainability.admin.ox.ac.uk/leaf>).



Charlotte Houghton is the Sustainability Project Manager for Laboratory Optimisation at Oxford University. As well as overseeing and managing the LEAF award process, she manages laboratory equipment upgrade projects and works on any new laboratory builds and retrofits to ensure the labs are built with sustainability in mind. Email: charlotte.houghton@admin.ox.ac.uk



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