

UCC GREEN LABS GUIDE



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WELCOME TO THE GREEN LABS COMMUNITY!

UCC Green Labs is a new bottom-up approach to sustainability in UCC. Run for and by the lab community it serves. The aim of this guide is to provide you with a step-by-step blueprint to show you how to make your lab more sustainable.

As the first university in the world to receive the Green Flag from the Foundation for Environmental Education, UCC is committed to reducing its impact on the environment. The laboratories play an important role in the university, but are significantly more resource intensive than other areas, as a result it is important to focus on specific ways to reduce their impact.

Contact the Green Lab Community at greencampus@ucc.ie to get your lab signed up and involved. Small changes can make a big difference when we all work together!



WHY ARE WE IMPLEMENTING A GREEN LABS PROGRAMME?

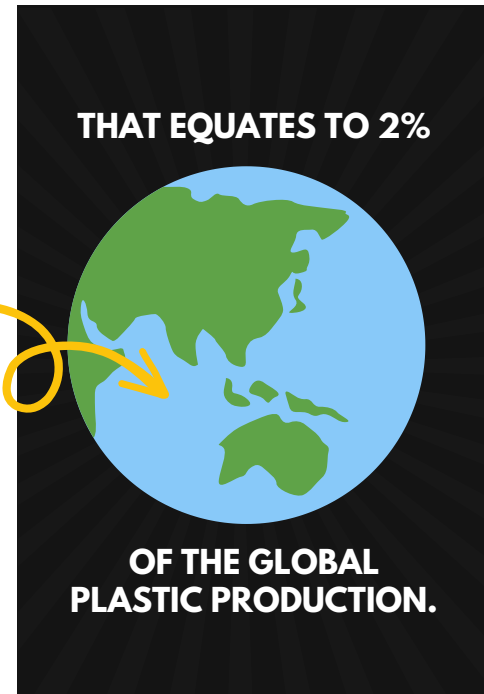
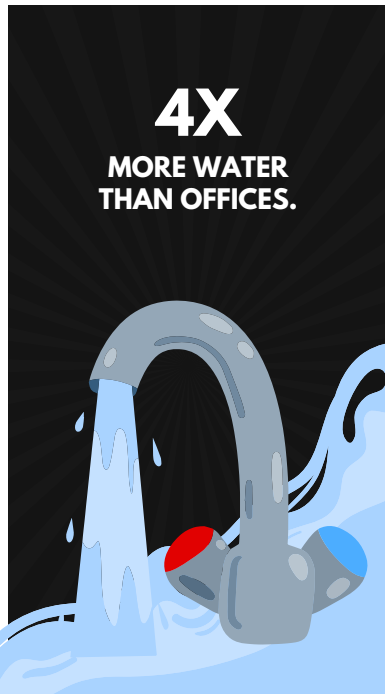
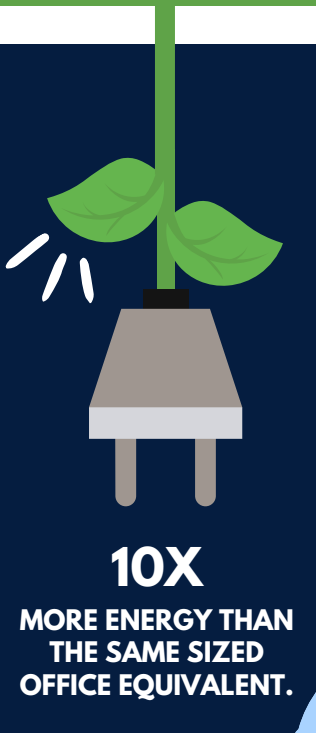
We are all aware of the impending challenge of the climate crisis that is facing our world currently. The clock is ticking, and we now more than ever need to make substantial changes if we are going to attempt to keep global heating to within 1.5 degrees agreed by the Paris Climate Agreement.

In order to achieve this, **we will have to evaluate all aspects of our lives and get people from all industries involved**, including scientific research. Laboratories are some of the most resource-intensive spaces of any industry and they create a lot of waste. But this doesn't have to be the case. By introducing new ideas and following already existing guidelines there are ways to reduce the impact of research on the environment.

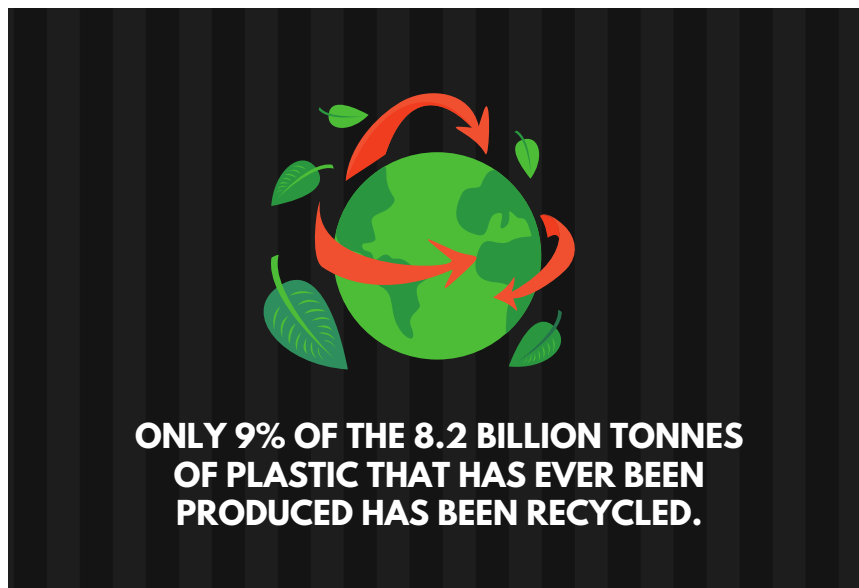
Even small changes can make a big impact in spaces where sustainability hasn't been the priority.



GLOBALLY, LABS CONSUME:



AVERAGE
PERSON IN
IRELAND
PRODUCES: **61 KG**
OF PLASTIC ANNUALLY



DIVERTING JUST 2% OF TOTAL LAB PLASTIC
FROM LANDFILL COULD SAVE 100 MILLION
TONNES OF CO₂ FROM BEING RELEASED
INTO THE ATMOSPHERE ANNUALLY.

WHAT IS LEAF?



LEAF (LABORATORY EFFICIENCY ASSESSMENT FRAMEWORK)

was developed as a green lab standard to improve the sustainability and efficiency of laboratories. It is a self-assessment tool targeted for use at research, teaching, and medical labs. It was developed in University College London and is currently operational in 70 institutions across 12 countries. Aiming to help reduce the impact of science on the climate and ecological emergency currently taking place on our planet.

Laboratory based research is essential for the advancement of our society.

However, it is extremely energy and resource intensive

Therefore, it is necessary that scientists play their part and try to change practices, however big or small, to reduce the impact of their research on the environment. LEAF is a tool designed to help labs achieve this reduction.

LEAF contains a variety of actions which enables lab users to reduce plastic, water, energy, and other resource usage. This in turn will help reduce the overall carbon emissions created by the lab in question and help to support an environment that champions quality research.

There are 3 different levels of interventions labs can introduce to reduce their impact: Bronze, Silver, and Gold. Each step is increasingly more 'sustainable'.

WHAT DOES LEAF INVOLVED?

1

The Framework: This is an online tool that guides users through the sustainability actions. Although, in UCC we are currently providing this information in an excel spreadsheet, and then this is uploaded to the online server by the Green Labs team.

2

The online calculator: This is a tool that helps you to estimate how sustainable your lab is right now, and to measure or quantify the improvements you have made. Scientists love to see actual results!

3

The toolkit and resources: This contains everything you need to know to implement the suggested changes to your lab. Including LEAF guides on everything from sustainable lab equipment and consumables to an induction and exit process for lab users. This contains a wealth of information, and it is highly recommended if you would like any additional information.

4

User engagement and training: This helps when you to get started. The LEAF programme offers each new institution a tailored training workshop to engage the lab staff and potential students on sustainable science and introduces LEAF.

HOW LEAF WORKS:

Labs and lab users will be provided with the bronze self-assessment framework from the Green Labs team. This is an excel sheet containing the sustainable activities as well as additional information on how to complete these actions, needed to achieve a each rating. Each lab will then self-assess their progress. Once they feel they have completed everything necessary and applicable, the Green Labs Community will complete an audit of the lab and award it Bronze, Silver or Gold depending on the actions that have been undertaken.

One benefit of the LEAF programme is it is multifaceted and covers not only direct environmental aspects (e.g. waste management, equipment efficiency, chemical management etc.) but also targets areas such as business travel, research quality and procurement.

The final step involves the LEAF calculators. These allow LEAF users to quantify the 'actual' environmental and financial savings achieved through the actions implemented. This allows people to contextualise often abstract 'green' savings. This is especially helpful when considering the Save and Keep scheme see more [here](#).

Some of the benefits of LEAF include:



**REDUCED
COSTS**



**REDUCED
ENVIRONMENTAL FOOTPRINT**



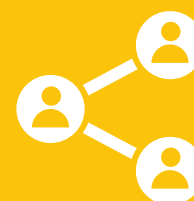
**INCREASED
EFFICIENCY**



**REDUCED
WASTE**



**GROUND-UP
SUSTAINABILITY MOVEMENT**



**ENABLES SHARING
OF IDEAS**

1. ENERGY USE



SWITCH IT OFF!

Labs are energy intensive places, any work towards reducing this will have a positive overall impact on reducing a lab's environmental footprint. *See section on Freezers and Fume Hoods specifically, as they are the most energy intensive items in the lab.* Shutting the sash and raising the temperature of storage are the most effective way to make real energy and cost savings.

The most basic step a lab user can take to reduce energy use in labs is to switch off equipment such as computers, incubators and weighing scales, when they are not use. Almost 40% of UCC's energy is consumed at night-time, when people are not in the building so this is an often overlooked step.

EQUIPMENT

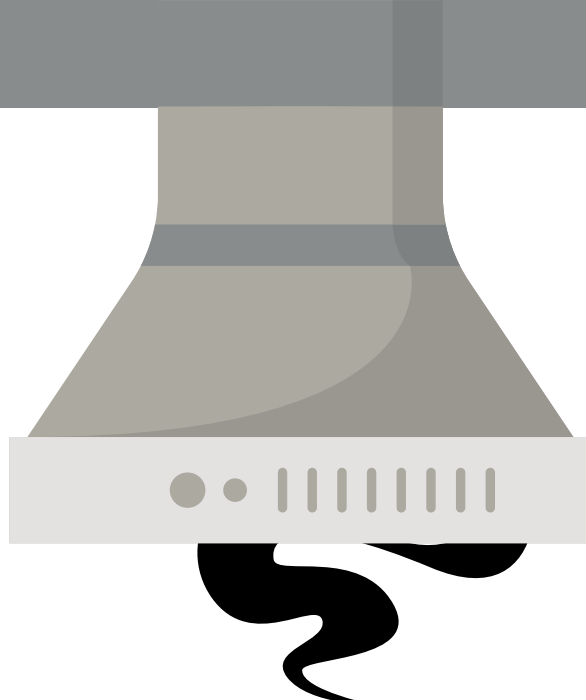
As much of 50% of a lab's energy use is in 'plug-in' equipment. Using colour coded stickers to inform all lab users of what items can be switched off directly after use, at the end of the day or should not be switched off at all. Compiling a check list for equipment that should be switched off at the end of the day in all labs can help to remind users and place energy savings at the forefront of lab activities. Alternatively using outlet timers can switch equipment off automatically.

Sharing equipment with other labs is another way to make a large impact on your energy bills. This can also help to reduce waste, as often a lab already has a piece of equipment you might need for an experiment, sharing this can help to save money and resources. It also then encourages lab users from different areas to work together and share knowledge as well. This can result in other interesting discoveries and should not be discounted.

LIGHTING

Switching from florescent light bulbs to LED bulbs can also reduce your energy use. LED lights have a longer lifespan and do not consume as much energy. This can be especially effective in operational growth cabinets for biological experiments. Putting lights on sensors (either time or motion) can also help impact a lab's overall energy bill as people can often forget to turn them off when leaving a room unoccupied. Contact building and estates if you want a detailed run down of your lab's energy use.





2. FUMEHOODS

Fume hoods are the most expensive and energy intensive pieces of machinery to run in a lab. They can consume twice as much energy as a -80 freezer and as much energy as up to 3 households in a single year. Therefore, managing your fume hoods in a more sustainable way can save operating expensive and reduce the carbon emissions of your lab.



The “*Shut the Sash*” programme began in Harvard University as a means of reducing energy consumption and promoting sustainability. It encourages lab users to keep the sash closed when the hood is in operation but not being used and according to a study conducted by the Harvard university it saves an average of \$20,000 per year of energy savings, while studies in Ireland suggest this action can result in energy savings of 75%. This is a huge saving financially but also has a large impact on the environment. It is a crucial step in making your lab more sustainable.

BEST PRACTICES FOR YOUR LAB:

- When working in your fume hood, **lowering the sash** allows for the hood to operate more efficiently. When working with chemicals in the hood, set the sash at the proper opening and do not open it further than is recommended. If you need to step away for a while, be sure to lower it until you hear the 'click' and this will reduce the speed at which air is running through the hood.
- **Ensure nothing is stored in hoods that should not be there.** Chemicals and equipment should never be stored in fume hoods as this can block the ventilation and cause the hood to use more energy than is necessary. Instead, chemicals and equipment should be stored in ventilated chemical cabinets. This will keep the hoods clear, unblocked and working as efficiently as is possible.
- **Switch off at night-time or when not in use.** Shut your sash before the last person leaves the lab in the evening and ensure lights and blowers are also turned off.
- **Monitor and keep track of your inflow and report any changes.** If you notice your inflow is suddenly much higher or lower than normal, be sure to report these changes to the facility manager. This is as much a safety hazard as it is a sustainability measure. If your fume hood has $>150\text{ft}/\text{min}$ inflow, turbulence and decreased containment can occur.
- **Work together with your facility and lab manager to improve the overall management of fume hoods in your lab.** Explore the possibility of installing occupancy sensor to automatically turn hoods off at night, even decommissioning hoods that are old and outdated and replacing them with more efficient variable air volume fume hoods.

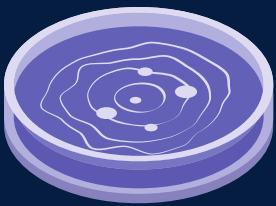


Any and all efforts to reduce the energy impact of fume hoods can make a big difference in universities such as UCC. UC Berkeley has designed a tool to help calculate how much can be saved by shutting your sash [here](#).

3. FREEZERS

One of the biggest users of energy in any lab is the cold storage equipment. This is especially true for the ultra-low temperature freezers (-80 freezers). One ultra-low temperature freezer can consume as much energy as a family home every year so anything that can be done in this area will significantly reduce energy consumption. In order to reduce their energy usage, storage should be optimised, old samples regularly cleared out and freezers defrosted regularly. Here is some guidance for sustainable freezer maintenance:

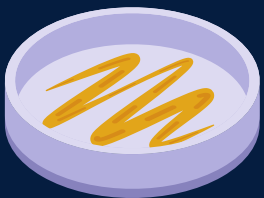
STORAGE OF SAMPLES



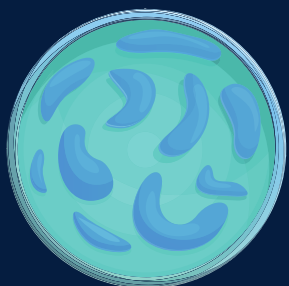
Look into storing samples at -70 instead of -80, this can result in 30% less energy required to run your freezer. There is anecdotal evidence to suggest there is little difference to the sample when storing at a 10 degree difference. *Note: if samples are required to be stored at -80 in the study protocol this might be more difficult to work around. However, we encourage lab users to question why this protocol exists. Just because something has always been done this way, does not mean it is the optimal way to do something.*



Storing samples at more appropriate temperatures. Not all samples and reagents need to be stored at -80, for example some DNA samples can be stored in the standard -20 freezers. These freezers consume up to 80% less energy than ULT freezers.



Samples should also be collected and stored with the smallest quantities possible for your study. Try to maximise the storage within freezers by using racks that fill the whole space, and containers that are organised most efficiently for your samples.



INVENTORY SYSTEM FOR SAMPLE MANAGEMENT

Following from this, samples should be correctly and clearly labelled and catalogued in an inventory system (*for example this can be a specific software such as Ziath Samples inventory software or just an excel sheet*). This way it is easy to locate samples. It will save time searching for samples by knowing exactly where all samples are, thereby increasing workflow efficiency.



CLEANING MAINTENANCE OF FREEZERS

- Freezers should be fully defrosted at least once a year and kept ice free in between defrosts. After a defrost, freezers can run approximately 10% more efficiently than before. It is important to ensure the freezer remains ice free, especially around the seal, as ice can prevent the door from closing correctly causing the freezer to use more energy to stay at a constant temperature.
- Regularly cleaning of the fans and coils should be part of regular freezer maintenance. Dust removal from the filter and coils can be done with a Hoover, enabling the freezer to run more efficiently. Freezer fans and coils should also not be blocked by boxes/other equipment stored on top of, next to, or leaning against the freezers. When these areas are blocked it causes the freezer to have to work harder, using more energy.
- Routinely clearing away samples that are no longer useful. This is one of the most important steps of sustainable freezer management. Not only does this clear space for new samples, preventing the need for potential additional freezers, it also helps lab users prioritise samples that will actually be used.
- Unlabelled samples or unclearly labelled samples should also be disposed of. If you cannot identify them, you cannot use them.

ADVANCED FREEZER MAINTENANCE GUIDE

- Sharing your cold storage space with other labs/lab users. This is often overlooked but an incredibly effective way of reducing the operational costs of your lab and saving energy. This should be considered for back-up/spare freezers i.e. 2 labs having one back up freezer between them. Sharing this between more than one lab can reduce the number of overall freezers needed. This encourages co-operation between different lab users and potentially help share other sustainable lab ideas.
- Another option is to avoid freezers altogether and try Room Temperature Sample Storage (RTSS). Using extremophile biology, organisms are able to protect their DNA, RNA, proteins, membranes, and cellular systems for long-term survival in a dried state or anhydrobiosis (life without water) and later revive by simple rehydration. The technology works by forming a thermo-stable barrier during the drying process to protect samples from degradation during storage at room temperature. This is becoming more popular for DNA, RNA and plasmid samples, especially when shipping is required (thus eliminating the need for dry ice), or for collections in the field. This method can be used for reagents and diagnostic kits as well.

Correct freezer management and maintenance is one of the most important aspects of sustainable lab management. See the International Freezer Challenge and think about signing up for your lab [Resources - International Laboratory Freezer Challenge](#).

4. WASTE

In Ireland the average person consumes approximately 59kgs of plastic per year, while the average bench scientist consumes approximately 1,000kg. Since the COVID pandemic single-use plastics have become even more common in labs, however one of the most impactful things your lab can do to reduce its environmental footprint is to reduce your reliance on single-use plastic and correctly segregate dispose of all your waste. The most important thing to remember when recycling correctly is for all plastics to be CLEAN, DRY and LOOSE. It's important to separate all plastic items i.e., remove soft plastic coverings from hard plastic containers etc.

REDUCE

Reducing your purchases is the most effective way to eliminate waste from your lab. Ask before purchasing, is it really needed? Do other labs have an excess of this that I could use instead? This can be discovered if both labs are using the same inventory management tool. Reducing your purchases can also be done by swapping out purchases for example holding on to your pipette tip boxes and only purchasing refill pipette tips.

REUSE

Reusing materials you already have is the next best thing to reducing your purchases. Opting for glassware instead of plastic is one way to do this, see below for further explanation. Reusing an item multiple times an hour/day/week before discarding or cleaning an item to reuse it.



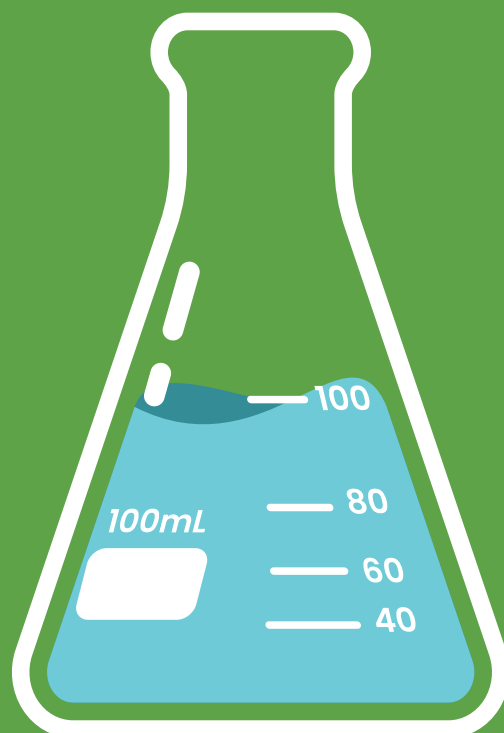


SWAP OUT PLASTICS

Switch out single-use plastics in your lab for **glass alternatives**. Historically glassware was always used in scientific research and plastic items are a relatively new phenomenon. Not all experiments can have glass substituted for plastic given the fear of contamination or carryover of residues. However, it would be advised to test this first, before assuming as many experiments could be made more sustainable by this simple switch. See here for demonstration of how carryover does not have an impact on the results of testing for shellfish toxins: [Reducing environmental impacts of marine biotoxin monitoring: A laboratory report | PLOS Sustainability and Transformation.](#)

Another benefit of using glass instead of single use plastics, is that it can be cheaper as you do not have to constantly repurchase items. It can also help to save time, as lengthy shipping times are an increasingly prevalent issue.

Instead of using plastic or cardboard containers for sample storage, try using compostable alternatives. These are often cheaper and more sustainable, as the likelihood of reusing plastic sample storage containers is small due to potential contamination and cardboard boxes cannot always be recycled if previously frozen. Compostable options work well and have been found to be cheaper in the past.





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BE SELECTIVE WITH YOUR PURCHASING

Buying from companies who offer a “take back programme” is a great way to manage your waste. Ireland is a relatively small market compared to UK or US, so this is not always an option.

We encourage lab users to make this request to your suppliers, in the hope of influencing them to start offering a ‘take back’ programme.

We have power in numbers so encourage all other lab users that you know to do the same thing with suppliers. If every lab in UCC requested this from suppliers, they would be encouraged to make this change and begin to offer a service such as take backs/buy backs. Reaching out to suppliers to request return of polystyrene boxes or ice packs is another thing to reduce the amount of waste in your lab.





Increasing the amount of plastic that can be recycled should be seen as one of the last options to reduce waste in labs. Although recycling is better than plastic going to landfill it is not always the silver bullet option it is sold as. All hard plastics in the lab can be recycled if they have been cleaned thoroughly, separated and dry. For chemical plastic containers these should be rinsed and have all hazard stickers removed or crossed out (labs could also print out “thoroughly rinsed stickers” to place over the labels). All plastic that is going to be recycled from labs should be rinsed well (to be sure they are uncontaminated) and dried before being placed in the bin. Some plastic containers could be reused for waste i.e. silica tubs could be refilled with silica waste and then taken for disposal.

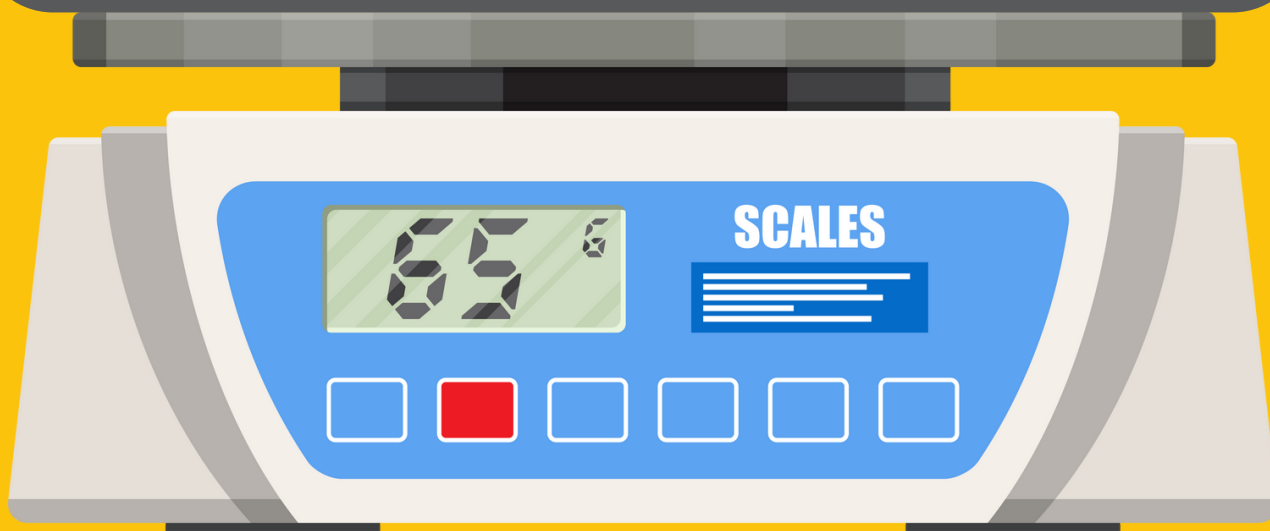
Large plastic items are more likely to be recycled. To enhance the chances of smaller plastics being recycled (it has been suggested by our waste company), to keep these items together and separate from general recycling waste. For example, if your lab goes through a large amount of needle caps, syringe plungers or falcon tube lids, collect these items together in a separate bin and then send them for recycling, as a whole.

Electronic waste (for example old computers, wires/cables and broken equipment) should be kept separated and recycled at e-waste recycling points. To minimise hazardous and chemical waste, the concept of Green Chemistry should be applied to all research in labs. See [here](#) for link to Green Chemistry. PowerPoint Presentation.

5. CHEMICAL & INVENTORY MANAGEMENT

Labs often have a large amount of chemicals, reagents and other inventory needed for various experiments. Due to the large volume of these present in labs, it can be very difficult to keep track of what is already in the lab, how much of it and when these need to be disposed of in a safe manor. This can result in lab users buying and throwing away the same chemical at the same time in a lab, and across labs in different departments. There is also a safety risk associated with not knowing exactly what chemicals are present in each lab. To combat these issues a chemical and inventory management software can be implemented.

Keeping track of chemical and inventory in labs can be difficult without the correct systems in place. This can come in the form of an excel sheet or shared document or a management software tool. Implementing these systems can help labs to prevent duplicate purchases, save money and reduce waste.





BENEFITS OF SUSTAINABLE CHEMICAL & INVENTORY MANAGEMENT:

FINANCIAL

Implementing a management tool can have numerous financial and safety benefits as well as being more sustainable. Labs often have to pay for the chemical/inventory when it is purchased and then pay again to get rid of it when it's no longer needed, or if it expires and cannot be used anymore. Both costs can be eliminated through the sharing of chemicals/inventory. This can only happen if lab users know exactly what is already present in their own lab, but also labs within their departments. This can also save time as lab users are not waiting for chemicals/inventory to be delivered. The Cavanagh Building has saved...



HEALTH & SAFETY

Having a chemical and inventory management tool can also improve the health and safety within labs. Many of the tools available such as LabCup, which is already used by multiple departments across UCC, allow users to save the SDS information within the tool and track when an item must be thrown away. This enables users to know exactly when and how chemicals/inventory must be disposed of.

The tools can also help making disposal more efficient as you can save all the chemicals/inventory that have to be disposed of in a certain way, until there is enough of them. This will reduce costs and is more sustainable.

SUSTAINABILITY

The final benefit of the management tools is they aid a lab in becoming more sustainable. By reducing the amount of duplicate purchasing across departments, the carbon emissions associated with deliveries are reduced, there is less packaging wasted and less of the chemical itself. Using up all of the chemicals/inventory before buying another one, also helps to prevent waste and is therefore more sustainable than the alternative.

Simple considerations such as this can make a big difference when used across multiple labs. Working together with other scientists in your own department, or across multiple different schools will inspire others in other labs to also become more sustainable. This saves money and time as well.

6. PURCHASING

One of the most important aspects of having a sustainable lab is ensuring the equipment and all other item purchased for the lab are as efficient as possible and therefore as sustainable as it can be.

ORDERS

Consolidating orders or purchasing in bulk is one of the ways purchasing can be made more sustainable. Usually each order is sent individually, which not only has extra financial costs, usually having to pay for delivery for example, but also additional environmental costs, as each order is shipped, transported and delivered individually. Consolidating orders reduces the environmental costs and purchasing in bulk can also minimise some of the financial costs and remove the additional delivery fees.

EQUIPMENT

When purchasing new equipment, it is important to assess the size of the piece versus what it is actually needed for. Although larger units are typically more efficient in terms of energy and space, this should be balanced with the actual need. A larger unit should not be purchased just for the gains in efficiency if the space is not going to be utilised to the full extent. However, it is also important to consider the potential future uses, for example is the lab going to expand, will you need more space in the future etc.

Another consideration when purchasing equipment is the durability of a piece versus the initial cost. The initial purchase cost should be weighed against the operational and maintenance costs (life cycle costs), as part of the procurement decision making process. If the initial cost of a piece of equipment is more expensive, it may have a lower carbon cost, and lower cost impacts throughout its lifetime including reduced day to day energy costs.

When purchasing new cold storage options, consider long-term storage requirements and a balance with environmental considerations before making any new equipment purchases. Individual manufactures data often varies in their collection methods, so it is important to request environmental testing conditions from when evaluation energy performance. Manufactures will usually provide this data in kWh/day figure, but to make a like for like comparison this must be converted to a kWh/litre figure.



GREEN LAB CHECKLIST

AREA

BRONZE

SILVER

GOLD

WASTE

Multiple waste bins for different types of waste.

Labelled clearly & appropriately.

Minimum contamination of waste (*no more than 10%*), lab members are aware of best practices & commonly thrown away items. Realistic plan to reduce use.

There has been a recorded reduction in total waste produced.

Increased rates of recycling.

PEOPLE

Procedure for new arrivals to show them the sustainable procedures, a producer for leavers to remove/track materials left behind. The lab has nominated a person or group to lead sustainability (*can be the person responsible for LEAF*).

Encourage other lab users/labs/groups to engage with the Green Labs Community.

Lights have been changed out for LEDs & the lab has implemented at least 1 action to reduce the overall impact.

Sustainability has been added to agenda at regular meetings.

PURCHASING

'Sustainability' of materials used & energy consumption is a consideration for new equipment and materials.

Aware of suppliers offering 'more sustainable' practices (*such as pipette tip box recycling*). Lab has requested suppliers consider offering more/any of these options.

Realistic effort is made to support suppliers who are engaging with sustainability.

EQUIPMENT

Fans on cold storage items are not blocked, filters cleaned regularly.

Autoclaves or ovens *etc.*, should only be used when full. Everything switched off when not in use.

Defrosting of & removal of old samples from freezers regularly. Correct sample management system in place. Sharing of large equipment is encouraged. Freezer temperatures have been queried & investigated.

Plan for excess equipment & materials to be shared, repaired, donated or sold.

Plan for recycling/disposal of old equipment.

GREEN LAB CHECKLIST

AREA

BRONZE

SILVER

GOLD

SAMPLE & CHEMICAL MANAGEMENT

All samples & chemicals are correctly & clearly labelled.

There is a system in place to share chemicals between and within labs/groups.

The 12 Principles of Green Chemistry have been communicated & understood by lab users.

Back-up space for samples is shared among lab users/labs/groups.

Excess samples, materials & chemicals are made available to other departments. Most (80%) samples & chemicals stored are actively used, stored correctly & identified easily.

Solvent & chemical selection has been considered for 'greenness'.

RESEARCH QUALITY

SOPs & common protocols are centrally shared & available to all lab members.

Any equipment that needs to be calibrated is done every 12 months.

Groups have a forum for sharing & discussing negative results.

Sterilisation & cleanliness methods have been reviewed for efficiencies & effectiveness e.g. *autoclave methods, UV sterilisation and cleaning rotas.*

VENTILATION

Any issues have been reported/users know how to report issues.

Fumehoods & safety cabinets have clear signage encouraging good practice - "*Shut the Sash*" posters are available.

Fume hoods are not used for long term storage of items, nothing impedes internal airflow.

Users are aware of best practices & switch everything off when not needed.

Fume hoods have been swapped to variable flow.

TEACHING

Sustainability is highlighted as a key consideration in the lab.

An awareness of resource use & the environmental impacts are incorporated into practical lab teaching & learning.

Environmental impacts have been reduced through improved experiment design for practical lab demonstrations.

UCC GREEN LABS GUIDE

