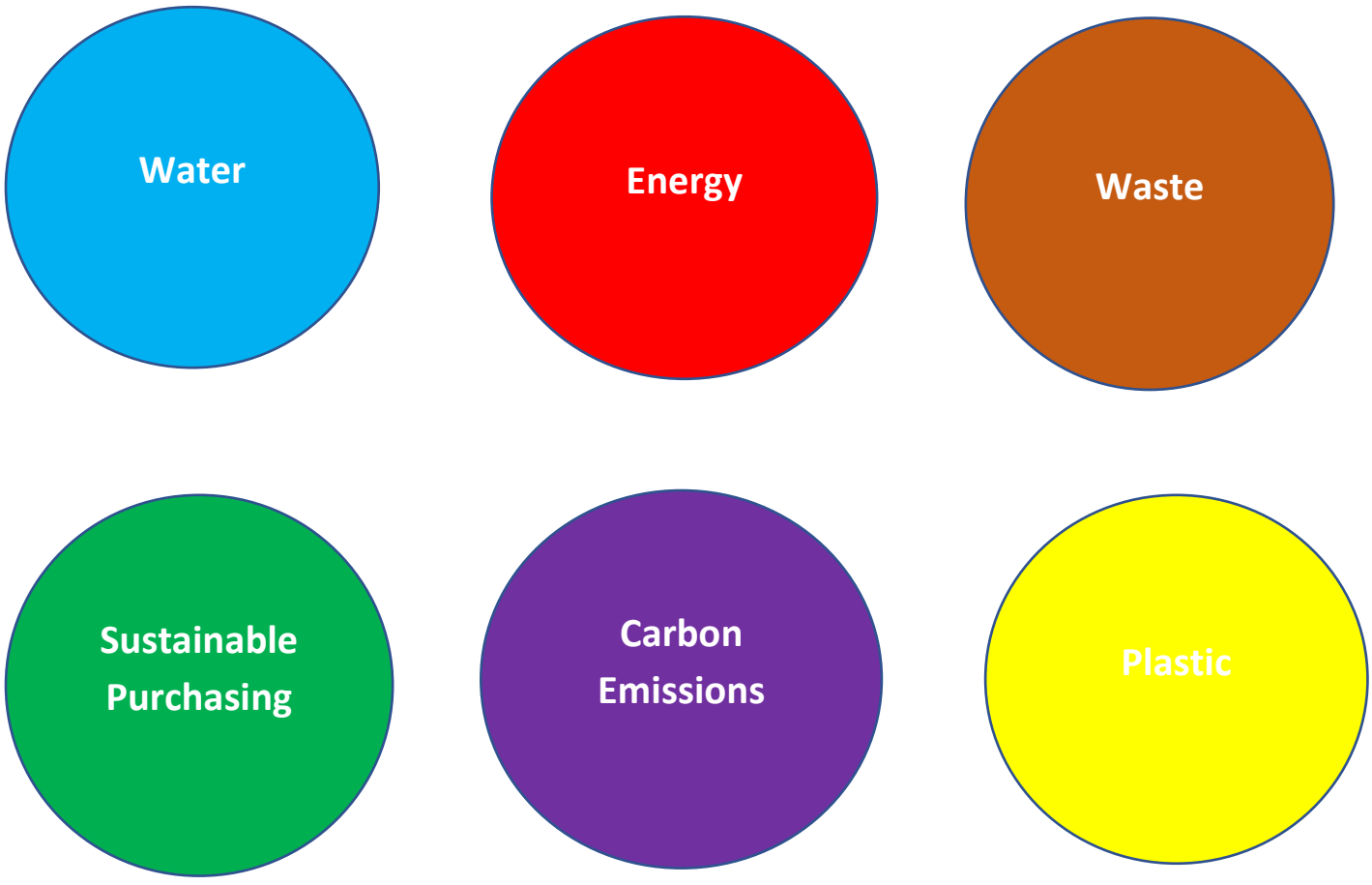
DCU Green Labs Guide



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Introduction:

Climate change has been recognized as a major threat in the scientific community for decades now, but we are fast approaching a tipping point. If humanity continues down its current path, we will do irreversible damage to the environment we live in and radically change it for the worse. There have been many attempts to change the practices which contribute to this threat on a global scale, most recently through the Paris agreement of 2015. Attempts must also be made, however, to change our practices on a smaller and more focused scale. Laboratories are often very wasteful and inefficient places. They use a lot of energy running low temperature freezers, fume hoods, autoclaves, and experiments. They use harmful chemicals like mercury, consume a lot of single-use plastics and can waste a lot of water.

It was found that the DCU biotechnology labs go through 1.5 tonnes of plastic every year. For context, A car would have to drive from the top of Norway across Europe and Africa to reach Johannesburg, South Africa, to emit the same amount of CO2e. That is to say nothing of the ecological and health implications of plastic pollution on this scale. Some of these operations are essential to the accuracy and quality of experiments, so it is important that whatever changes are made do not negatively impact the results of a scientific study but rather improve the running of the lab while keeping its environmental impact in mind.

The changes in this document range from small to large, from technological fixes to changes of behavior and practices. We will not dictate how best to best implement these changes, as that will undoubtedly vary from lab to lab and person to person. Some of these changes require labs to work together, so it will be important to establish a unified and overarching response to the challenges we face together.

The authors of this guide also advise each school to prepare a lecture to be delivered at the start of each semester for all lab users, espousing the need for (and benefits of) these changes and supporting people in their efforts to change the way they conduct research in the lab.

These changes are meant to help the world around us. Many of our most vital ecosystems are on a precipice, and we need to help pull them back for the future of humanity and non-human animals alike. Some of these changes are small and others are large, but they are all worthwhile. Everyone in the Western world has contributed to the environmental devastation our planet is currently facing, and it is in everyone’s interest that we mitigate those impacts as quickly and radically as possible.

Water

While our planet's surface area is more than 70% water, less than 1% of that is freshwater.

- **Install Aerators on Taps:** Aerators are inexpensive devices that screw onto the end of taps and add air to the water to reduce water wastage.
- **Replace Old Machines with More Sustainable Models:** Equipment which requires water for its operation should be replaced with more sustainable models where possible. For example, water vacuum aspirators can be replaced with membrane/oil-free/diaphragm pumps.
- **Turn Off Taps When Not in Use**: This is a no-brainer, but it is still important to mention. There are few better ways to waste water than to flush it straight down the drain!
- **Use Low-Grade Water Where Possible:** Deionized water needs to be processed using high pressure and filters, so it requires more energy. Domestic hot water costs five times more than cold water.
- **Only Run When Full:** Machines like autoclaves and dishwashers should only be run when at full capacity to minimize water and energy wastage.
- **Report leaks ASAP**: Leaks can cause a lot of water loss. dripping taps can waste 600 gallons a year! The sooner a leaky tap is reported, the sooner it can be fixed. That means less water going down the drain.
- **Establish Efficient Lab Procedures:** Collect water purification cartridges for recycling through takeback program (If applicable). Use waterless baths like Armor bead baths. These are metallic beads which can be heated and cooled, then reused.
- **Measure Before You Pour:** Use graduated cylinders to measure out the exact amount of water needed to dilute chemicals.
- **Install Miser Valves:** Miser valves are devices which can cut down on 70% of water waste. Installing these devices only takes about 5 minutes so it is definitely worth the effort!
- **Use Water Timers:** Water timers can be installed to minimize water usage by measuring the volume of water in containers and limiting it to a pre-set quantity.
- **Install a Recirculating Water System:** Closed loop systems are much more efficient when it comes to water usage. That is because you don't have to keep topping up the water periodically. No lab equipment should be connected to the mains water supply, as this can cause wastage

Energy

Energy production has contributed around 72% of all greenhouse gas emissions to date

- **Send less emails:** Each email emits 4g of CO_2 and emails with attachments can emit up to 50g! Better building management such as proper insulation, energy efficient windows, motion sensing lights and dimming switches on lights. Using only the necessary ventilation and maximum only in emergencies.
- **Shut Fume Hood Sash:** Leaving a fume hood open can use the same amount of energy as 3.5 homes! The reason fume hoods are so energy intensive is that health and safety requirements mean all the air must be pumped in from outdoors. That air also must be heated or cooled for the lab user's comfort. Make sure that the fume hood sash is only ever open when the fume hood is in use.
- **Monitor Energy Usage:** This should be done to see where energy is being wasted, lost or at least where it could be conserved. Unplug infrequently used devices as devices draw power even when turned off.
- **Share freezers with other labs and keep them full:** It is better to have one full freezer then to have two half-empty ones. Running half as many freezers uses half the electricity and emits half the carbon!
- **Only Run Autoclaves When Full:**

Just like with the freezers, it is important to make sure you only run the autoclave when you have enough to fill it. A smaller load means you will be running it more frequently.

- **Reduce Freezer Temperature:** In modern labs, many samples are kept at -80°C. However, many samples do just fine at higher temperatures! The Universities of Boulder and California have developed a database of common biological samples which can be stored at -70°C. Increasing the temperature by just 10°C can reduce energy usage by about 30%!
- **Only Use Lights When Needed:** Make the most of the natural lighting during the day. Not only does this save energy, but natural light is also better for our health! Make sure to turn off all the lights before you leave the lab. If you are having trouble remembering to do this, you can install timers to make the lights turn off automatically.
- **Repair Broken Equipment**: Rather than replacing broken equipment, efforts should be made to identify and fix the problem, since the manufacture of new equipment can have a large environmental impact.

Waste

Humanity produces approximately 13 tonnes of hazardous waste every second

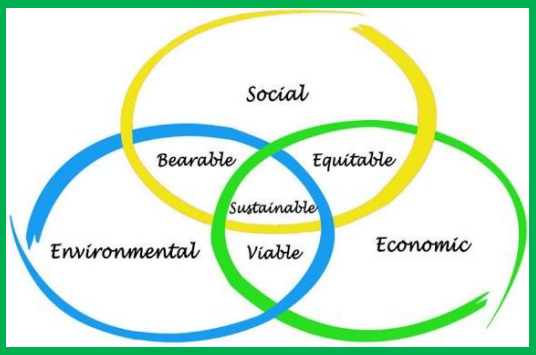
- **Have a Paper Recycling Bin:** Putting a wastepaper basket beside printers and photocopier is a great way to reduce paper waste.
- **Purchase a solvent recycler**: These can recover spent solvent to be used again.
- **Use Chemicals on a First in/First out Basis:** This means that you use the oldest chemicals first to reduce or eliminate chemical waste.
- **Reduce the Scale of Experiments**: If you can reduce the size of experiments, this helps to reduce energy and chemical use.
- **Substitute Hazardous Materials:** Often, it is possible to replace dangerous chemicals with safer alternatives. Here is a guide for how to assess whether a substitute is safer for the environment or for human health.
- **Borrow from Other Labs**: If you need a small amount of something, see if another lab has some lying around rather than buying an unnecessarily from a retailer. This will save on packaging waste and delivery emissions.
- **Unsubscribe From Junk Mailing**: This reduces the level of wastepaper to deal with. You can also introduce desk side recycling. If it is easy people will do it!
- **Buy From the Campus Storerooms**: Avoid purchasing from retailers but if you need to make sure to consolidate orders with others to save on packaging waste and shipping emissions.
- **Know Your Stocks:** Maintain a chemical and equipment inventory across all labs and audit it annually to avoid over-buying.
- **Practice Green Chemistry:** This is the practice of avoiding pollution by either finding new methods of doing experiments or using less hazardous chemicals.
- **Practice Green Printing:** Set double sided printing as the default and reduce margins to get the most out of each page. This will reduce paper and electricity waste at the same time!
- **Do Not Mix Chemical Waste with General Waste:** Not only will this contaminate the general waste, it also creates the risk of hazardous chemicals finding their way into the environment, where they can harm wildlife and enter the drinking supply.
- **Redesign Teaching Experiments:** Try replacing experiments which use heavy metals or other hazardous materials with safer alternatives.

Sustainable Purchasing

To be sustainable, you need to buy sustainably. We vote with our wallets!

- **Buy in Bulk Where Possible:**
  This reduces the number of delivery trips that need to be made which, in turn, reduces the carbon footprint. Be careful, however, not to buy more than you need just to reduce transport emissions!
- **Know Your Vendor:**
  Shop around to see if other lab suppliers place a greater emphasis on sustainability. Do they sell recycled or compostable materials? Do they dedicate space on their website to sustainability concerns?
- **Know Your Product:**
  Purchase paper and plastic that is at least partly made from recycled material. In the case of paper, also look for the Forestry Stewardship Council symbol:

  This means that the wood used to make the paper was sustainably sourced!
- **Use Refillable Consumables:**
  Try buying refills for your pipette tips instead of buying a new box each time. The same goes for tubes! Refilling the racks during a lab meeting means you won't have to waste any time when you should be experimenting. Plus, it gives you something to do with your hands!
- **Talk to Your Vendor:**
  When you are contacting your vendor to purchase equipment or consumables, ask them about the environmental impact of the products. If they can see that their



customers are concerned about things like packaging and renewable energy, they will make more of an effort to address these problems.
- **Use the ACT Label:**
  My Green Labs have developed a label for the environmental impact of lab equipment, consumables, and chemicals. Similar to a nutrition label on food, this can tell you all you need to know about the impact of a product. You can find more information on ACT Labels here.
- **Buy De-icing Kits:**
  These are often overlooked during purchasing but having de-icing kits around the lab will go a long way towards reducing your footprint. Freezers get less and less efficient over time, and de-icing can help you get more bang for your buck when it comes to energy usage.
- **Downsize If you Can:**
  Are you regularly using plates or tubes that only get half-filled? By purchasing the next size down, you reduce plastic waste and create extra space in your freezers! Aside from anything else, it's cheaper!
- **Purchase Green Cleaning Supplies:**
  This means fewer harsh chemicals. It also means that you should purchase, for example, a mop instead of paper towels. The more you can reuse your cleaning equipment, the better the environmental impact over its lifetime

Carbon Emissions

Each of the last four decades has been successively warmer than any decade that preceded it since 1850

- **Know What Matters Most:**
  It is sometimes difficult to know which actions you can take to help in the fight against climate change. Knowing how much carbon different activities emit is a great way of focusing in. Did you know, for example, that taking one single transatlantic flight cancels out the carbon savings from 10 years of recycling?
- **Carbon is Everywhere:**
  It is important to remember that we emit carbon all day every day. Any time you use electricity, buy a product, travel, or even breathe, you are releasing carbon dioxide. No one expects you to stop breathing. It is a matter of working out where the carbon can be avoided and where it is necessary.
- **Systemic Change is Required:**
  Often, too much emphasis is placed on individual actions. Climate change affects every sector of society, so overarching policies and government initiatives are required in order to make the changes we need. There is not much you can do, for example, about the speed at which renewable energy infrastructure is being built.
- **Be Aware of Vampires:**
  Vampire power refers to the electricity which is used by electronics when they are in standby mode. A good indicator of whether something is an energy vampire is whether it has some form of light or display which stays on when not in use. If you do not need a device to be on, it should be switched off at the wall!
- **Know Your Energy Provider:**
  Reducing electricity use is a great way to reduce carbon emissions. However, reducing the proportion of energy you are buying that comes from fossil fuels is also very effective! By switching to a provider with higher levels of renewables, you can increase demand for renewable energy and reduce demand for fossil fuel energy.
- **Know Your Heating:**
  There are plenty of sustainable ways to heat a building, from thermal solar panels to ground source heat pumps. The more renewable option is also often the cheaper option in the long run, and heating is no exception. Talk to your lab techs about switching to a more sustainable heating system.

Plastic

At least 8 million tonnes of plastic waste enter our oceans each year!

- **Triple-rinse and Vent Containers Before Recycling**: Recycling centers cannot accept dirty items and will reject them. What's more, dirty items can contaminate clean ones!
- **Reuse Plastic Gloves Where Possible**:
  They can be removed and worn again once or twice. Try to identify the areas where contamination is not so important, and reuse gloves for those activities.
- **Replace**:
  Replace single use plastics with reusable glassware or other alternatives such as bio-degradable plastics.
- **Know Your Vendor:**
  When you are buying a product, ask if the vendor has their own recycling program. Take advantage of it if they do! Several suppliers will also take the packaging from your orders back from you!
- **Use Glass Where Possible:**
  Glass can be reused over and over again. Eventually, when it is time to get rid of it, glass can be recycled without losing any of its quality. While glass production can be environmentally damaging, this reuse and recycling aspect makes it more sustainable overall.
- **Repurpose:**
  Ask yourself whether any leftover plastic containers could be used for another purpose. For example, you could take home a plastic bottle and use it as a vase for flowers!
- **Separate Packaging:**
  The moment you remove the packaging from your consumables or chemicals, put the packaging straight into the recycling bin. This will prevent the plastic from being contaminated during the experiment.
- **Downsize Your Containers:**
  If you are consistently only filling your test tubes halfway, you should consider purchasing a smaller size. This will reduce the amount of plastic being produced, as well as the amount that ends up in the incinerator or landfill.
- **Use Bioplastics:**
  Bioplastics are any plastics that are either bio-based, compostable or biodegradable. Make sure if you are using a compostable plastic that it goes into the correct waste stream, since many bioplastics will not break down naturally in the environment.