Sustainability is one of the core values of the DREAM3D Lab

At the Dream3D lab we strive to make an impact in the way scientific research is conducted. Life sciences research is responsible for about 2% of the plastic waste worldwide and a fair amount of energy usage as well. This kind of disproportionate effect compared to the share of the population we represent is largely due to common wasteful policies of reliance on single-use materials, poor waste management and inefficient data and sample storage. By making an effort towards more sustainable science, we not only improve the footprint our work leaves on the planet but also, we standardise and optimise our procedures, making them more reproducible and ultimately better. Therefore, we are committed to green-up our lab practices and this document will help you get familiar with the best practices to apply this in your day-to-day research.

The DREAM3D lab actively participates in LEAF

To help scientists and public research institutions become more green, sustainable lab oriented programmes have been developed to guide their efforts to increase the sustainability of research. One such programme, named the 'Laboratory Efficiency Assessment Framework' (LEAF)[1], has been developed in the UK in 2018 by Martin Farley for University College London (UCL). LEAF offers an assessment framework through which research groups can achieve a bronze, silver or gold accreditation. The practical criteria implemented through LEAF help research groups become

[1] https://www.ucl.ac.uk/sustainable/staff/leaf

more sustainable by lowering their overall CO_2 footprint. Moreover, built-in calculators are available for research groups and organisations to assess monetary and CO_2 savings.
LEAF is now being rolled out over the Netherlands by **Green Labs Netherlands** (Green labs NL; https://www.greenlabs-nl.eu/) with seed funding from the Ministry of Health, Welfare and Sport. The Princess Máxima Center was one of the first institutes to enrol in this program in the Netherlands and has participated since September 2021. **Maxima Green Labs** is the driving force of implementation of LEAF within our center. Within the DREAM3D lab we have dedicated people that coordinate implementation of LEAF criteria for our group (Mario & Esmee) or take on a role as LEAF administrator (Hannah & Florijn).

Maxima Green Labs and Maxima Green Team (groups on Join)

Maxima Green Labs was formed early in 2021 and consists of volunteers (all research-related functions) for various lab groups that meet monthly. The main focus is implementation of LEAF within the research department and imbedding the sustainable work practices that are prompted by the criteria.
The Maxima Green team is an institute-wide initiative to discuss and push for increasing sustainability. The group can be joined on **Join** to stay up to date with the institute-wide green movement.

On this document

This document contains information on different topics related to sustainability in the lab. Please use them as a guideline, along with your own ideas and common sense to conduct your research in the most sustainable way possible.

Purchasing

When purchasing new equipment or consumables, always consider the product but also the supplier. Check if there are suitable, more sustainable alternatives to the product in mind. You may also be able to buy the same product from an alternative supplier who are making clear, conscious efforts to act on sustainability when it comes to packaging and shipping.

Any orders above 500€ need to be approved. Always provide this information when requesting approval for your purchase.

Consumables:

- Consider if a reusable product is possible
- Consider if there is a less toxic/animal free alternative
- Consider if there is a product available that produces less waste
- Consider if there is a product available that uses less packaging
- Consider if there is a supplier that collects and reuses (part of) the packaging and/or the waste derived from their consumables.
- Consider if your supplier is local, reducing the shipping footprint

Equipment:

Always compare the energy consumption and life expectancy of the desired piece of equipment with other similar pieces of equipment in the market. This information will be required in the LEIC (Laboratory Equipment Investment Committee) application form.

If you have the option to purchase a similar piece of equipment from multiple providers, consider if they have a clear policy regarding their efforts towards a more sustainable production line.

Waste Routing

Ultimately, it is unavoidable to produce waste in the lab but it's important to reduce waste as much as possible. Be mindful and careful that you dispose of your waste appropriately.

Chemical and biological waste can be a huge environmental hazard and non-contaminated plastic waste should be recycled where possible. Here are some resources to learn about appropriate waste routing in the Maxima:

Not contaminated:

- Paper and cardboard: there is a collection box in the molecular lab, bins in the corridors and a large container in the waste room.
- Hard plastics: there are collection crates in most labs
- Soft plastics: there is a large bag near the entrance of the lab
- Others: used tissues and other non-contaminated waste that has not been mentioned before can be thrown in the grey foot-pedal bins in the lab. Do not use these for any food related items.

Biological waste:

- Always use the grey biohazard bins. Refer to the specific lab introductions to make sure you label the bins appropriately when sending for disposal, depending on whether it's the molecular lab, ML-I, ML-II or VMT.

Chemical waste:

- Different chemical groups require different waste management. Information on this can be found on the door of the chemical cabinet in the molecular lab, which also contains the waste jerrycans to dispose of chemicals. Consult with other team members if you're unsure of where to dispose of a certain solution.

Stickers for energy saving

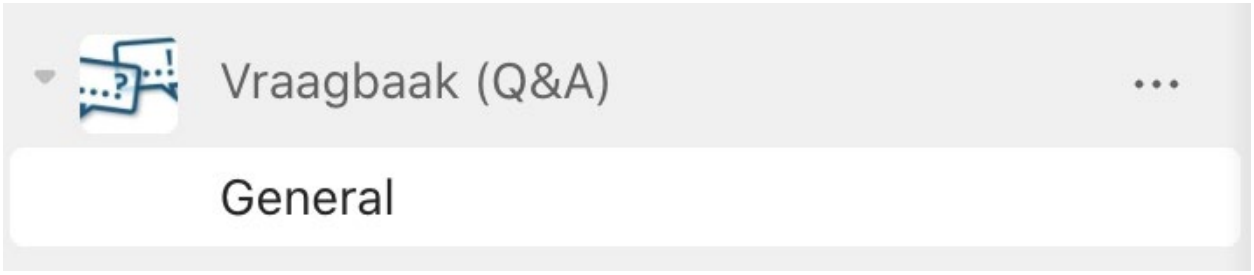
These stickers are placed on certain pieces of equipment. Keep an eye out for them and follow the instructions on the stickers:

- GREEN: turn off as soon as you're done using it.
- ORANGE: turn off if you're the last user of the day.
- RED: keep on at all times.

If you feel like a sticker should be placed on a certain piece of equipment or that a sticker should be replaced, contact greenlabs@prinsesmaximacentrum.nl or talk to the person responsible for that piece of equipment.

Lab Vraagbaak / Q&A

The team "Vraagbaak / Q&A" on Microsoft teams can be used to ask other researchers in the Maxima for reagents or advice. You can go directly in *General* and open a new thread. This way we can avoid buying multiples of the same reagent that will not be fully used.



Reporting routes

If there is a spill that you're unsure how to handle, immediately check the flash card Emergency hazardous substances. *These can be found in every lab, on the whiteboard in the office and in the general lab manual.*

Minor incidents

Minor incidents that take place in your own department/in your own space can be cleaned up with the materials present from the spill kit: above chemical cabinets in the molecular labs and chemical rooms.

Major incidents

1. Assess the situation and determine what has happened. Avoid coming into contact with the substance or vapour. Think of your own Safety!
2. If safe to do so, try not to contain the spill by already using the spill kit.
3. Alert anyone in the immediate vicinity of the hazard. If necessary, evacuate the room, department and/or building, depending on the specific characteristics of the hazardous substance (you can find this in the Chemwatch program - *Emergency Report Button*, the safety information sheets and/or packaging of the substances).
4. During working hours always call the department's emergency response team (BHV):
   Research: 06 50006375
   Diagnostics: 06 50173080
   After office hours emergency (security): (088) 97 25555
   Clearly mention:
   - Who you are
   - Where you are
   - What is going on
   - Specific characteristics of the hazardous substance
5. If necessary and safe to do so; help victims to a safe area. If they have difficulties with breathing, sit them in the open air in a half-sitting position (never leave the victim). In case of contamination on the victim (skin and clothes), use the eye and/or emergency shower if necessary (see Emergency Report Button in Chemwatch).
6. Wait for the emergency services to arrive and provide detailed information regarding the situation. Make sure that the correct information of the hazardous substance is available.
7. End of calamity: complete an incident form on **iMáxima** (see lab manual: Laboratory Regulations PMC). Make sure the spill kit is replenished - contact Jessica Buijs-Gladdines

Labels Chemicals

Some reagents are toxic and/or dangerous and need specific labels. These can be found in the molecular lab, next to the tubes and pipettes.

All tubes and/or bottles containing chemicals must have the appropriate labels on them. This includes any tubes and/or bottles that may be left unattended even for a short while.

Hazard category	% Dangerous substance	H phrases	Danger icon
Explosive	>15%	H200-204, 240, 241, EUH 001, EUH 006	
Flammable	>15%	H220, 222, 224-226, 228, 241, 242, 250, 251, 260, 261	
Oxidizing	>15%	H241, 242, 270-272	
(Highly) toxic	>0.1%	H300, 301, 304, 310, 311, 330, 331	
carcinogenic, mutagenic and reprotoxic (CMR)	>0.1%	H350, 340, 360, 362	
suspected CMR	>1%	H351, 341, 361	
STOT, **SENS**itizing agents (oral and inhalation)	>0.1%	H304, 334, 370, 372	
Corrosive	>1%	H290, 314, 318	
Harmful (irritating)	>1%	H302, 312, 315, 317, 319, 332, 335, 336	
Environmental hazard		H400, 410, 411	

Labelling of Tubes and Samples

It is important to label both tubes and samples carefully.

Tubes (including both pre-purchased bottles of medium and other solutions, and those you prepare yourself) stored in the communal areas take up precious space. It should be clear immediately who the owner is, what the contents are, and how old the tube is. This facilitates assessment of items during regular cleaning sessions.

TUBES

With alcohol-proof marker or a printed sticker, add minimum:

Name of the solution	**Breast Cancer Medium**
Initials	**EV1**
Date (DDMM[YY]YY)	**06/07/2022 or 06/07/22**

For samples, (e.g. collected medium, cell pellets, isolated tissues, RNA/DNA, primers, etc.) it is crucial to be able to link the sample to a specific person and the relevant project. This makes future experiments, recalling data and information on samples in Elab journal (by yourself and others) and your lab exit much easier.

FOR SAMPLES

Preferably use stickers (clearly legible handwriting is acceptable with an alcohol-proof marker if sticker is not appropriate) for long-term stored samples such as DNA, cell pellets, supernatant etc.

For short term storage or soon to be used samples (within 2 weeks), such as fixed tissue or organoids, use clearly legible handwriting with an alcohol-proof marker. Samples should always contain the following information:

Type	**34T-05 Pellet**
Project ID	**FUNC_Exp044**
Initials	**EV1**
Date (optional)	**06/07/2022 or 06/07/22**

Personal storage division

Something important to take into account during your research is how you organise your samples and data. Proper organisation can drastically impact the amount of storage space needed and the ability of users to find back data and avoid repeating experiments.

Cooled storage and servers have one of the highest impacts in energy consumption in a lab setting, so minimising storage space can greatly reduce the amount of energy used by the lab. Therefore, always consider these points when deciding how to organise your samples and data:

- **Do you need all of that?**

  It sure looks nice to have your own compartment or box in the Cryospace but realistically speaking, do you think you will use all that space? Assess this along with your supervisor and share space with other people in the team if possible. Your samples will be just as cold and you may be saving a lot of energy.

  If you do not need a lot of space right now but have a clear projection of that need to grow, assess with your supervisor to reserve enough space to avoid having to reorganise lots of samples too often.

- **Name your data properly and add explanation files**

  Use the DREAM3D Lab naming structure (See section ***Labelling of tubes and samples***) to make sure your data can be easily located by anyone in the team even after your departure.

  Add a .txt file in your folders with a short description on the type of data that is stored there, where it comes from and where can the experimental design be found.

- **Check what you have at least once a year**

  At least once a year, around the time of the ‘lab clean-up’, go through your samples and double check that 1) everything is labelled and organised according to this document 2) you are not keeping samples or data that can be discarded (either because it’s no longer relevant, cannot be used anymore or similar reasons)

Experiment Design

By including proper controls, planning when to have your material ready, and maximising the amount of information you can get out of one experiment, you will save waste and effort in the long run. Proper experimental design is key!

Before starting your experiment and during the planning phase, consider the following points:

- What am I going to get out of this experiment? How will it further my project?
- What prior information is already available to help minimise physical experiments?
- What small pilots should be conducted first?
- What will I include?
    - How many technological replicates are needed?
    - How many treatments / concentrations?
    - How many different antibody mixes will I test?
    - What are appropriate controls for my experiment?
    - Is everything that I'm including relevant?
- Have all reagents and antibodies been tested and validated, on your model system?

  If not, it is no use to set up a large experiment directly. Take a step back and first make sure your necessities (antibodies, treatments, dyes) work for your model system.

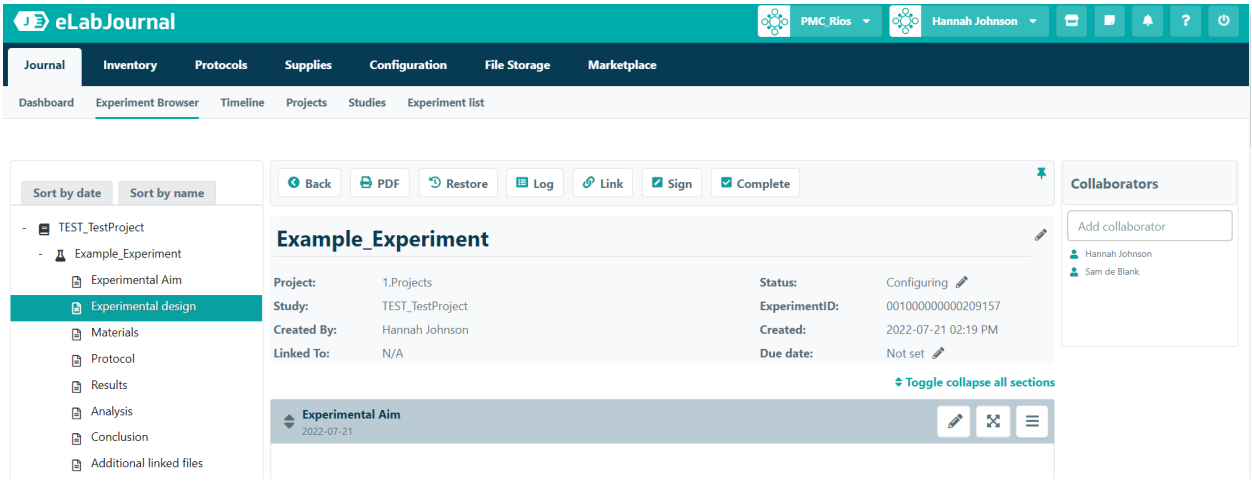
- How much material am I going to need? Do you need linked samples, e.g., of treatment readout and pellets?
- Who do I need to contact when, to make sure I get all the material and assistance I need?

Lab Journal - eLab

When documenting your experiments, it is important that this is done in an accessible way. This means not only keeping your lab journal up to date in the shared **eLab** environment, but also recording your research and experiments in a widely understandable way.

Current colleagues and any future colleagues wanting to look back at your work after you have departed, should be able to easily read your experiments and understand-

- Which project your experiment belongs to?
- Experimental aim
- Experimental design
- Materials used
- Results and Analysis
- Conclusion



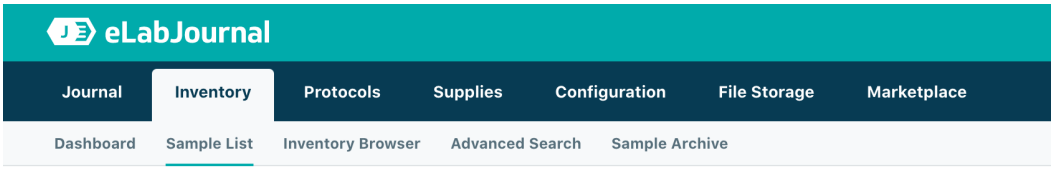
Use eLab to link samples, reagents, pre/follow up experiments, protocols etc. so that your research is accessible to others in the group, supervisors, and collaborators.

Lab databases

At the Dream3D Lab we try to share as many reagents as possible to minimise waste and optimise the window of time in which a product is most effective. Always check the databases thoroughly and talk to your colleagues before acquiring a new item/cell line/plasmid to make sure it is not already available in house. The following databases are available on eLabJournal:

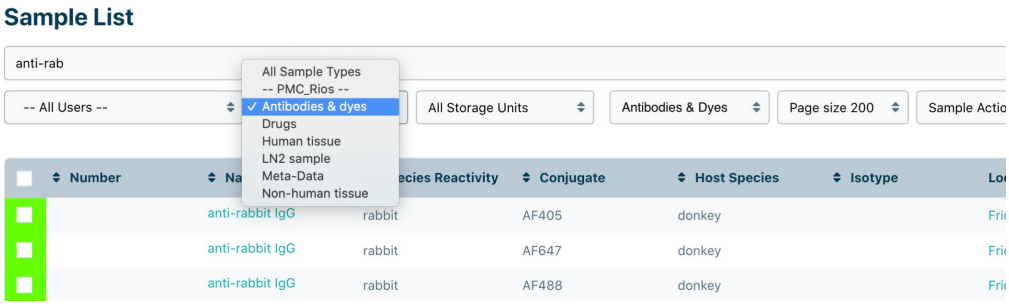
1. Liquid Nitrogen frozen living samples
2. Ultra-Low Temperature frozen living samples
3. Plasmid
4. Drugs
5. Antibodies and Dyes

On eLab Journal, section inventory you can find the Sample List:

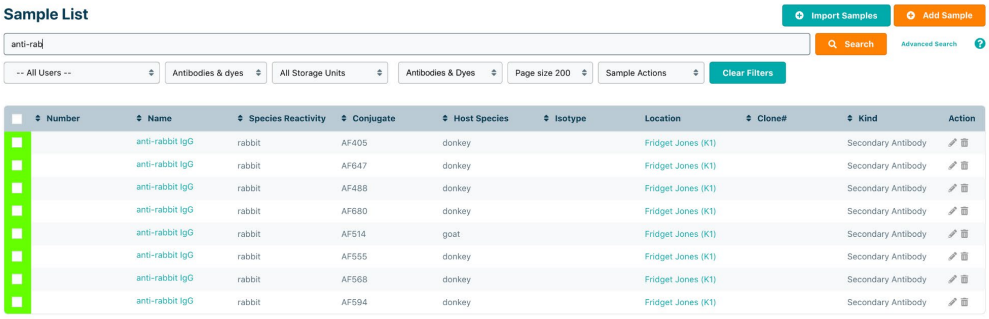


Sample List

In the Sample List, you can filter on the type of sample that you want to check:

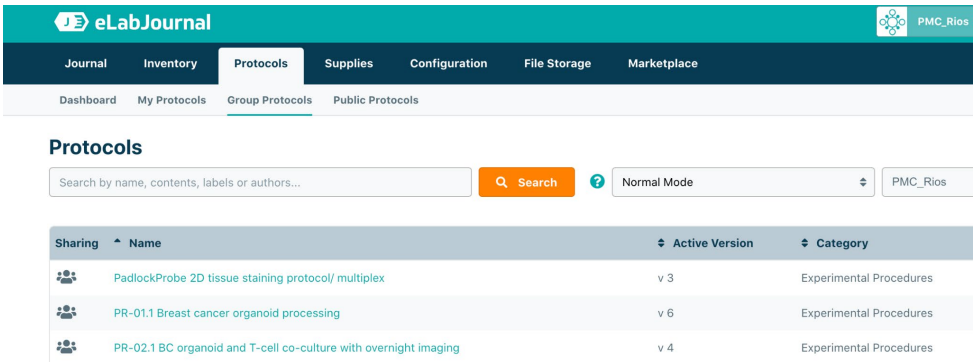


Then you can type in the search bar to find the items that you need:

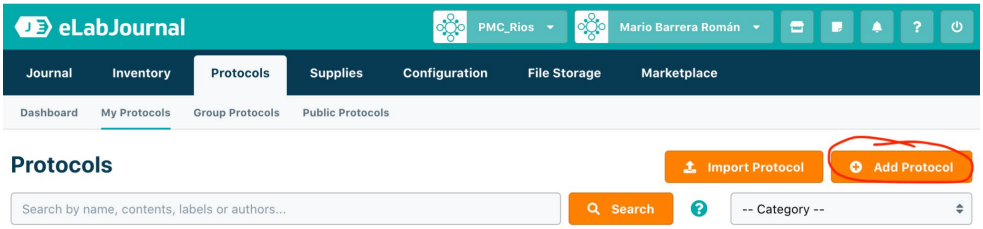


Lab Protocols

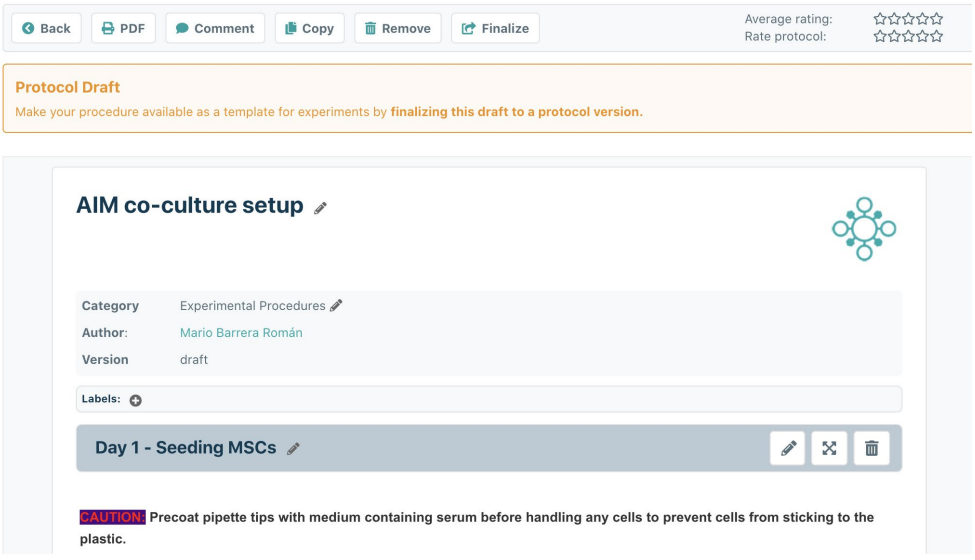
All our protocols are shared within the group on eLab Journal: Always write down your protocols and assign them a new number following the current numbering: PR-##



To write a new protocol, you can go to *Protocols>My Protocols* and click on *Add Protocol*:



You can edit it for as long as you need and *Finalise* it when you're ready to share it with the rest of the group. After the protocol is finalised, you can still update it as it evolves through time. eLabJournal will keep all versions of the protocol so you can go back to a previous version and check how it was done before.



FAIR Data

The *FAIR data* concept is that your data meets the principles of:

Findability
Accessibility
Interoperability
Reusability

This is an important concept and aids towards sustainable science by ensuring the research you do can be shared with colleagues, collaborators and anyone in the community wanting to access your work. This can lead to a reduction in unnecessarily repeated research or duplicated storage, and ensuring your research gives value to the scientific community.

Ensure you follow the Máxima *Data research management course* and read through our *Data entry PowerPoint* on the Dream3D lab data storage structure.

These will give you all the tips and knowledge you need to make your data *FAIR*.

Laptop usage

Small and easy steps can be taken when using your laptop to ensure you run it as sustainably as possible:

- Close your laptop when not in use for a short period (e.g., 30 minutes)
- Turn off screens when leaving for a short period (e.g., 30 minutes)
- Shut down computer/laptop when not in use for a longer period
- If possible, enable the power-saving settings from your operating system
    - E.g., set up the “hibernate/sleep” mode of your laptop/computer so it automatically goes to sleep after # minutes of inactivity
- Set a lower brightness for your laptop and optionally attached screens
- Keep accessories for your laptop unplugged unless they are being used