Project title: **Sustainable mini refrigerator for reagent storage.**

Lab members that helped with the completion of the project: Gokul Raghunath (Instructor), Mariana Marin (Res. Asst Prof), Yinglin Li (Res. Specialist) and Dariana Torres Rivera (Grad. Student).

Incentives Fund Award Type: Green Labs
Date of equipment arrival: 05/29/2024

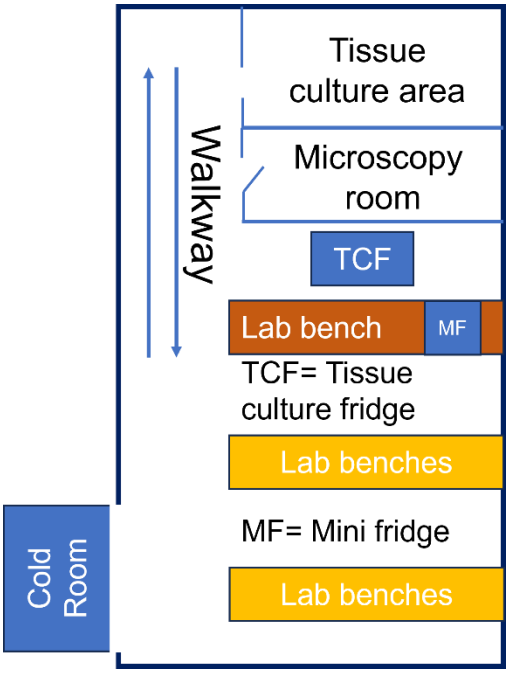
Award amount: $2668.98.

Amount spent: $2749.06.

Project description and motivation

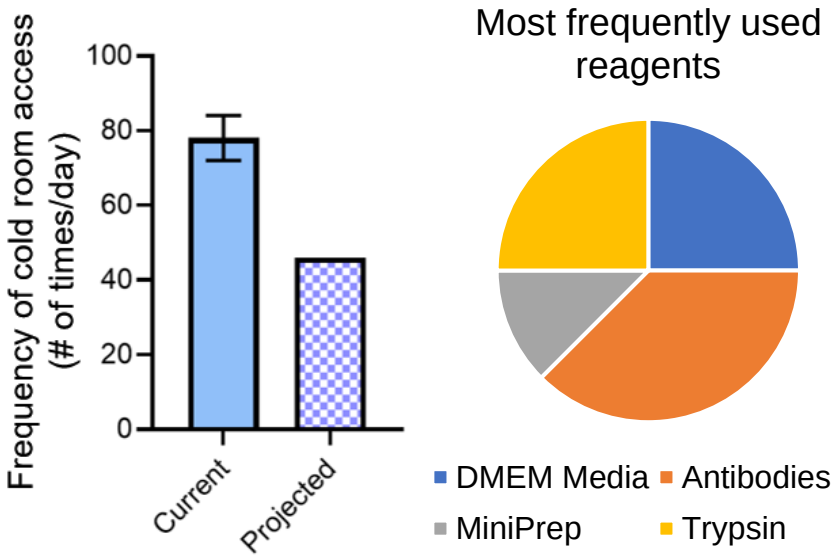
Biological reagents often have strict storage requirements often necessitating the use of different refrigerated environments. While long-term storage ranges from -20 to -80°C, short term storage of very frequently used reagents typically need 4-8°C storage for optimal performance. Several labs utilize cold temperature-controlled rooms that typically are 100s of sqft in size. Cold rooms enable large equipment usage in a temperature-controlled setting, alongside being a convenient modality for reagent storage. However, owing to its size, and its constant operation, cold rooms are not an efficient mode of storage, particularly if there was a need to access the reagents on a regular basis. A sustainable solution to this problem would be to minimize, if not eliminate the necessity to frequently access the cold room by storing the "frequent use" reagents in a smaller, more environmentally friendly refrigerator which is more efficient in terms of power consumption, with modular features. **The final objective of this project is to strategically identify and transfer heavy-use reagents to a sustainable refrigerator to minimize overall energy consumption and maximize efficiency.**

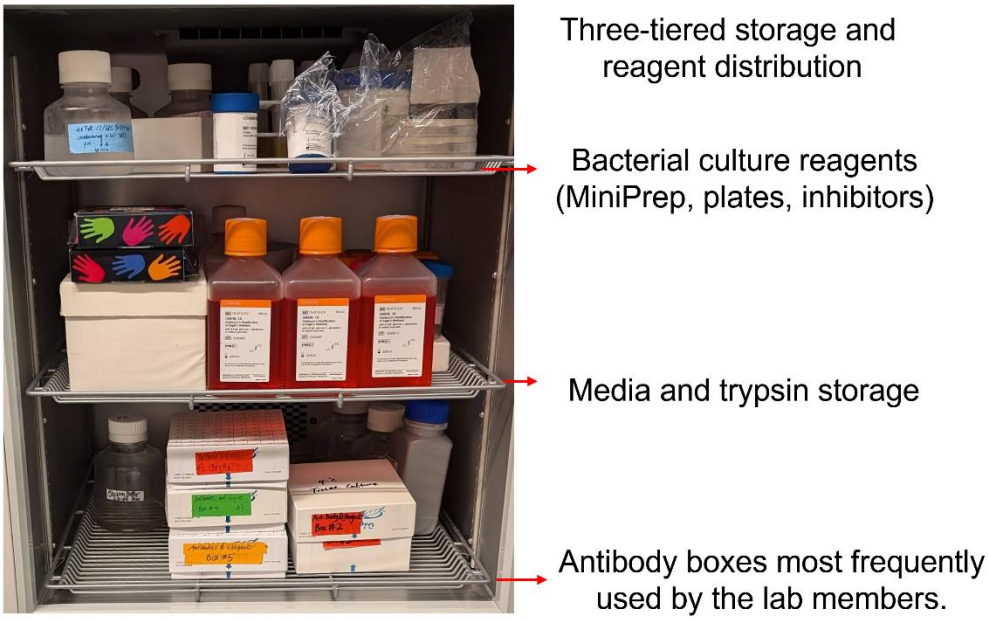
Results



After receiving the equipment, we set it up close to our large double-door refrigerator (to be called a tissue culture fridge). This compact, energy-efficient appliance with modular temperature control, has quickly become integral to our day-to-day lab activities, and we foresee that it will continue to greatly improve the storage and management of critical biological reagents, including buffers, antibodies, proteins, and enzymes. We took the decision to place the mini-refrigerator closer to **the tissue culture fridge, owing to its location and proximity to our tissue culture stations, where the reagents will be used most frequently**. A rough sketch of the lab's layout is included for convenience. We reasoned that, besides offering a more sustainable storage solution, the mini fridge will offer organic incentives for the lab members to minimize cold room usage by reducing the distance required to be covered on foot in a crowded walkway as demonstrated in the layout figure.

Another key aspect of our initial proposal that will enable us to achieve our sustainability goals, involved identification of heavy-use reagents that necessitates the opening and closing of large cold-room doors and our tissue culture fridges. To that end, **we questioned and polled several key personnel in the lab, particularly those heavily involved in biological research**. Our systematic approach helped us not only to identify the number of times the lab members were accessing the cold room, or the tissue culture fridge, besides helping us identify our most used reagents that needed to be accessed from the cold room and the tissue culture fridge. On average, we found that the Melikian lab personnel accessed the unsustainable refrigeration options at least 6-7 times a day (per person). Extrapolating this number to a ~12-person team (Current size of the lab) indicates that the **cold room and the tissue culture fridge gets opened at least 72-84 times a day**. While it's not feasible to eliminate cold room usage, owing to equipment usage, we decided to poll key personnel about which reagents they needed to access frequently from unsustainable storage spaces. The results were wide ranging, but most common responses were as follows: **DMEM media, antibodies (both primary and secondary), mini prep-kits and trypsin**. Based on our polling data (represented in the figure), we made the decision next to strategically move certain reagents to the mini fridge. After the move, we currently now estimate **that we have reduced the frequency of cold room access by nearly 40%**, with more room to improve as we continue to identify and improve the choice of reagents.





Additional observations from completing the project: Despite its deceptively small size, the refrigerator provides ample storage (**almost 50% higher storage space in comparison to refrigerators of comparable sizes available on the market**) Its compact design allows for efficient utilization of laboratory space, promoting an organized and productive work environment. A key feature that the refrigerator offers that our tissue culture fridge does not offer, is **the pre-set alarm function, which can be programmed according to the user's choice**.

Previously, due to a malfunctioning thermocouple, the tissue culture fridge accidentally froze several of our antibody samples leading to loss of reagent quality and integrity stunting research progress to a considerable degree. The TSG series mini fridge we acquired using the Greenlabs grant, offers a robust alarm system, which is sensitive to temperature changes and fluctuations and offers a warning system that is programmable and can be accessed via an alarm log, which will give us a clear indication of the time and situation that led to the eventual loss of desired storage temperature.

Conclusion

In conclusion, the integration of the mini refrigerator into our laboratory setup has significantly enhanced the efficiency and sustainability of our biological research operations (and will continue to do so). By providing optimal storage conditions for a select array of reagents, it has bolstered our ability to be less wasteful and brings us a step closer to our sustainability goals.