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| **Goals**  The development of artificial cells can be a useful tool for engineering within biology. By using genetic elements of a cell to create a completely non-living, synthetic cell, a wide variety of experiments and applications can exist.  We have shown that synthetic cells, constructed from liposomes, are capable of regenerating ATP without any need for additional experimental methods after the initial deposit of cell extract. We have identified a set of robust, efficient parameters for long-lasting energy production. With this technology, synthetic cells will be able to survive on their own from months to years. | **Technical Challenges**   * Choose and implement machinery (ATP synthase etc) from eukaryotic cells and test efficient, robust functionality in liposomes * Identify advantages and drawbacks of machinery from various cell types (test efficiency, robustness to perturbations, etc) * Identify a metric of ATP production (fluorescence detection assays etc) * Ensure there are no toxic effects or buildup so the functionality of the machinery does not decline over time * Identify methods to quantify metabolism |
| **Objectives**   * Develop a liposome that is able to adopt the machinery from eukaryotes for oxidative phosphorylation and produce ATP from ADP (given a sugar source or cell extract) by week 2 of SURF * Develop a liposome that is able to last 3-10 days with the accepted machinery by week 4 * Develop 2-4 liposomes with TX/TL machinery to test/quantify the rates (and other properties) of metabolism by week 6 * Understand and identify parameters that affect the rate of ATP production by week 8 * Attempt to identify the optimal set of parameters for long-lasting, robust, efficient ATP regeneration by week 10 | **Approach**   * Attempt to implement machinery from various eukaryotic cells (specify) into liposomes * Use the quantification of ATP production to understand properties of different machineries and select top candidates * Use ATP detection assays at different time points to understand the distribution of ATP production * Remove certain chemicals or structures of the machinery, pathway, buffer, etc to test and understand the dependency of ATP production on these variables * Use a cellular metabolism assay to understand rates under different parameter sets |