

Synthetic Biology at UC Davis: A Model for Student Involvement and Leadership in a Biomaker Space

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About Synthetic Biology

Synthetic Biology at UC Davis is an undergraduate student organization and research group. The organization currently has roughly 100 general members, 60 of which are involved in the research projects. Primary activities include running 5 undergraduate research projects and cultivating relationships with the biotechnology industry by hosting guest speakers, organizing facility tours, and facilitating industry “brainstorming nights.”

Microfluidics Project

The microfluidics project aims to rapidly prototype 3D printed microfluidic devices and use these devices to sort cells based on DNA/RNA characteristics. Over the course of the past school year, the group has drafted protocols and built two microfluidic controllers. The controllers allow users to control the amount of fluid, type of fluid, and the velocity of the fluid pumped into microfluidic chips. The protocols the group drafted are adapted from previous microfluidic work, and will allow the group to conduct in-depth QC analysis of their controllers and chips. Once the QC protocols have been executed, the group will run cell sorting experiments.

Real Vegan Cheese Project

Real Vegan Cheese is a transplant of a project that began at a community biomaker space in the SF Bay Area. The project aims to make real cheese—just without the cow! Expressing casein proteins in yeast, the project has the potential to lead toward more sustainable production of cheese. The project at UC Davis is in its early stages, with the majority of progress over the 2017-2018 school year realized not in the project itself, but in training students in essential molecular biology skills, like PCR, gel electrophoresis, and using these skills to assemble a gene construct. Over the course of the 2018-2019 school year, these students will use their new skills to assemble a portfolio of constructs, express these proteins in yeast, and formulate them to make cheese.

3D Bioprinter Project

This group has designed a 3D Bioprinter capable of printing plant cell cultures into complex geometries. While bioprinters have a wide range of applications, the group is collaborating with a professor in the Chemical Engineering Department at UC Davis to print a macroporous scaffold to immobilize transgenic plant cells. This structure can be used as a perfusion bioreactor, in which the plant cells are locked

in place while the nutrient medium flows through the scaffold. This configuration simplifies the protein purification process because it separates the cells from the desired protein by design, rather than requiring a separate purification step for the same task. The group is subdivided into a mechanical team to build, test, and modify the printer hardware, and a biology team to optimize hydrogel formulation and maintain cell cultures.

Project Structure

Excitingly, students participated in these projects during the course of the 2017-2018 school year without receiving course credit, which indicates that they find inherent value in the projects. In addition, Synthetic Biology at UC Davis is committed to inclusivity, and allowed any and all interested students to participate in a project. By the end of the school year, over 60 students had contributed to the three main projects Synthetic Biology runs (Real Vegan Cheese, Plant Bioprinter, and Microfluidics). Each project has 2-3 subteams that focus on a specific component of the project. Project teams organized their own weekly meeting times and were led by a designated Team Lead.

All new members are required to complete a standard lab safety training before joining a project group, and meet with project team leads to assign them to a role that fits their interests and skill sets.

Mentors and Funding

Synthetic Biology’s work would not be possible without the help of dedicated mentors and funding. Mentorship for the 2017-18 school year was provided mainly by UC Davis TEAM lab staff, including its lab managers and directors. The casein synthesis and microfluidics projects are spin-offs of existing projects done by Bay Area community biohackers at Counter Culture Labs and BioCurious. All material for projects was purchased with funding from the non-profit VentureWell, an organization dedicated to promoting collegiate research and entrepreneurship. Synthetic Biology plans to build stronger relationships with industry this upcoming school year to secure funding and collaborate on new industry-specific projects.

Work with Industry

Synthetic Biology aims to foster relationships with start-ups and established biotechnology companies to provide undergraduates with the resources and mentorship they need to succeed in the biotechnology space. During 2017-18 school year, the organization hosted speakers working on biotechnology startups, and toured a biotechnology incubator space. The organization also worked with collaborators to host the first annual Night with Biotech, where students met with scientists from HM Clause and Bayer Crop Sciences to brainstorm solutions to technological problems faced by these companies. Synthetic Biology is currently working with HM Clause to turn the results of this brainstorming session into a funded undergraduate design project: developing a cheaper, more convenient way to assay crop disease in the greenhouse and in the field.

Going forward

Synthetic Biology plans to continue working on its three main projects for the 2018-19 school year, thanks to the generosity of VentureWell and mentors. The organization is looking to increase its research output and make its projects sustainable during the upcoming school year. To accomplish this, the organization plans to offer course credit to project participants, hire graduate student mentors (with additional funding from UC Davis) for each project group, and establish other independent undergraduate projects within the TEAM lab space. The organization is also looking for funding for student lab managers, who would maintain the TEAM lab space.