



The NSF BioFoundry for Extreme & Exceptional Fungi, Archaea and Bacteria (ExFAB)

Strategic Implementation Plan

Version 1.0

NSF Cooperative Agreement No. DBI-2400327

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1.0 Mission/Vision Statement

The National Science Foundation (NSF) Biofoundry for Extreme and Exceptional Fungi, Archaea, and Bacteria (ExFAB) will establish and operate a first-of-its-kind user facility that empowers researchers to learn, prototype, and translate biology from unusual microbes in our environment to advance biotechnology and biomanufacturing.

2.0 Roles and Responsibilities

ExFAB operations are overseen and managed by an internal and external governance structure, as described below and in the organizational chart attached as Appendix 1.

2.1 Internal governance

2.1.1 **ExFAB Director** (Dr. Michelle A. O'Malley). The ExFAB Director, who is also the lead Principal Investigator, serves as the chief executive officer for ExFAB. She is responsible for all technical and non-technical aspects of ExFAB, chairs the ExFAB Management Team, and is the primary liaison to the External Advisory Board and primary contact for the NSF Program Managers. The ExFAB Director reports to the UCSB Vice Chancellor for Research. The ExFAB Co-Director (Ian Wheeldon) represents the ExFAB Director when she is not available.

2.1.2. **ExFAB Managing Director** (Ms. Sherylle Mills Englander). The ExFAB Managing Director serves as the Chief Operating Officer for ExFAB. Working closely with the Director, she oversees all non-technical aspects of ExFAB, including reporting obligations to NSF, and oversees and implements strategic programming. The Managing Director leads the Operations Team and Education Team meetings and serves on the User Feasibility Committee.

2.1.3. **ExFAB User Program Director** (Dr. Ian Wheeldon). The ExFAB User Program Director oversees and manages all aspects of the ExFAB user program.

2.1.4. **ExFAB In-House Research Director** (Dr. Michelle A. O'Malley). The ExFAB In-House Research Director oversees and coordinates all aspects of ExFAB's internal research program.

2.1.5. **ExFAB Management Team**. The ExFAB Management Team consists of the five principal investigators (Drs. Michelle O'Malley, Ian Wheeldon, David Valentine, Jason Stajich, Jamie Snyder) and the Managing Director (Ms. Sherylle Mills Englander), and is chaired by the ExFAB Director. The Management Team meets weekly and is responsible for overseeing all aspects of the ExFAB as its executive committee. The Management Team also reviews all user proposals for mission fit, the final approval step in the user proposal review process.

2.1.6 **ExFAB Operations Team**. The ExFAB Operations Team consists of the lab managers from all three campuses, the ExFAB User Coordinator, the User Program Director and the Managing

Director. The ExFAB Operations team meets biweekly to coordinate facility development and use, exchange best practices and collaborate in the development of tools and initiatives that span the facilities at three campuses. The Operations Team also serves as the feasibility committee in the user proposal review process.

2.1.7. ExFAB Education Team. The ExFAB Education Team consists of the CPP principal investigator (Dr. Jamie Snyder), an education lead from each campus, and the Managing Director. The ExFAB Education Team meets biweekly and is responsible for implementing all ExFAB educational and training programming, including the ExFAB Fellows program, the CSU Masters Scholars program, and the annual ExFAB Summer School.

2.2 External governance

2.2.1 ExFAB External Advisory Board. The External Advisory Board (EAB) reports to the UCSB Vice Chancellor for Research. It is comprised of leaders from industry, national laboratories, government, universities and nonprofit organizations. The EAB's charge is to ensure that ExFAB remains relevant on the national scale and to guide ExFAB's long-term strategic growth. The External Advisory Board meets annually to provide feedback to ExFAB's leadership. A list of current EAB members is attached as Appendix 2.

2.2.3 ExFAB Industrial Advisory Board. The Industrial Advisory Board (IAB) reports to the Managing Director. It is comprised of leaders from the industry, investment and entrepreneurial ecosystems. It meets no less than semi-annually. The IAB's charge is to advise ExFAB on research translation and technology development, and workforce development. The IAB will be implemented in the first quarter of ExFAB's second year.

2.2.4 ExFAB User Committee. The ExFAB User Committee reports to the ExFAB Management Team and is managed by the ExFAB User Coordinator. It is responsible for reviewing user proposals to provide feedback on which projects should receive ExFAB support. The committee meets as needed to review submitted user proposals, either in whole or by a subset of members who have expertise in the proposed project. It is externally sourced, composed of a number of invited and rotating faculty from the ExFAB community outside of UCSB, UCR, and CPP who have no connection to the proposed projects. Members rotate on a yearly basis. The ExFAB User Committee will be implemented in the first quarter of ExFAB's second year, when the ExFAB facilities are fully operational.

3.0 Scope

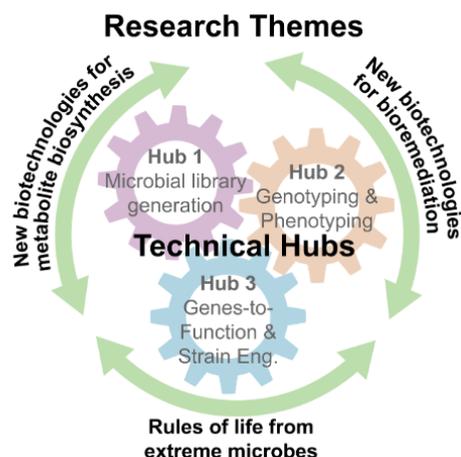
3.1 Research

ExFAB's in-house research is structured around three areas that stem from extreme and exceptional microorganisms – Bioremediation, Biosynthesis, and Discovering new Rules-of-Life. Each research area is supported by the technical Hubs that comprise ExFAB's infrastructure. Importantly, new instrumentation, workflows, and protocols developed as part of the internal research program will drive new infrastructure that is available for the external user program. The

main mechanism of in-house research support is through the ExFAB Fellows and ExFAB Scholars research program (described below), which support trainees pursuing research in ExFAB PI laboratories.

Research Sub-committees

ExFAB uses Research Sub-committees composed of ExFAB faculty across all campuses to help drive research that addresses important challenges in Bioremediation, Biosynthesis, and Discovering new Rules-of-Life. Initial members of each sub-committee and the research goal of each is listed in Appendix 3. Sub-committees will meet quarterly to discuss research progress and initiate new ideas and projects. We anticipate ~1-2 publications per project completed at ExFAB. Given the multidisciplinary nature of ExFAB's research, we anticipate that ~75% of our publications will be collaborative with 2 or more ExFAB PIs per publication.



3.2 User access program

ExFAB facilities are open to researchers (PIs, scientific staff, students) from academic, industry and government institutions. Users can use the facilities directly (in person, hands-on), or indirectly (projects performed by ExFAB's technical staff). Users access the ExFAB facility through one of two avenues: i) by submitting a user project through the user proposal process; or ii) through payment of an access ("recharge") fee. The user proposal process allows ExFAB to identify, and support the facility costs for, projects that align with its research priorities. For proprietary projects (including industry projects) or projects that do not align with ExFAB's research priorities, users can access ExFAB facilities through a pay-per-use system by paying a recharge fee. Facility access for approved user projects always takes precedence over generalized access.

3.3 Knowledge transfer and partnerships

3.3.1 Knowledge Transfer. ExFAB knowledge transfer occurs robustly and multi-directionally. Users share their research experiences with ExFAB's technical staff to help ExFAB identify protocol, workflow and technology gaps that limit research conducted on extreme microbes and then collaborate with ExFAB staff to develop solutions to overcome these challenges. As solutions are developed and novel research outcomes are generated, the knowledge and technology is transferred through publications, conference presentations and seminars and, when appropriate, intellectual property licensing. Knowledge transfer is also accomplished through ExFAB's training and education programs (the Fellows, CSU Master Scholars and Summer School), and through its newsletter and social media channels. ExFAB's intellectual property policy was specifically designed to create a strong foundation for knowledge transfer, embracing open source principles

and incorporating use rights to assure ExFAB can access the novel workflows and protocols its users develop for future projects.

3.3.2. Partnerships. ExFAB's approach to partnerships is three-fold: (1) to develop collaborative relationships with synergistic biofoundries to allow ExFAB to focus on its core strengths and to minimize duplication across the nation; and, (2) to develop partnerships with industry leaders to develop a strong industry user base, create opportunities for collaborative research projects and to support technology translation; and (3) to develop partnerships with leaders in the innovation ecosystem (including investors, incubators and accelerators) to support ExFAB technology translation and ExFAB-affiliated startup companies.

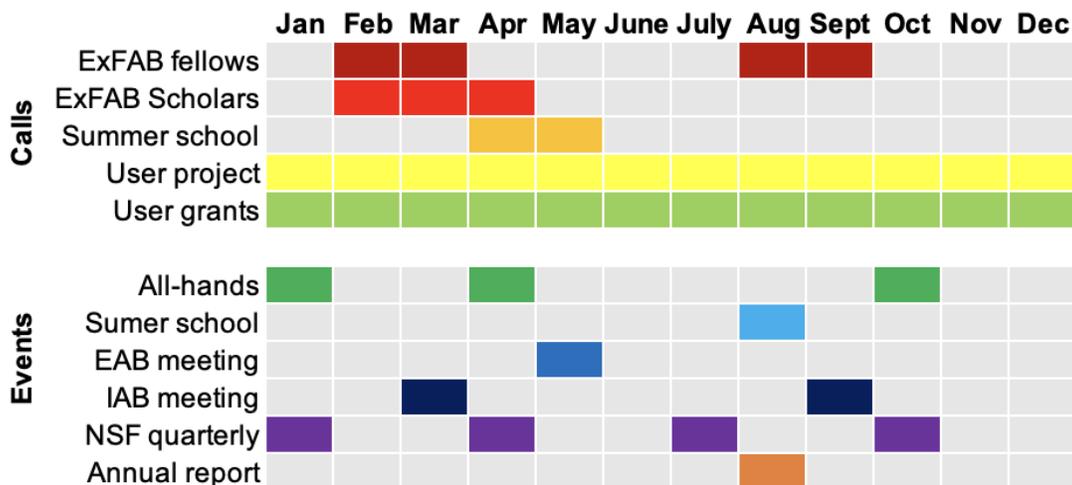
3.4 Training and Education

ExFAB offers three primary programs for training and education designed for training UCR and UCSB graduate students and postdocs, Cal State University (CSU) Master's students, and external users. The ExFAB Fellows program provides research training and professional development for UCR and UCSB postdocs and graduate students who are in ExFAB-affiliated labs and are conducting in-house research that will develop new technologies for the benefit of the microbiology research community. The CSU Masters Scholars Program embeds CSU masters students in ExFAB-affiliated labs at UCSB or UCR for a 10-week, in-depth research experience. And finally, the ExFAB Summer School provides in-depth technical training to enable researchers to leverage ExFAB's unique facilities for their own research and build their technical expertise in automation. The ExFAB Summer School is open to the entire microbial research community: graduate students, researchers, faculty, and industry professionals from institutions at non-R1 and R1 institutions across the state and nation.

4.0 Project Schedule

ExFAB seeks to complete a minimum of 100 user projects in its first six years, as outlined in Section 5.3.7. Year 1 projects focus on developing automated workflows and protocols; as of May 2025, four internal projects have been approved and initiated with an additional four anticipated by the end of June 2025. External projects are slated to begin in year 2, increasing in number in subsequent years. By Year 3, ExFAB anticipates completing more external projects than internal projects, eventually achieving the goal of at least 50% of total projects to be initiated by external users.

ExFAB's annual cycle of programs, meetings and events are as follows:



5.0 User Facility

5.1 Development. In developing its facilities, ExFAB’s primary directive is to develop and enable automated workflows for the discovery and engineering of extreme microbes.

5.1.1. UCSB Facility. The ExFAB UCSB facility enables automated workflows for studying extreme microbes with a focus on anaerobes. It is supported and managed by two lab managers, supplemented by ExFAB “Workshop Wizards,” undergraduate students who serve as laboratory assistants. The UCSB facility currently provides access to seven (7) stand-alone pieces of equipment, including a high content imager and two mass spectrometers. By late-July 2025, the facility will have a fully operational, custom-built anaerobic platform that encloses twelve (12) instruments connected to a robotic arm and coordinated by a single scheduling software. With this integration, the platform will enable fully automated multi-step workflows using advanced liquid handling, imaging, flow cytometry, environmental control and nucleic acid processing within an environmentally controlled chamber. By summer 2026, ExFAB UCSB will install four (4) additional offline instruments expanding capabilities to include cell sorting of both small and large cells, as well as high-resolution mass spectrometry, bringing the total number of available instruments to twenty-one (21) (see Appendix 4 for a full instrument list and estimated dates of installation). Lab managers prioritize user support through hands-on training, development of SOPs, and implementation of workflows.

5.1.2. UCR Facility. The focus of ExFAB’s UCR facility is to develop automated workflows suitable for isolating, phenotyping, and engineering aerobic microbes. UCR’s facility includes robotic liquid handlers, a high throughput low magnification imaging system, automated microbial culturing, microbial isolation equipment, and the computational, scheduling, and tracking systems needed to coordinate user projects across both UCSB and UCR’s ExFAB facilities.

During the initial stand-up phase, UCR’s facility is focused on designing and validating automated workflows for (1) genomic DNA library preparation, (2) DNA extraction from extreme microbes, (3) microbial arraying, (4) colony picking, and (5) microbial phenotyping. These workflows were

selected based on input from the ExFAB community and will enable internal user projects during year 1. Based on the results of a community-wide survey, these workflows also meet the needs of external users. UCR ExFAB is equipped with two liquid handling robots: one is a low-cost, easy-to-use Opentrons system, which is used to pilot new protocols; a second is a Tecan Fluent 780 with associated peripheral equipment (UV-vis spectrometry, shaker incubator, and centrifuge), which will be used to access rapid, high throughput workflows previously validated on the Opentrons system.

The UCR facility is also leading the development of computational workflows for data analysis and the establishment and operation of a laboratory information system (LIMS) that supports all ExFAB sites. ExFAB's LIMS incorporates an open source platform using SENAITE. Functionalities include sample and project tracking, data storage, and reporting. The system is built organically and piloted against the most common workflows to ensure efficacy. Initial stand-up of the system is being conducted with the NGS library preparation workflow and expansion to other workflows at UCSB, UCR, and CPP at the beginning of ExFAB's second year. Additional features and functionalities will be developed on an as-needed basis.

5.1.3. *CPP Facility.* ExFAB CPP is developing long read sequencing capabilities. A set of Oxford Nanopore sequencing instruments will be the first core facility established at CPP. Lead by Dr. Snyder and with the assistance of the User Program Director, low cost, long read capabilities will be established for use in ExFAB fellows and scholars training. Beginning in ExFAB's second year, these sequencing capabilities will be integrated into ExFAB user projects as needed. For projects with larger sequencing needs, ExFAB will engage sequencing cores at UCR, UC Berkeley, and UC Davis, all of which have high-capacity sequencing equipment that can be accessed by ExFAB PIs at competitive rates.

5.1.4. *Ongoing Facility Development.* ExFAB's technical staff aligns the development of new workflows and additional automated workflows with user needs and the research goals defined during ExFAB's quarterly all-hands meetings. Future equipment acquisitions are identified and assessed through annual user surveys, informal interactions with users as they engage the ExFAB facilities, coordination with other campus facilities, review of functionalities at other BioFoundries, and consultation with the ExFAB External Advisory Board. A needs assessment for LIMS is made no less than annually, through discussions with the lab managers and in user surveys.

5.2 Institutional Synergies.

ExFAB recognizes the need to create an integrated user facility across three physical sites – UCSB, UCR, and CPP. To enable this, ExFAB is centralizing project management, creating workflows and protocols that are used at all sites, using common equipment vendors, and creating ExFAB-wide collaborations. ExFAB's User Program Director, with the assistance of the User Coordinator, leads these efforts. Project management is centralized through the User Coordinator with assistance from UCR ExFAB administrative staff. Protocol, data, and project information sharing occurs through a single LIMS platform integrated into both the UCSB and UCR facilities.

Led by UCR ExFAB's tech team (see above), the LIMS collects sample data, tracks sample progress from beginning to end, and reports project status, information that is accessible to the technical teams, leadership group, and user program team via a centralized system. The LIMS will be developed in year 1 and deployed at all sites in year 2 and beyond. Developing common protocols is facilitated by ExFAB's use of common vendors. For example, central to many workflows is liquid handling. UCSB and UCR sites operate Tecan Fluent systems to meet this need, thus facilitating the sharing of protocols and knowledge developed at each site. Lastly, through the formation of internal research teams created around common interests, ExFAB is establishing research collaborations across all campuses.

5.3 Use Strategies

5.3.1. *User Base.* ExFAB facilities are open to researchers (PIs, scientific staff, students) from academic, industry and government institutions. Researchers ("users") can access the facilities directly or indirectly. Any user affiliated with UCSB, UCR, or CPP (including researchers conducting ExFAB's in-house research) is considered an internal user. All other users are external. Similarly, ExFAB projects are designated as internal or external based on the user type. To assure the facilities are broadly accessed, if demand exceeds capacity, no more than 50% of the overall facility time will be allocated to in-house research and other internal user projects and all external use requests will be subject to a competitive review process. Additionally, if demand exceeds capacity, no less than 10% of the facility time will be dedicated to users from nonR1 universities.

5.3.2. *Recruitment of Users.* ExFAB acquires new users through five primary channels: i) its educational and training activities such as the ExFAB Summer School and CSU Masters Scholars program, ii) leveraging existing networks such as the CSUBIOTECH Network, LinkedIn, professional organizations, and the ExFAB mailing list, iii) direct engagement at users' home institutions, with a strong focus on travel to the California State University campuses, iv) collaborations with other user facilities, such as the Joint Genome Institute, and v) participation in technical conferences and trade shows. In Year 1, users are exclusively internal and are recruited from the existing ExFAB network. During Year 2, internal and external user projects will be generated from ExFAB educational programs and professional networks, and travel to CSU campuses. In subsequent years recruiting activities will have a national reach.

5.3.3 *User Access.* Users access the ExFAB facility through one of two means: i) submitting a user project through the user proposal process; or ii) payment of an access ("recharge") fee. The user proposal process allows ExFAB to identify, and support the facility costs for, projects that align with its research priorities. For proprietary projects (including industry projects) or projects that do not align with ExFAB's research priorities, users can access ExFAB facilities through a pay-per-use system by paying a recharge fee. Facility access for approved user projects always takes precedence over generalized access.

5.3.4 *User Proposal Review and Approval Process.* To be considered for funding, users submit proposals in a specified, standardized format through the ExFAB website. The proposals must

clearly demonstrate how the proposed research will enhance ExFAB's capabilities and/or knowledge of extreme and exceptional fungi, archaea, and bacteria. Potential users are strongly encouraged to contact the ExFAB User Coordinator to discuss their proposed project prior to submission. The steps of the user proposal process are as follows: i) optional communication between prospective users and the ExFAB User Coordinator to discuss feasibility and alignment of the research objectives with ExFAB research priorities, ii) online proposal submission, iii) proposal review by the Feasibility Committee, iv) proposal review by the User Committee (to be implemented in Year 2), and v) proposal review by the Management Team, who will take into consideration feedback from the other groups as well as project-mission fit, and grant final approval to convert user proposals into active user projects.

5.3.6 Project execution. Following approval, each project receives a unique identification number and is subsequently tracked for expenditures, equipment utilization, and ExFAB scientific staff engagement hours. Projects have a one-year execution window, with potential extensions of 3, 6, or 9 months. Users are contacted monthly to check on activity and progress. ExFAB allocates an average of \$7500 in user support per project, with increased budgets considered for high-impact initiatives. Project closure, occurring after one year or the expiration of any extensions, includes knowledge sharing, user instructions for acknowledging ExFAB in presentations and publications, and potential sharing of project completion and outcomes to spread awareness.

5.3.5. User onboarding. The ExFAB User Coordinator assures all required documentation and lab safety training is in place before the User accesses the facility. The User's institution must execute an appropriate facilities use agreement, and evidence of insurance (academic institutions may apply for a waiver of insurance requirements). The facility use agreement and insurance requirements are set using the host university's standard forms and processes. Users who receive support from ExFAB (through an approved user proposal or user grant) must also sign the ExFAB Policy Acknowledgement, where they agree to provide ExFAB with use rights and to acknowledge ExFAB in resulting papers and presentations, among other things. Lab safety training requirements are determined by the Lab Managers and leverage the host university's lab safety training modules whenever possible.

5.3.7 Project Goals. In the first 6 years of operation, ExFAB will complete a total of 100 user projects as set forth in the table below.

Table 1. Projected internal and external user-based projects to be managed at UCSB or UCR. Steady-state between external and internal users reached by Year 3, after an internal development phase. ExFAB facilities at CPP can be accessed through a user proposal routed through and managed by UCSB or UCR.

	Site	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total Projects
Internal Projects	UCSB	4	3	3	4	5	5	48
	UCR	4	3	3	4	5	5	
External Projects	UCSB	0	2	3	6	7	8	52
	UCR	0	2	3	6	7	8	
Total		8	10	12	20	24	26	100

5.3.8 *Additional User Support.* The User Grant program, which will be launched in ExFAB's second year, offers \$5,000 to \$15,000 in additional support for nonR1 users to facilitate access to ExFAB's facilities. User Grants can be used for extra research supplies not covered by the project budget, for recharge fees at university facilities other than ExFAB, or to support travel for in-person access to ExFAB's facilities. Users can apply for a User Grant when they submit a project proposal. Additionally, the ExFAB Management Team reserves the ability to request a user to apply for a User Grant if their project budget exceeds \$7,500.

3.2.8 *Outcome tracking.* ExFAB will track project progress and outcomes through a series of activities. All user proposal reviews and approvals are tracked through a Smartsheet database, which retains project descriptions and budgets for future reference. The User Coordinator monitors project progress and reports to the User Committee and Leadership team on a quarterly basis. The goal of this reporting is to help understand the composition of the overall project portfolio so that adjustments can be made to best match the project goals stated above. The User Coordinator will also solicit feedback from users at the conclusion of each project, with the goal of capturing the user experience and identifying potential bottlenecks in the user program and highlighting project and process successes. During the initial start-up phase and through year 2, the User Coordinator will also focus on tracking project timelines. During the approval process, the Feasibility committee makes an estimate of the time and cost required to complete each project. Tracking progress and costs as projects are executed will help build ExFAB's expertise in making accurate estimates of the resources needed to complete various projects. By the end of year 2, ExFAB will be able to accurately estimate the resources required to complete each project, thus enabling a streamlined process for project evaluation, approval, and execution.

5.4 User fees

5.4.1. *The University of California.* The development of user fees for shared experimentation facilities on UC campuses is governed by policies issued by the UC Office of the President (Business & Finance Bulletins A-47, A-56, and A-59) as well as campus-specific policies and procedures. The ExFAB facilities at the UC Santa Barbara and UC Riverside campuses follow these policies in the development of their user fees (i.e. "recharge rates"). The policies require the annual review of all recharge rates.

At each campus, the ExFAB facility submits a detailed recharge rate proposal that calculates the estimated costs of supplies, equipment and technical staff, and the estimated number of users, broken down by type. The calculations for the first year of operation are based on reasonable estimates. Annual revisions are based on the previous years' actual costs and activities, as well as a future trend analysis.

The initial recharge proposal is submitted to the host department's control point for initial review and approval, then to a central rate and recharge committee for final review and approval. The reviews assure all costs are properly accounted for, an acceptable cost allocation basis is used, the rates will result in full cost recovery, and the rates comply with all applicable federal regulation.

UC recharge facilities operate on a “no-gain/no loss” basis and are expected to operate close to break-even over time. To accomplish this, all recharge rates (including ExFAB user fees) are updated on an annual basis. An updated recharge rate proposal is developed by the facility based on the previous year’s actual activities and future trend analysis. The updated rate proposal is submitted for review and approval by the central rate and recharge committee in February of each year. Any modifications in the user fees are effective July 1, which is the beginning of the next fiscal year.

If a user fee needs to be adjusted upwards, the policy recognizes the importance of rate stability for the user base. If the adjustment is dramatic, it may be phased in over several fiscal years.

ExFAB uses the following types of user fees (recharge rates):

- *Internal User Rate.* The internal user rate is used for: (a) users affiliated with UCSB, UCR or CPP; (b) users accessing the ExFAB facility under approved user proposals; (c) users accessing the ExFAB facility for other federally-funded research projects.
- *External User Rate.* The external user rate is used for all other users, including industry users pursuing proprietary research projects. The external user rate is equivalent to the internal user rate, plus a NUD (non-university differential) that is equal to the host university’s federally-negotiated indirect cost rate.

The schedule of approved user fees are posted on the ExFAB website.

5.4.2 CalPoly Pomona. The ExFAB facility at CPP will be CPP’s first shared facility. CPP will be purchasing and installing an Oxford Nanopore sequencing device to support CPP faculty research and to serve as a teaching lab for students to learn sequencing technology. CPP is also purchasing and installing high temperature incubators to expand the campus’ current capacities. CPP’s facility will be fully operational by the end of ExFAB’s first year.

5.5 Operations/staffing levels

5.5.1 UCSB Facility. The UCSB ExFAB facility is staffed by two lab managers. By the first quarter of ExFAB’s second year, the lab managers will be joined by an automation specialist. The lab managers are also supported by 2-3 ExFAB “Workshop Wizards.” Workshop Wizards are UCSB undergraduate students who join ExFAB as laboratory assistants. CNSI, where ExFAB is housed, also employs a full-time building manager who provides infrastructure assistance and support to the ExFAB facility.

5.5.2 UCR Facility. UCR ExFAB operates with four full time staff including, one project administrator, one project scientist, and two research specialists. All staff have been hired in year 1. Lab management is shared between the project scientist and the administrator, who is also responsible for communications, record keeping, scheduling, meeting organization, and assisting

ExFAB's user coordinator. Led by the project scientist, the UCR tech team (the project scientist and two research specialists) maintains and operates the facilities and executes the work needed to complete ExFAB user projects. In addition to leading the tech team, the project scientist is the technical lead for ExFAB user projects. In the initial start-up phase, staff expertise is focused on software coding, script development, data storage, and the development of data analysis pipelines. This focus on software and scripting is necessary at the outset so that these critical systems are operational prior to a ramp-up in facilities use and data generation. In year 2 and going forward, one research specialist will shift focus to lab operations to accommodate the increase in use.

5.5.3 *CPP*. The CPP facility will be managed by co-PI Jamie Snyder.

5.6 Intellectual Property Policy

The ExFAB Intellectual Property Policy (exfab.org/IPPolicy) recognizes the different categories of assets produced through ExFAB activities and the needs of its various users through the following key elements:

- *Intellectual Property Ownership*. ExFAB's host universities do not assert ownership over intellectual property developed through the use of ExFAB facilities unless ExFAB technical personnel are sufficiently involved to qualify as an inventor or author under U.S. patent law. Since the majority of users will either directly access ExFAB facilities or send detailed protocols for ExFAB staff to follow, it is unlikely that ExFAB's host universities will acquire ownership over intellectual property developed by ExFAB's external user base.
- *Protocols, Workflows and Equipment Improvements/Modifications*. To preserve ExFAB's ability to effectively serve the microbiology research community, ExFAB requires all users to provide ExFAB's host universities with non-exclusive, royalty-free, paid-up licenses to use, and authorize the use of, any novel protocols, workflows or equipment improvements/modifications within ExFAB facilities. This license does not reach through to the results generated through the use of the novel protocols, workflows or equipment improvements/modifications.
- *Physical Samples*. Except in the case of proprietary research, upon request, users are required to deposit with ExFAB a portion of any biological sample brought to ExFAB facilities, together with any sequencing, phenotyping, metabolomic or other data generated from the use of the ExFAB facilities for academic research and educational use. The samples and associated data will be retained by ExFAB for at least one year, after which ExFAB will help facilitate transfer of the sample to an appropriate depository. At the request of the depositing user, ExFAB will agree to embargo public access to the samples and related data for up to two (2) years or until publication, whichever occurs first.
- *Genetically-Engineered Microbes*. Except in the case of proprietary research, ExFAB's host universities retain the standard academic use rights to any genetically-engineered

microbes developed through the use of ExFAB facilities; however, external users remain in full control of the commercial exploitation of the engineered microbes.

- *Proprietary Research.* Proprietary research occurs when a user directly pays the full user fee to access ExFAB's facilities, rather than through an approved user proposal.

5.7 Safety

UCSB's laboratory is a Biosafety Level 1 (BSL1) designated facility that will host an integrated robotic system housed within a large anaerobic chamber. At UCR, ExFAB operates in a BSL2 certified laboratory. Laboratory safety is managed by ExFAB's technical staff, with guidance from campus Environmental Health and Safety (EH&S). The User Coordinator assures all users complete required lab safety training prior to accessing the facilities. Periodic review of ExFAB facilities and lab processes are performed by EH&S to advise on necessary safety protocols and user training. Current Standard Operating Procedures (SOP) for all equipment and processes, as well as Safety Data Sheets (SDS), and laboratory-specific Chemical Hygiene Plans (CHP) are maintained in a dedicated location (UCSB:Box folder, UCR: on-site and in a shared drive) and made available to all users to comply with OSHA's Hazard Communication Standard (29 CFR 1910.1200(g)). Prior to gaining access to laboratory spaces, users complete all necessary on-boarding and safety training. All users are required to complete Fundamentals of Lab Safety and Biosafety Training courses, provided online through the [UC Learning Center](#). Facility staff then deliver lab-specific safety training, covering the location of exits, safety documents, chemical and biohazard spill kits, eye wash stations, and fire extinguishers. Additional training requirements are identified on an as-needed basis for individual users, and as new hazards are introduced to the facility.

Access to ExFAB facilities at UCSB and UCR are managed according to campus-wide protocols for laboratory safety and security. All physical laboratory spaces are secured by centralized keycard access-controlled security systems, and users are only provided physical access to the facilities following completion and certification of all required safety training and laboratory-specific orientations. When applicable, access to laboratory equipment is managed using user-specific login credentials for workstations, assigned only after equipment training has been completed. Equipment training, usage, and access are managed with FBS, a centralized laboratory management system.

6.0 Education and Training

6.1. CSU Masters Scholars. The CSU Masters Scholars is designed to broaden the biotechnology workforce by training CSU master's students (CSU MS Scholars) in automated labs-of-the-future using the ExFAB facilities at UCSB or UCR. Each CSU Masters Scholar is embedded in an ExFAB-affiliated research laboratory at UCSB or UCR for ten (10) weeks during the summer months. The Scholars conduct in-depth research projects and participate in various professional development opportunities (leveraging existing programs on the host campus, when possible.). A mentor is assigned to each Scholar with weekly meetings as touch points. The summer program culminates with an event where each Scholar presents their research project to the broader

ExFAB community. The target population is 1st or 2nd year MS students from all CSU campuses across the state.

6.1.1. *Recruitment Cycle.* To assure top candidates, ExFAB's primary recruitment is through CSUBIOTECH, the CSU System's affinity group for biology and the life sciences. CSUBIOTECH holds an annual research symposium each January, which is attended by faculty and students from all 23 CSU campuses. ExFAB representatives attend the CSUBIOTECH research symposium maintaining a dedicated table during poster sessions and participating in special events that highlight opportunities for students. Students who express interest are added to a special ExFAB mailing list. Supplemental recruitment strategies include info sessions (Zoom and live), posting on LinkedIn and other social media channels, distribution of on-campus flyers, emails to relevant CSU labs, posting on ExFAB's website, and announcements in ExFAB's newsletter. Word of mouth also increases visibility for the program.

6.1.2. *Application Process.* A call for applications is issued in early February, a few weeks after CSUBIOTECH's annual research symposium, with a deadline approximately one month later, in early March. Throughout the application period, ExFAB sends regular reminders to apply through its various outreach channels. Students apply through a portal on the ExFAB website. Application materials include a brief application form, as well as a statement of interest, statement of research, transcripts and three letters of recommendation. The laboratories that will host the Masters Scholars are posted on the ExFAB website; applicants are encouraged to identify their preferred lab to join.

6.1.3. *Selection Process.* The ExFAB Education Team reviews each complete application to confirm eligibility and assess its strength. The Education Team then meets to select a list of finalists (a number that is approximately double the number of open slots). The finalists are interviewed by the Education Team, via Zoom, with a prepared set of questions. The education team scores each finalist against a pre-prepared rubric to determine the top candidates and alternates (who are ranked). The top candidates are then matched to host laboratories according to interests and experience and offered a slot. In the event an invitation is declined, the alternate list is used to assure all positions are filled.

6.1.4. *Program Metrics and Tracking.* For its first two years, the CSU Masters Scholars program seeks to place four (4) Masters Scholars, two (2) at each host campus. In Years three and four, ExFAB will place six (6) Masters Scholars and in years five and six, ExFAB will place eight (8) Scholars. The ExFAB Education Team will follow-up with each Masters Scholars no less than annually for three years after they participate to track the students' education and career progress. The Education Team will further monitor the progress of the CSU Masters Scholars through Linked In. The goal of the program is to matriculate Masters Scholars into PhD programs or employment in the biotechnology industry.

6.2 ExFAB Fellows Program. The ExFAB Fellows program provides research training and professional development for UCR and UCSB postdocs and graduate students who are affiliated with the biofoundry and are conducting in-house research that will develop new technologies for

the benefit of the microbiology research community. The Fellows program targets individuals who are early in their graduate or postdoctoral training but have at least one year remaining in their research. The program focuses on three primary elements: research development, professional and career development, and community.

ExFAB Fellows receive in-depth training on EXFAB's facilities and processes with strong focus on automation, either through the ExFAB Summer School program or specialized training courses tailored to the Fellows. Training sessions include exposure to industry perspective through talks by industry representatives. Fellows also participate in monthly Research Ideation Meetings during the academic year in order to exchange ideas around new research projects and problem solve project challenges and are required to participate in both innovation and professional development activities (both in person and virtually), including ExFAB's Innovate + Elevate seminar series, Innovation 360 (an 8 part series on technology translation) and the "Whole PhD" online series. Fellows are expected to submit user proposals to access the ExFAB facilities for specific research projects and to present their research findings and new technologies at the quarterly ExFAB All-Hands meetings.

ExFAB Fellows receive financial support during the period during which they are actively engaging with the ExFAB facilities, typically for 6-12 months. However, the Fellows are eligible to participate in all programming and ExFAB activities throughout their time at UCSB or UCR, even after the financial support period has ended.

6.2.1. *Recruitment.* ExFAB issues a call for applications for the ExFAB Fellows program no less than twice annually. The call for applications is announced in ExFAB's newsletter, through messages sent to ExFAB's Google Group (which reaches all ExFAB-affiliated research groups), on the ExFAB website, and through targeted communications to laboratories that are not yet affiliated with ExFAB but possess cross-disciplinary knowledge and skills that would advance ExFAB technology.

6.2.2. *Application Process.* Interested graduate students and postdocs apply to the ExFAB Fellows program through a portal on the ExFAB website. Application materials include a brief application form, as well as a statement of research, a description of the technologies they desire to develop, how those technologies will benefit the microbiology research community, and their curriculum vitae.

6.2.3 *Selection Process.* The ExFAB Management Team reviews all complete applications to select ExFAB Fellows, reviewing experience and credentials, as well as the potential impact the proposed research and technology could have on the microbiology research community. If the student or postdoctoral scholar is a member of a management team member's group, that member recuses themselves from the discussion of, or voting upon, that candidate.

6.2.4. *Program Growth and Outcome Tracking.* ExFAB will appoint at least twelve (12) ExFAB Fellows in its first year and expand to eighteen (18) ExFAB Fellows by its third year, with equal representation at UCSB and UCR. Further expansion will be dependent on research needs. Each

cohort of Fellows will complete an initial onboarding survey to solicit input on their expectations for participating in the ExFAB Fellows program (research and career-related interests). Fellows will complete a post-program feedback survey (annually, Summer) to track effectiveness of the programming elements, as well as steer future programming modifications and directions.

6.3. Summer School. The ExFAB Summer School is a one-week, intensive program at UC Santa Barbara designed to provide in-depth technical training to enable researchers to learn how to use and leverage ExFAB's unique suite of instrumentation for their own research. The 2025 Summer School will focus on "Automation in Biology" and will teach participants the basics of creating automated workflows using Thermo's Momentum Software as a testbed system, as well as how to incorporate ExFAB instrumentation into research projects. Topics include how to build workflows and schedules, and how to evaluate whether automation is worthwhile. The theme of each Summer School will change each year. There is no fee or tuition to attend the ExFAB Summer School. Course materials, lodging, and most meals are provided by the program.

6.3.1. *Recruitment Cycle*. Recruitment strategies include info sessions (Zoom and live), posting on LinkedIn and other social media channels, distribution of on-campus flyers, and targeted emails to relevant UC and CSU labs, posting on ExFAB's website, and announcements in ExFAB's newsletter. Word of mouth also increases visibility for the program. Recruitment of users from the CSU system is driven through CSUBIOTECH. Students who express interest are added to a special ExFAB mailing list.

6.3.2. *Application Process*. A call for applications is issued in early February, with a deadline approximately one month later, in early March. Throughout the application period, ExFAB sends regular reminders to apply through its various outreach channels. Individuals apply through a portal on the ExFAB website. Application materials include a brief application form, as well as a statement of interest, statement of research, CV, and a letter of support (for students/postdocs only).

6.3.3. *Selection Process*. Members of the ExFAB Education and Operations teams review each complete application to confirm eligibility and assess its strength. The teams then meet to select a list of finalists. In the event an invitation is declined, the alternate list is used to ensure all participant slots are filled.

6.3.4. *Program Metrics and Tracking*. For the first year, the Summer School will consist of ExFAB fellows, CSU Scholars, and additional students and faculty from CSU campuses. In future years, ExFAB's summer school will be open more broadly to external participants. The goal of the Summer School is to increase ExFAB's user base. Key metrics include whether participants submit user proposals and become regular users of the ExFAB facilities.

7.0 Knowledge Sharing

7.1. Communications. ExFAB employs an open communication policy. All ExFAB researchers are strongly encouraged to share research results, technologies, workflows and protocols enabled

by ExFAB through academic publications, conference presentations, and public lectures and media outreach. As part of the onboarding process, ExFAB Users agree to acknowledge ExFAB support in all of the above communications.

ExFAB directly transfers knowledge of new technologies, protocols and workflows it develops, as well as key external resources and advances in microbiology through the ExFAB's Summer School, Fellows and Masters Scholars programs, regular seminars and lectures, conference presentations, and ExFAB's LinkedIn account. Users are also taught relevant protocols and workflows during 1:1 training with lab managers during their use of the facilities.

The ExFAB newsletter, issued quarterly, announces upcoming programs and events, provides facility updates, and reports on key publications and presentations. Each issue is developed by the ExFAB Managing Director with input from the ExFAB Management Team. Interested parties can sign up on the website through a simple process. The subscriber database is maintained in MailChimp, allowing ad-hoc communications through email blasts in addition to the quarterly newsletter.

The ExFAB website (exfab.org) is the hub of all communications. It provides information about ExFAB's facilities, education and training programs, events, and policies, as well as the ExFAB leadership, staff, researchers, Fellows, and Scholars. The website is also the platform to apply to all ExFAB programs (Fellows, Scholars, Summer School, the User Program, User Grants, etc.). ExFAB uses Smartsheet to generate application forms and manage and archive submissions.

The website is overseen by the ExFAB Managing Director. The ExFAB Program and Administrative Coordinator, who reports to the Managing Director, is responsible for day-to-day updates. Content on specific programs is developed through a collaboration between the Managing Director and the team responsible for the program. The website includes a generic email, info@exfab.org, that can be directed to multiple ExFAB personnel to ensure a timely response. Contact information for key staff and the ExFAB leadership is also included on the website.

7.2 Biological Samples and Data.

Biological samples and materials sent to ExFAB facilities are managed by the host university's standard material transfer agreement policies and processes. Except in the case of proprietary research (where a user directly pays the full access fee), Users must agree to deposit a sample of any material they bring to ExFAB facilities, together with any sequencing, phenotyping, metabolomic, or other data on the material that is generated through the use of the ExFAB facility. Users grant ExFAB the right to use these materials and the associated data for any research or educational purpose. ExFAB keeps the deposited materials and data for up to one (1) year, after which the User may either deposit the material in an appropriate third-party depository that allows access for research and educational use or the User may directly provide the materials to interested researchers upon request. Users may request that access to the materials or

associated data is embargoed for up to two (2) years or the earliest publication, whichever occurs first.

8.0 Metrics of Success

As a user facility, ExFAB's primary goal is to enable science and engineering for our community and region. We will use a range of metrics to measure our success, including the number of ExFAB users, the number of students and researchers trained, and the number of training opportunities offered are key metrics to understand success in workforce development. Projects initiated, projects completed, workflows developed, and the costs of these activities will help us understand our productivity in meeting user needs. Papers published, student degrees and collaboration among the ExFAB community will be used to measure our academic productivity. IP development and new connections with the biotech industry will be tracked to help understand our innovations and our impact on the regional biotech economy. Annual user surveys will assist in understanding the facility's ease of use.

Using the anticipated project timeline (see Table 1), we aim to initiate 4 projects in year 1, each developing at least one new automated workflow. On a yearly basis, we will train at least 20 ExFAB fellows and scholars and engage an average of 3 researchers per user project. We expect that each project will generate at least one publication, a peer-reviewed work of research and/or a published protocol describing the project workflows. Year 1 data collected for user projects and outcomes of this work will help inform year 2 metrics and beyond.

9.0 Budget Guidance and Policies

ExFAB will adhere to the approved budget.

9.1.1 User Program. *Regarding* user projects, the budget allocates an average of \$7,500 in supply costs to each approved project. Project budgets will vary, and we anticipate that some high-value projects, such as those that develop new ExFAB workflows that meet community needs, will be allocated as much as \$20,000 or more.

9.1.2 Staff. Staff time will be allocated to external and internal projects, with the goal of 50% commitment to external projects by year 3. During the initial start-up phase, staff time and supplies will largely be allocated to internal projects and start-up operations (e.g., protocol development, validation, and optimization), transitioning to a larger focus on external projects as they come on-line.

9.1.3 Equipment. We anticipate potential changes to the equipment budget as ExFAB adjusts capabilities to meet user needs. Regular equipment maintenance and vendor warranties help minimize the risk of increased costs due to equipment failure, but repair costs may require changes to the budget. In the event that the equipment budget is underspent in a given year, the carryover will be saved and used toward future equipment repairs, capacity expansion, or the

acquisition of new equipment. Similarly, carry over in user project funds will be used for additional projects in subsequent years.

9.1.4. *Program Income.* Program income will be realized primarily when users pay the recharge rate for proprietary research. In accordance with applicable federal and UC policy, program income is reinvested in ExFAB through equipment purchases, graduate student support, additional user projects, and other activities that help achieve ExFAB goals.

9.1.5. *Ongoing Oversight.* Potential changes to the budget will be discussed with the PI and co-PIs, with advice from the Managing Director on a case-by-case basis. Significant changes in the budget (e.g., acquisition of new equipment valued at \$50K or more) will require approval of the majority of the PI and co-PIs. This approval process is in place to ensure broad agreement in the use of ExFAB resources.

10.0 Sustainability Plan

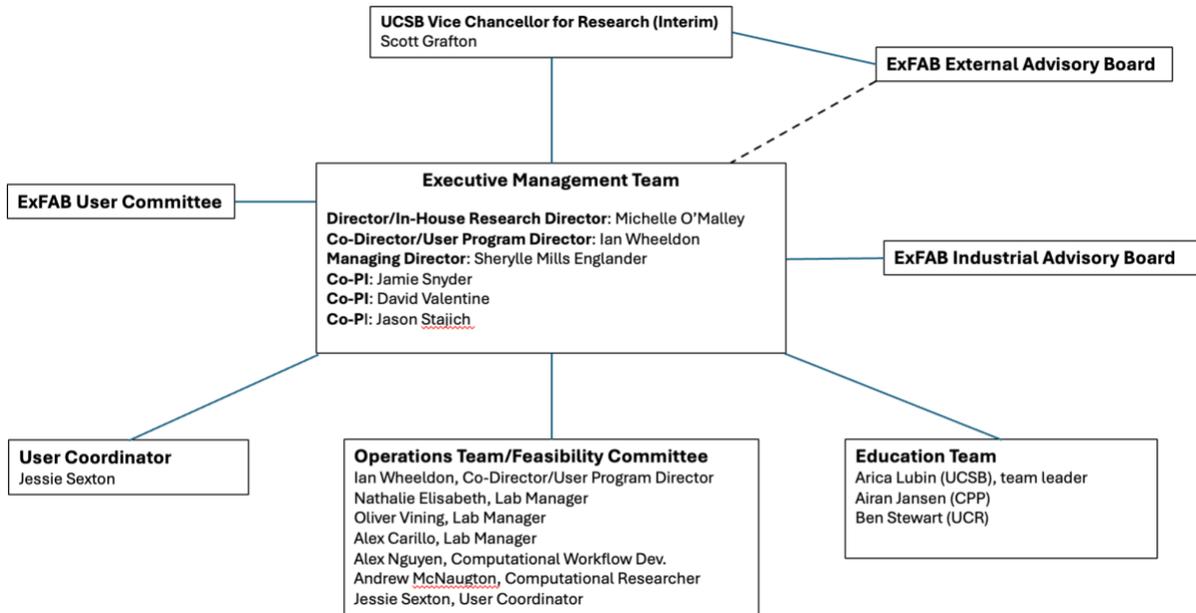
The research and training goals of ExFAB are synergistic with a sustainability plan. ExFAB seeks to create a robust user base comprised of users external to ExFAB, industry users, and internal users from all three of ExFAB's campuses. Through the various feedback mechanisms outlined above (see section 5), ExFAB will offer services and workflows that meet users' needs, needs that will continue past the end date of NSF funding. To sustain ExFAB research capabilities, ExFAB is establishing cost-competitive recharge rates for workflows and equipment use. These recharge services are anticipated to generate income that supports the user facility at the end of the grant period. To this end, as of May, 2025 UCSB has established recharge rates for installed equipment. UCR has established a recharge rate for DNA library preparations that is substantially lower than core facilities across the University of California system, thus providing a competitive advantage. ExFAB will also seek out industry-sponsored research. By understanding and meeting the needs of our industrial partners, we anticipate sustainable income through industry-sponsored research. In addition, ExFAB PIs and users will leverage ExFAB capabilities to support the successful submission of new grants targeting research collaborations, workforce development, and research translation and commercialization in response to relevant federal, state and nonprofit funding calls, as well as philanthropic organizations.

11.0 Revision History

May 27, 2025: Original Version

APPENDIX 1

EXFAB ORGANIZATIONAL STRUCTURE CHART



APPENDIX 2

EXTERNAL ADVISORY BOARD MEMBERS

Name	Title	Organization	Expertise
Dr. Carrie A. Ekert	Synthetic Biology Group Leader	Oak Ridge National Laboratory	High throughput methods for genotype-phenotype discovery for applications in metabolic engineering of microbes.
Dr. Nathan Hillson	Computational Senior Staff Scientist	Berkeley Lab	Development of experimental wetware, software, and laboratory automation devices that facilitate, accelerate, and standardize the engineering of microbes.
Dr. Trent Northern	Senior Scientist	DOE Joint Genome Institute	Development of mass spectrometry and fabricated ecosystem approaches to study processes by which microbes interact to harness microbes for sustainability applications.
Dr. Ikhide Imumorin	Executive Director, CSUBIOTECH	Cal State University, San Diego	Leader in CSU System for biotechnology education; research background in genetics and genomics.
Dr. Michael Koepke	Chief Innovation Officer	LanzaTech	Responsible for LanzaTech's genetic engineering and automation platforms and strain development programs.
Dr. Caroline Ajo-Franklin	Professor and Director, Rice Synthetic Biology Institute	Rice University	Applies biophysics and synthetic biology to engineer the nanoscale interface between living microbes and inorganic materials, with applications in carbon capture and sequestration and bio-solar energy.

Dr. Arye Lipman	General Partner	Mars Bio VC	Investor focused on synthetic biology and materials science with deep ties to Los Angeles investors and accelerator programs.
Dr. Jens-Uwe Kuhn	Dean of Math and Sciences	Santa Barbara City College	Chemist and microbiologist with deep experience with preparing students to seek advanced degrees and engage the research environment.
Dr. Claudia Schmidt-Dannert	Distinguished Professor and Director, Biotechnology Institute	University of Minnesota	Design of self-organizing systems from genetically encoded protein building blocks for applications in biocatalysis, biosynthesis and functional materials, including the engineering of microbial cells to produce living materials and biocomposites as well as synthetic biofilms.

APPENDIX 3

ExFAB Internal Research Subcommittees

Bioremediation

ExFAB team: Valentine, Greene, Men, O'Malley, Santoro, Wang

Goals: In the presence of manmade pollution and contamination, many natural microbial communities adjust to and begin to thrive in the new harsh environment. One research focus of ExFAB is to collect, identify, phenotype, study, and ultimately engineer these microbial communities to advance biotechnology using microbial systems sourced from soil to the sea.

Biosynthesis

ExFAB team: Wheeldon, O'Malley, Stajich, Mills, Wilson, Lonardi, Borkovich

Goals: The research of this theme exploits novel phenotypes of extreme microbes to design and realize strains that can efficiently convert low-cost and waste carbon sources into high value and commodity chemicals. Automated culture manipulation and environmental controls provided by ExFAB infrastructure support microbial phenotyping and transformation to engineer strains across multiple species for biomanufacturing applications.

Rules-of-Life

ExFAB team: O'Malley, Hanein, Volkman, Borkovich, Volland, Snyder, Rothman

Goals: Research captured in this in-house theme focuses on understanding the rules of life through extreme examples of microbiology by integrating the knowledge learned in functional genetic studies of extreme microbes and in our application-oriented research. In particular, a key goal of ExFAB is to identify and characterize microbes that host non-conventional compartments (e.g. prokaryotes with nuclei), novel pathways and energy generation mechanisms, and feature unique ultrastructures that alter our conventional understanding of cellular life.

APPENDIX 4

ExFAB UCSB INSTALLATION TIMELINE

	Equipment	Ordered	Delivered	Installed	Open Use
Integrated	Anaerobic Enclosure		06/25	06/25	07/25
	Robotic system			07/25	07/25
	PlateLoc (Plate sealer)				
	Xpeel (Plate peeler)			07/25	07/25
	Echo 525 (Liq handler)				
	Fluent 780 (Liq Handler)		06/25	07/25	07/25
	Multidrop (Liq Handler)			07/25	07/25
	4x ATC (Thermocyclers)			07/25	07/25
	Ultra Seal Pro (Plate sealer)			07/25	07/25
	2x Cytomats (Incubators)			07/25	07/25
	Cytoflex S (Flow cytometer)				07/25
	HiG4 (Centrifuge)			07/25	07/25
	Cytation C10 (High content Imager)				
	Offline	Optima XE-90 (Ultracentrifuge)			
5300 Fragment Analyzer					
Orbitrap Ascend Tribrid (MS)					07/25
TSQ Altis Plus Triple Quad (MS)					
ISQ7610 GC (MS)					
UIP400MTP (Sonicator)		TBD			
BioSorter (Large particle sorter)		TBD			
Aurora CS (Sorter)		TBD			
Bruker Neoflex MALDI (MS)			06/25		

 : Completed task

MM/YY : Estimated date of completion

TBD : To be determined