Chancellor’s Advisory Committee for Life Sciences (CACLS)
Spring 2021 Report

May 17, 2021 Executive Summary:
Answering the charge of the Vice Chancellor for Research at the start of Spring semester 2021, CACLS explored the critical issue of what shared facilities are essential to assure Berkeley’s leadership in 21st Century life sciences, with an eye towards issues whose immediate attention will have the most impact on our future excellence. CACLS members collected survey data at the department level about such needs and in our spring meeting we collectively consolidated the ‘long list’ to a short list of extremely high priority areas, each of which tie into the [2020 CACLS Vision for Hubs of Cluster Hires Across Biology]. The CACLS co-moderators, together with Tiff Dressen (VCRO), then conducted interviews with relevant campus stakeholders to refine the scope of the challenges and associated opportunities for surmounting the same. Below we summarize our findings, including a proposal for a new Climate Change Core Facility designed to address current infrastructure gaps, while mobilizing significant existing research strengths for sustainable excellence.

Animal Research Infrastructure

One of the most critical infrastructure needs on campus relates to the animal facilities. These are central to the biological sciences (and some social sciences e.g. psychology) and have reached a state where in the absence of immediate attention, the ability to hire new faculty and retain existing faculty—and thus maintain Cal’s excellence in multiple fields ranging from immunology to cancer biology to neuroscience— are directly threatened. Our animal facilities should be tied to donor-based fundraising, as they are needed for translational and intellectual property-related work on campus, including *in vivo* CRISPR and gene editing projects, drug screening and immunotherapy, as well as ecological and behavioral studies.

The current challenges are twofold. First, space constraints are severe and thus new facilities are an imperative. Second, the existing facilities are in dire need of upgrades to address user-specific requirements (e.g., for behavioral, pathogenesis and imaging research) and replace outdated equipment (e.g., HVAC systems, fans and generators to protect against rolling power outages). Layered into these challenges are prohibitive upfront costs -- both in time and in funding -- associated with Capital Projects. Even getting the required estimates to put in infrastructure grants to fund improvements is costly; for example, Capital Projects needed $40,000 and nearly 1 year to make an assessment for an animal facilities-related infrastructure grant. Campus may be able to remove or lessen this and similar barriers to data-informed fundraising.

In the absence of immediate construction of a new facility, three potential stopgap solutions to the current situation were identified. In order of favorability, these solutions include:

1. Increase space either by renovating existing space not currently used for animals (e.g., the large facilities space in the Weill Hall basement) and/or moving certain types of animals (e.g., bats, birds) to remote locations like the Richmond Field Station or LBNL. Note that movement of

animals off-site has been explored in the past and found to be problematic due to procedural differences in addition to the major inconvenience for researchers.

2. Renovate existing animal facilities to increase efficiency. For example, there are a series of small rooms in the NAF for observational work that do not get used to full capacity and could be repurposed to increase animal storage. There are also old ‘cold boxes’ that could be removed from the facilities in the basement of Weill Hall (at a cost projection of $50,000 from Capital Projects). For Minor Hall which is at 100% capacity, the simple removal of 4 large cubicles that are no longer used would double the mouse capacity in that facility.

3. Impose restrictions on animal use space to a certain maximum (e.g., 1,000 sq ft) for each faculty member. Such restrictions exist in other institutions with space issues. Additionally, a comprehensive audit of space may reveal a minority of faculty who are ‘holding’ onto space they are not actively using. While these changes may recover some space, the perception is that significant space recovery would not be realized and imposing space limits could be problematic for recruitment promises.

Plant and Climate Change Research Infrastructure

A second area of critical need is modern plant growth and phenotyping facilities. A growing number of faculty at UC-Berkeley are using plants to investigate fundamental questions in plant biology and ecology and to conduct translational research on food production, impacts of climate change, and biological carbon sequestration. This research is an integral part of the campus’ focus on research associated with the environment, energy, and climate. Indeed, a number of organized research units (ORU) on campus have these areas of focus, for example The Energy, Climate & Environment ORUs (https://vcresearch.berkeley.edu/energy), including the California Institute for Energy and Environment (CIEE) (https://uc-ciee.org/), the Energy Biosciences Institute (https://energybiosciencesinstitute.org/), the Climate Readiness ORU, and the Innovative Genomics Institute (https://innovativegenomics.org/).

However, the lack of adequate experimental facilities on the UC-Berkeley campus is impacting our ability to recruit and retain faculty and threatening our standing as one of the world’s top universities for studying plant biology. The Oxford Tract Greenhouse facility provides greenhouse and field space for plant growth, but these facilities are in need of upgrading, and they lack state-of-the-art instrumentation such as gas chromatographs, isotope ratio mass spectrometers, cavity ringdown lasers for greenhouse gas analyses and associated isotopic compositions. There is also no infrastructure for high-throughput plant phenotyping or even basic soil, plant, water, and gas processing facilities. Moreover, the campus completely lacks a centralized facility for plant growth and phenotyping in highly controlled environmental conditions, including elevated CO_2 concentrations and temperatures that are necessary for cutting-edge climate change research. The lack of these facilities greatly hampers identification of mechanistic drivers of patterns observed in the field and the development of solutions to major environmental problems like climate change, and, most alarmingly, it is limiting the scale and scope of plant research conducted by our junior faculty. The advent of plant genome editing using CRISPR-Cas9 technology has facilitated the generation of new plant varieties, but campus plant researchers face a severe bottleneck in their ability to perform high-throughput phenotypic measurements on edited plants. The lack of suitable facilities means that we are losing ground to competing institutions around the world that have invested heavily in plant phenotyping (https://www.plant-phenotyping.org/infrastructure_map).

The largest concentration of plant growth chambers is currently located in the basement of Koshland Hall, but this facility is badly outdated. Most of the chambers are 30-40 years old and are not suitable for the research needs of our plant biologists, especially new faculty, whose research is increasingly focused on plants other than *Arabidopsis* (the fruit fly of the plant world). Plant research on campus, both fundamental and translational, is now being conducted with rice, wheat, maize, sunflower, and a variety of other crops and wild species.

We propose upgrading of instrumentation and phenotyping capabilities at the Oxford Tract and creating a centralized, controlled-environment plant growth facility for the campus in Koshland Hall. These facilities would serve plant researchers across several departments, units, and colleges (e.g. PMB, ESPM, IB, IGI, BioE, ChemE, Chemistry, and JBEI). To fully realize the opportunities and importance of environment, energy, and climate research to solve critical issues for the future livelihood of the Earth, upgrading and extending these plant growth and climate change facilities should be a high priority for the campus. Reframing how upgrading and expanding these facilities are essential to solving environmental and climate crises could be an avenue to obtain donor support.

Data Handling and Storage Infrastructure

The flow and storage of data is central to the success of the modern research enterprise, especially at a premier university like UC Berkeley. As we look to the future, the collaboration desired and (quite frankly) required to drive the convergence of fields hinges on updated and expanded data infrastructure. Such world-class, secure, dependable infrastructure is a perfect example of campus resources required to dissolve siloed disciplines and investigator-initiated research. We see interdisciplinary research as an emerging strength for UC Berkeley, of great animating interest to researchers across the campus, and a must-have to keep pace with our peer institutions.

Unfortunately, there is urgent concern that the data handling infrastructure of our campus is not up to the task of supporting modern biological research, including imaging and sequencing among other data-intensive endeavors. The concern is particularly paradoxical, given the tremendous attention and emphasis on data sciences on our campus. The data handling infrastructure is in need of cohesive leadership, strategic directions, and resources to keep UC Berkeley at the forefront of science.

In assessing the major gaps in data infrastructure, a handful of areas where attention would yield notable improvement to maintaining our edge as a destination for top researchers:

- Leadership and strategic direction in cyber infrastructure may be missing entirely, but is at the very least not apparent among the scientific staff running the most data-intensive core facilities. We see the gap as reflected at the staff level, where scientific staff are neither empowered, trained, or expected to prepare grant applications to fund expansion or enhancement projects. In one counter example, our discussions with QB3-Berkeley pointed to serious professional staff enrichment training and empowerment regarding grant applications for the most modern tools and capabilities;

● Emerging interdisciplinary research is driving the demand for enhanced and updated data infrastructure. Bridges between microscopy, life sciences, and data sciences are needed and -- while there are examples of success -- these key interdisciplinary efforts are not 'at scale' here yet;

● Generating financial resources to make the infrastructure upgrades and enhancements has not yet seen the needed success. While infrastructure proposals have been submitted, UC Berkeley may be missing a sustained effort in both identifying opportunities and supporting the grant writing necessary to make the science possible. There may be rare opportunities that arise if the campus considers data handling as core infrastructure, the lifeblood of our core facilities. Opportunities such as those from the State of California's investment in the UC system and at the Federal level should be pursued.

Each observed gap presents an opportunity to not just remedy the overarching challenge, but to invent new ways to address critical data requirements for fast-moving scientific research demands. One example solution would be for the VCRO to offer seed funds to support grant application development teams including PIs who have the vision and motivation to create data infrastructure strategy for UC Berkeley. To align with CACLS FAll 2020 suggestions, the seed funds could focus around each of the suggested 'convergence' hubs (animals, plants, data), working with the BRDO, and building a path for the next generation of campus leaders and research frontiers.

Core facilities: staff and financial models

While state-of-the-art core facilities are necessary for Cal to maintain excellence across the biological sciences, equally important are the talented scientific/technical staff whose expertise and state-of-the-art know-how serve to maintain and, in many cases, enhance core facility capabilities. As well, core facility staff are the primary trainers for the next generation of student and postdoctoral researchers. Retaining talented core facility staff is a perennial challenge at Cal where University salaries simply cannot compete with industry. Core facilities must remain competitive in an environment where costs are increasing and budgets are flat. Additionally, core facilities are expressly prohibited from "banking" any funding derived from recharges. To clarify, recharge covers only ~ ½ the cost of core facility expenses; the other ½ must come from other sources. One potential source of income could be derived from increased 3rd party users (who pay market rate) for use of campus core facilities. What is the capacity for such 3rd party users? Are there "seats on the plane" that could otherwise be filled by 3rd party users? We might benefit from knowing more about how other public universities manage such challenges. The next iteration of CACLS could do a deeper dive into exploring other financial models for core facilities including an analysis of our public peers.

CACLS Membership Spring 2021:

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