



UC DAVIS

Mouse Biology Program

Annual Stakeholder Report 2018-2019

Launching the Next Decade of Service

As we enter our 21st year of operation, it is time again for us in the UC Davis Mouse Biology Program (MBP) to highlight our many accomplishments, scientific activities, new technologies, and collaborations over the past year in support of the UC Davis campus community.

Fiscal Year Overview

This past year (2018-2019) marks two decades since the MBP, one of 17 UC Davis-designated Campus Research Core Facilities (CRCF), first started serving the mouse modeling needs of campus researchers. The MBP remains the only one-stop in-house research resource of unique expertise, services, and training in the creation, testing, and application of mouse models to study human biology and disease. From the latest in CRISPR/Cas9 genome editing, to advanced *in vivo* imaging technologies, the MBP is at the forefront of developing precision mouse models to catalyze human and animal health research. Our efforts have helped position the UC Davis brand as an international leader in mouse genetics.

New PET/MRI Scanner at MBP



In partnership with the CMGI, we are pleased to announce the launch of our newest service, simultaneous PET/MRI imaging, using the SimPET M7 scanner (Aspect Technologies), one of only 4 instruments of its kind in the world. This new service combines functional with anatomic imaging in one convenient process. Now installed within our Phenotyping and Analytics Center, the scanner will be up and ready for broad use by late 2019.



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Our Vision

Our vision is to *catalyze* the development of mouse models to *accelerate* biomedical research that *advances* both human and animal health.

We also seek to *cultivate* an innovative environment that *encourages* technology development, *breakthrough* discoveries, exciting partnerships, and *strategic* collaborations.

Training, Education and Outreach

Training – The MBP provides an incomparable environment for experiential learning and technical training in many areas of mouse biology. Last year we hosted a high-school student from the UC Davis Young Scholars Program, veterinary technician students enrolled at Yuba City College, and two pre-vet undergraduate student researchers. To date, more than 165 high school, undergraduate, graduate, and professional students in medicine and veterinary medicine have interned at MBP in order to gain valuable experience in laboratory animal medicine, molecular biology, bioinformatics, and more.

Education – As an academic based program, the MBP contributes to the UC Davis teaching and education mission by contributing lectures and symposia on the latest developments in molecular manipulation of the mouse genome, veterinary care of laboratory animals, and more. This past year our senior staff taught lectures in several courses including *Clinical Applications for Biomedical Device Design* (BIM 171), a first year seminar course entitled “*Stem Cell and Genetic Engineering*”, and the “*Methods Course*” component of the Mentored Clinical Research Training Program (MCRTP). MBP scientists served as guest speakers and served on academic and industry panels at over a dozen conferences nationwide and internationally.

Outreach – Our outreach director, Dawn Rowe, has worked tirelessly to broaden awareness about the MBP on local, regional, national and international levels. She has revitalized our social media efforts, resulting in a four-fold growth in followers, and created a framework for monthly program and service announcements to the UC Davis campus community, including participating in annual research fairs. events on the UC Davis and Health System campuses.



Representing UC Davis Around the Globe

As a founding member of the International Mouse Phenotyping Consortium (IMPC), the MBP contributed mice and data for over 150 new gene knockout models last year to the creation of a comprehensive catalogue of mammalian function. Of particular note is a group of 52 genes, 35 of which previously unknown, that affect both skin and eye organ systems. According to lead scientists Ala Moshiri and Bret Moore, both from UC Davis, the majority of these genes are likely to cause similar problems in humans (*Nature Sci Reports*, 2019).

External Collaborations

On the private sector front, MBP external collaborations have continued to grow. This past year we collaborated with and provided research services to 4 industry and 6 non-profit clients outside UC Davis in the areas of cancer, metabolomics, neurodegenerative diseases (e.g. Alzheimer’s), aging, and cardiovascular disease.



Committed to the Campus’ Green Lab Goals

MBP became the first multiple laboratory/office space to receive consolidated certification by the UC Davis Green Labs Program. This program helps campus laboratories adopt sustainable practices that

help to reduce their carbon footprint. MBP staff took a number of “green” steps in freezer management, water conservation,



fume hood monitoring, electricity consumption reduction, and waste recycling. Home also to the first “green” mouse vivarium, we are leading the way as a model of sustainable and environmentally friendly practices for animal-focused research laboratories.

New Services and Projects

Biostatistics Consultation – Lihong Qui, MS, PhD, and Associate Professor in the Department of Public Health Sciences, has joined MBP as our new biostatistics consultant, providing MBP clients with statistical expertise in study design, analysis, and interpretation.

Gnotobiotic Mouse Resource Center (GMRC) – After a year of validation tests and procedures, we have now established breeding colonies of axenic (germ free) C57BL/6NTac, BALB/C and Swiss Webster mice in the MBP GMRC. As the only gnotobiotic mouse core facility at UC Davis, we are ready to offer assistance and support for handling, management, and manipulation of experimental (e.g., microbiome research) germfree mice.

Modeling Human Genetic Variation – In association with clinicians and staff in the UC Davis Division of Genomic Medicine, and the Undiagnosed Disease Projects at Stanford University and UCLA, the MBP has begun targeted phenotyping of mouse models that recapitulate unique genetic variants identified in more than 20 human patients. This service aims to contribute to the diagnosis of pathogenic genetic variants in order to help inform clinical decision-making.

PDX and PetDX Services – The MBP continues to create, maintain, and assess human patient-derived xenografts (PDX) and pet-derived xenografts (PetDX) cancer models. Last year we successfully generated PDX models from more than 15 freshly harvested or previously passaged tumors, with a >90% overall success rate.

Microbiome Fecal Collection Kits – To facilitate microbiome studies in mice, the MBP has created a Fecal Collection Kit for investigators to use for taking and preserving fecal samples from mice during experiments. After collection, investigators can just drop the kit in the mail or off at our laboratory for 16s or metagenomic analysis.

The MBP is now considered an “approved vendor” by 32 academic institutions across the nation, making us one of the largest providers of mutant mouse related products and services in the world.

IT Launches Upgrades & New Help Desk System

This past year we launched two large IT projects. First, we expanded our total active data storage to 39 terabytes in order to accommodate additional data from our enhanced imaging and immunophenotyping projects, and increased our backup storage capacity to 80 TB.

We also introduced a new issue tracker and management platform for our Help Desk system which supports our continued commitment to pinpoint bugs and code errors quickly and efficiently.



Staff Resources and Development

With a dedicated and motivated team of ~110 scientists, technicians, staff, and students, the MBP continues to attract top-tier talent. This past year we had staff members who reached career milestones of 10, 15 and 20 years with the MBP.



We are also proud to have served as a training environment for former staff who have left to enroll in graduate programs in nursing, veterinary medicine, podiatry, health sciences, and medical school. Just this summer, we said goodbye to our own Julia Zavala who started at the MBP as an undergraduate student, was hired as a vivarium assistant, and left the MBP to attend Harvard Medical School this Fall.

Building Collaborations Through Staff Events

Our staff-run Social Committee organized and sponsored in-house events and external activities that fostered intra-programmatic communication and camaraderie. Big highlights this year were our 20th Anniversary Open House BBQ and TODS event. Our activities also supported the local community, including the homeless, animals in need, and mental health organizations.



Budding young scientists showing their mice at this year's TODS event.

Research and Innovation Briefs

Research and innovation is front and center at the MBP. This past year we performed research services for 828 researchers, 75 right here at UC Davis. As a result, MBP was co-author and/or acknowledged on 141 peer-reviewed scientific publications, including in *Nature* and *Science*. A few of our research highlights include:

- Efficiencies in zygote electroporation of Cas9 protein with pgRNA have increased project success to greater than 90% while decreasing mouse use 4-fold.
- Innovations in the use of single stranded DNA oligos (ssODN) to generate conditional alleles and medium size (up to 2kb) insertions by CRISPR-mediated homology directed repair (HDR).
- Development of a nuclear DNA fragmentation index (DFI) using a modified TUNEL assay to measure and monitor quality and fertility of frozen-thawed sperm from genetically-altered mice.
- Application of CRISPR/Cas9 gene editing technologies to higher order animal models, including non-human primates.
- Improved bariatric surgical techniques and post-operative care for mouse models of obesity (*J Comp Med*, 2019).

Rat Research Services Growing

Our research support efforts have made great strides on projects and grants in the areas of gnotobiotics, bariatric surgery, and pharmacokinetics. Over the past year, the MBP managed two new rat colonies at Meyer and Tupper Halls, and our vivaria staff managed 27 rats used for developing a new method of vaccine delivery. In addition we successfully created and managed Roux-En-Y gastric bypass models in rats.



Newborn CRISPR rats.

MBP—MIND Institute IDDRC Collaboration

We are excited to announce our newest collaboration, finalized this past year, with the Intellectual and Development Disabilities Research Center (IDDRC) at the UC Davis Mind Institute. This initiative provides subsidized and prioritized access by IDDRC members to MBP services (e.g., gene targeting in murine ES cells, CRISPR/Cas9 genome editing, etc).



MBP Division Updates

Information Services – provides and maintains all informatics, database management, and data tracking services for the MBP. Last year the division supported 42 terabytes of research data consisting of 10.3 million files, including a subset of 1.8 million high resolution images using 27 terabytes of storage.

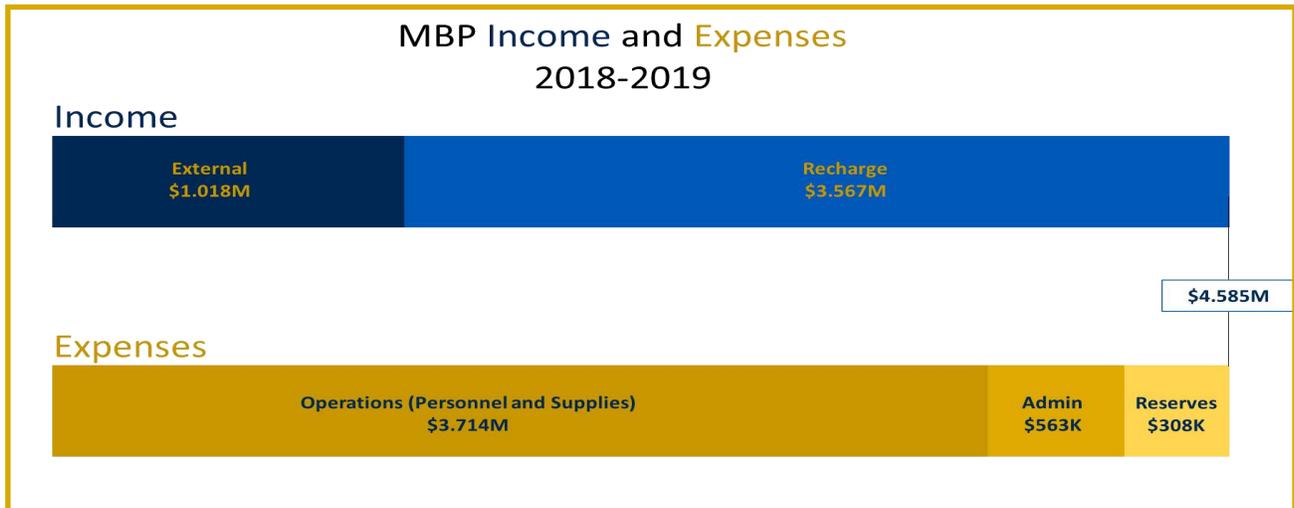
Laboratory Operations – includes four science and service laboratories that conduct transgenic, gene targeting, genome editing, artificial reproduction (e.g., IVF, ICSI), embryonic stem (ES) cell culture, embryo manipulation, genotyping, cryopreservation, rederivation, and more. Last year the division performed 67,449 services for 168 investigators, including 36 at UC Davis, generating more than 225 mutant mouse models by ES cell gene targeting and CRISPR-mediated genome editing.

Phenotyping and Analytics – provides a full suite of *in vivo* and *ex vivo* testing services to screen, identify and characterize the pathophysiological consequences of genetic mutations and other in-life manipulations in mice. The division conducted over 50,000 phenotyping and analytical tests on hundreds of mice, and generated several new PDX/PetDX mouse models for cancer researchers.

Projects and Repository Management – provides customer concierge and project navigation and management services, conducts all client communications and collaborator relationships, manages the biorepository, performs billing and recharge, and much more. Last year the division processed 1,030 orders for 8,608 products, addressed 2,075 import/export requests, and provided management support for ~50,000 services. The division responded to 3,745 phone calls and 82,000 emails requesting customer and technical service, and helped 1,060 researchers navigate, obtain, and use MBP products and services.

Vivaria and Veterinary Care - operates and oversees four mouse vivaria – a high containment shower-in barrier (M3), a restricted access specific-pathogen free vivarium (Second Street), importation quarantine (M1), and a new gnotobiotic facility (GMRC), as well as overseeing MBP rat colonies housed on campus. Last year the division cared for 120,004 rodents and fulfilled orders for more than 7,602 mice and 4,115 services, many of which at a lower price than in previous years.

MBP Financial Statement



Priorities for Next Year

- Launch projects using the dual PET/MRI scanner.
- Renew campus investment in MBP as a vital research, education, and service resource at UC Davis.
- Expand mouse modeling of human genetic variation to guide clinical decision making in patients.
- Develop improved methods for knockin of moderate to large size alleles using CRISPR-Cas9 in mouse zygotes.



MBP Vivarium Staff "mouseketeers" celebrating our 20th anniversary.

Contact Us

For more information about our products and services, please contact us by phone, email, on the web, or in person.

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