HEALTH
UNIVERSITY OF UTAH

2019 Annual Report

HSC CORES
UNIVERSITY OF UTAH

HSC CORES

ADMINSTRATION

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HSC CORES Facilities

Overall Financial Summary

Revenue & Expenses

- HSC Core Facilities budgeted $7.43 million for FY19, with expenses totaling to $7.46 million. Approximately $4.46 million in expenses went to salaries and benefits while $2.99 million was spent on equipment and operating supplies.
- In FY19, $5.09 million in services were billed, and collected from all units combined. An overhead fee of 5% ($254,256) was used for administrative support.

Core Research Facilities

Core	FY19 Expenses	Total Revenue	SVPHS	VPR	RIF
Administration	$762,675	$766,940	$513,000		
BIDAC	$123,539	$135,830	$40,000		
Cell Imaging	$367,758	$477,416	$235,000		
DNA Peptide	$353,831	$320,996			
DNA Sequencing	$355,439	$374,480			
Drug Discovery	$143,700	$121,279	$80,000		
Electron Microscopy	$641,503	$755,382	$20,000	$50,000	
Flow Cytometry	$503,334	$592,346			
Genomics	$220,473	$289,027			
Machine Shop	$297,130	$314,773	$87,500		
Mass Spectrometry & Proteomics	$686,016	$667,347	$559,000		
Metabolic Phenotyping	$214,181	$254,615	$75,000		
Metabolomics	$657,310	$569,939	$240,000	$21,702	
Mutation Generation & Detection	$134,797	$116,726	$15,000		
Nuclear Magnetic Resonance	$106,606	$141,766	$100,000		
Small Animal Imaging	$281,631	$284,455	$50,000	$100,000	
Small Animal Ultrasound	$41,139	$30,674	$10,000		
Zebrafish	$523,249	$471,413	$137,000	$10,000	

Service Recharge Centers

Service Recharge Center	FY19 Expenses	Total Revenue	SVPHS	VPR	RIF
Genetics Science Learning Center	$676,823	$777,205			
Iron & Hematology	$23,144	$24,042			
Material Sciences-Engineering	$59,792	$71,440			
National Center Veterans Studies	$45,323	$108,252			
Nuclear Engineering	$3,460	$3,412			
Scalable Analytics & Informatics	$77,036	$155,442			
Transgenic Mouse	$602,804	$656,161	$435,118		
UTAH Center Genetic Discovery	$388,767	$179,984			

Cores Administration

Overview

The Health Sciences Center (HSC) Core Facilities operate administratively reports to Dr. John Phillips, who reports to Dr. Will Dere. The administrative office is managed by Ms. Brenda Smith, with assistance from Ms. Audrey Gallagher, Ms. Terra Curley, and Mrs. Sovanna Behrmann. Responsibilities of the Core Administration office include - personnel management, budget preparation, financial affairs, ordering of supplies, and tracking expenses for all 26 Core Facilities and Service Recharge Centers. In addition, the Administrative Core supports general research infrastructure for the community, e.g. maintaining the X-ray film developer in the SOM and the research irradiator logging and access requests. All cores and recharge centers operate on a charge-back basis, with the Administration Core recovering 5% of the revenue collected for these billing and collection services. The management of the administrative office is performed by the HSC Core Advisory Board.

Personnel

- John Phillips, Ph.D., Director HSC Core Facilities
- Brenda Smith, Director of Finance
- Audrey Gallagher, Administrative Manager
- Terra Curley, Accountant
- Sovanna Behrmann, Administrative Officer

2019 Annual Update

- In FY19, the Cores Administration office was successfully able to process billing in 1 business day even though the amount of billed revenue has increased to 26 labs. The new HSC scheduling/billing system validates chartfields with the University's CIS system which has eliminated the majority of billing errors.
- In FY19 the core billed 5.1 million; however, what is most impressive of this past year was the collection rate for billed services was **100%**. We have developed an account management system to allow each Director to view revenue and expenses in real time. The tracking system stores fiscal data so that historical comparisons between revenue and expenses can be performed as well as validation of expenses, and operational analysis.
- The two new Service/Recharge Centers (National Center for Veterans Studies and USTAR Center Genetic Discovery) are now managed through the administrative office to increase accountability and reduce expenses associated with billing and collections.
- The sixth annual retreat was held on September 14th. Approximately 100 people attended. Directors had an opportunity to discuss methods for maintaining market share, engaging researchers to provide higher quality data analysis and methods to track usage. National Center Veterans Studies, Utah Center Genetic Discovery, BIDAC, Electron Microscopy and Nanofab all made presentations showing their services.
- The electronic inventory system created for capital equipment tracking is still being heavily used by additional departments and groups in Health Sciences and Main Campus. Upgrades for FY19 allow more reporting and tracking of equipment and better access from hand held devices. As of July 2019, there are 66 Departments, and 5,494 items entered into the system. These items are located in 989 rooms across campus. The total asset value of these items is $90.8 million. This system continues to expand and is free to use by any group on campus.

Goals for FY2020

- Upgrade the electronic inventory system
- Upgrade the resource/billing system

Cores Administration Revenue & Expenses

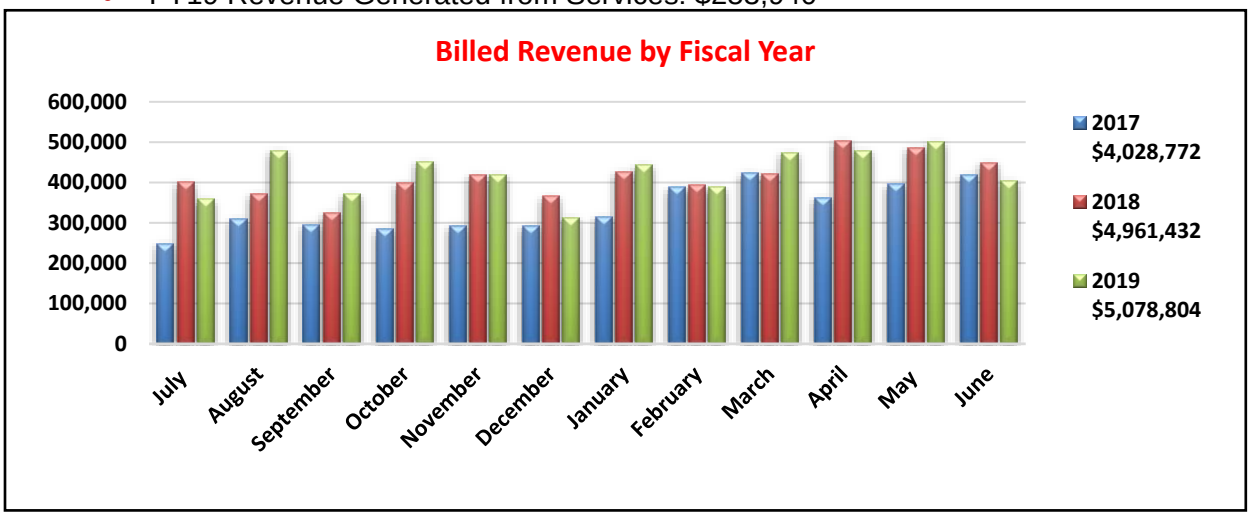
FY19 Expenses: Total $762,675

The Cores Administration Budget covers the following expenses:

- Salaries/Benefits: $530,541
- Fixed Expenses (IT Support for 73 staff, developer, x-ray, software): $135,659
- Unanticipated equipment repairs and replacement: $96,475

FY19 Revenues: Total $766,940

- VP of Health Sciences Support: $513,000
- FY19 Revenue Generated from Services: $253,940



* This represents the income from the 5% administrative fee charged to each core, based on collected revenue from billed services; legend displays 5% of annual revenue collected for each fiscal year.

Advisory Board Committee

Last meeting date: January 24, 2019

- Andy Weyrich[1], Associate Dean for Basic and Translational Sciences
- Joseph Yost[1], Professor, Neurobiology and Anatomy
- Mark Yandell[1], Professor, Human Genetics
- John Phillips[1], Director, Core Facilities
- Will Dere[1], Professor, Professor, Endocrinology
- David Stillman[1], Professor, Pathology
- Wes Sundquist, Professor, Biochemistry
- Brad Cairns[1], Professor, Huntsman Cancer Institute
- Carl Wittwer[1], Professor, Pathology
- Eric Schmidt[1], Professor, Medicinal Chemistry
- Matthew Rondina[1], Associate Professor, Internal Medicine

[1] in attendance

Addendum

The administrative core ensures that all cores maintain a regular faculty advisory committee meeting that conforms to the following guidelines:
http://cores.utah.edu/wp-content/uploads/2015/09/Faculty-Advisory-Committee-Responsibilities-2.pdf

Biomedical Image & Data Analytics Core

Overview

The mission of the Biomedical Image and Data Analytics Core (BIDAC) facility is to provide advanced medical computing, scientific visualization and data science services to research groups at the University of Utah. We offer services and consulting that range from standard image processing tasks (image registration, image segmentation…) to more advanced group-wise studies, including morphometric analysis and deep learning (artificial intelligence). BIDAC leverages the computational resources and software development infrastructure of the Scientific Computing and Imaging (SCI) Institute. In partnership with CHPC and the HSC Core imaging facilities, we are actively developing new services that are based on the needs of HSC researchers and Core users. As a resource for advanced medical computing, data science and data analytics, our goal is to further the scientific mission of the University of Utah by significantly enhancing the capabilities and competitiveness of HSC research laboratories.

Services

BIDAC offers a range of services including consulting, training, image processing, image analysis, image visualization, workflow development, software prototyping, and algorithm development.

Main services that have been developed and/or used during FY2019 include:

- **Deep learning analysis (artificial intelligence) for biomedical image classification, regression and segmentation.** We have been developing expertise in applying, comparing and fine-tuning state-of-the-art Convolutional Neural Networks (CNN) to enable robust biomedical image classification and/or image regression.
- **Big data engineering workflow for inpatient and outpatient medical imaging, enabling subsequent machine learning analysis.** In partnership with researchers from Radiology, the Enterprise Data Warehouse (EDW) and the Center for High Performance Computing (CHPC), we have developed software and hardware infrastructure to support secured data transfer (from the hospital PACS), HIPAA-compliant data storage and data management of large radiological datasets to enable deep learning and natural language processing analyses. Clinical studies of interest focus on retrospective 2D chest X-ray and 3D CT images.

Personnel

- Clement Vachet, Director

2019 Annual Update

Grant Support - BIDAC performed preliminary work and/or provided letters of support for the following grant/contract submissions:

- NIH R21 – Tolga Tasdizen, PhD, Dept. Electrical and Computer Engineering
- DOD BHSAI sub-contract – Ken Monson, Dept. Mechanical Engineering
- NIH R21 - Josh Bonkowsky, Dept. Pediatric Neurology

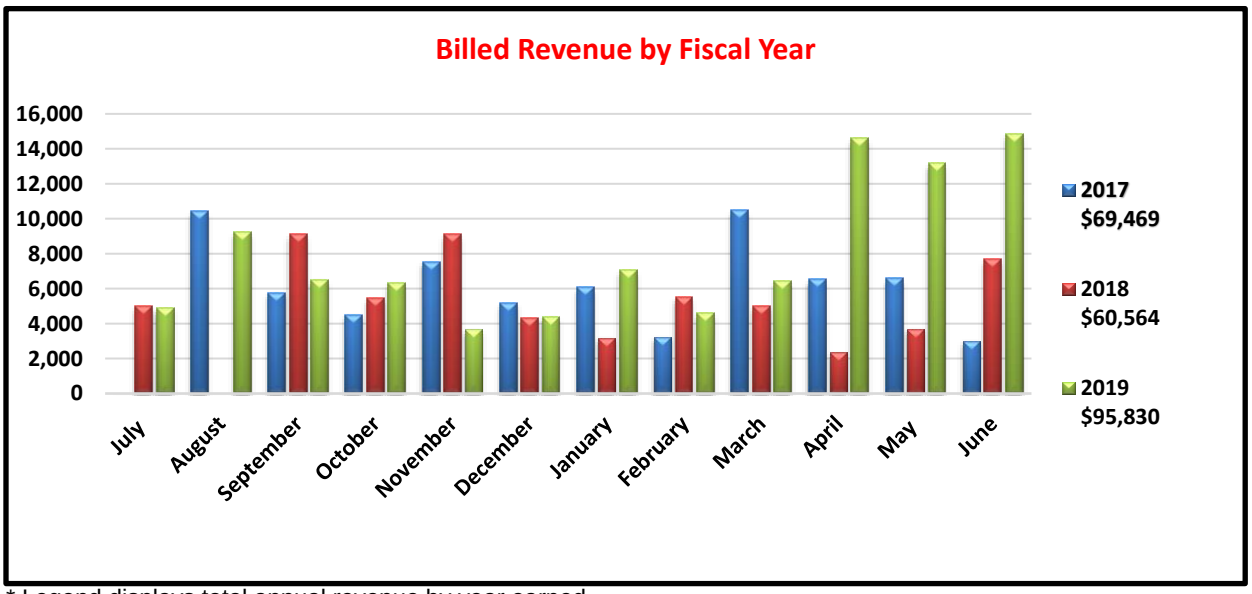
Inter-disciplinary collaborations - projects to enhance imaging capabilities have been performed with the Center for High Performance Computing (CHPC) and with several Health Sciences Cores (directly or involving end-users).

Revenue/Expenses

FY19 Expenses: Total $123,539

FY19 Revenue: Total $135,830

- VP of Health Sciences Support: $ 40,000
- FY19 Revenue generated from services: $95,830



* Legend displays total annual revenue by year earned.

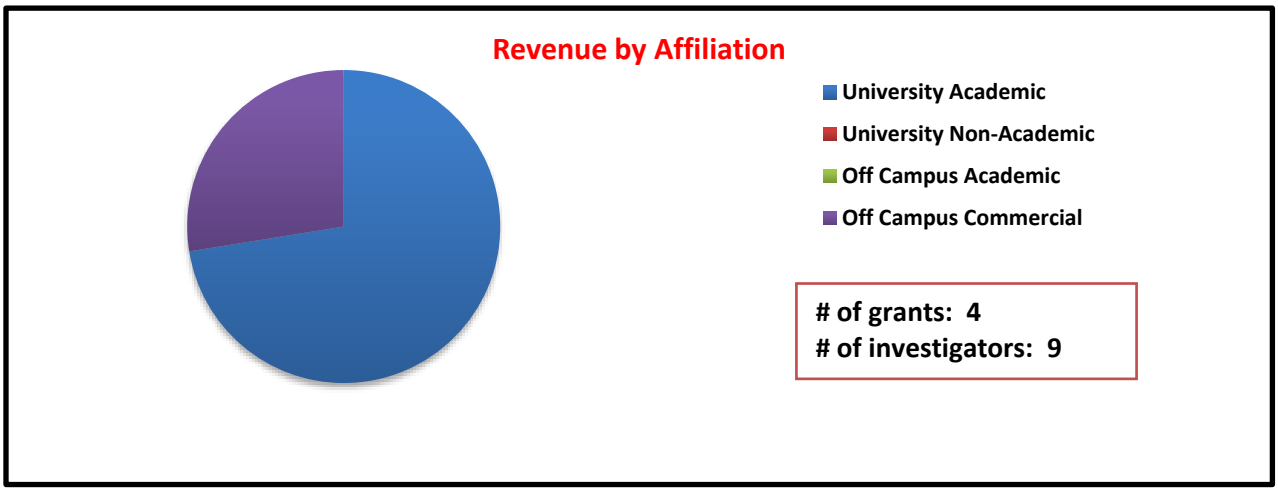
Advisory Board Committee

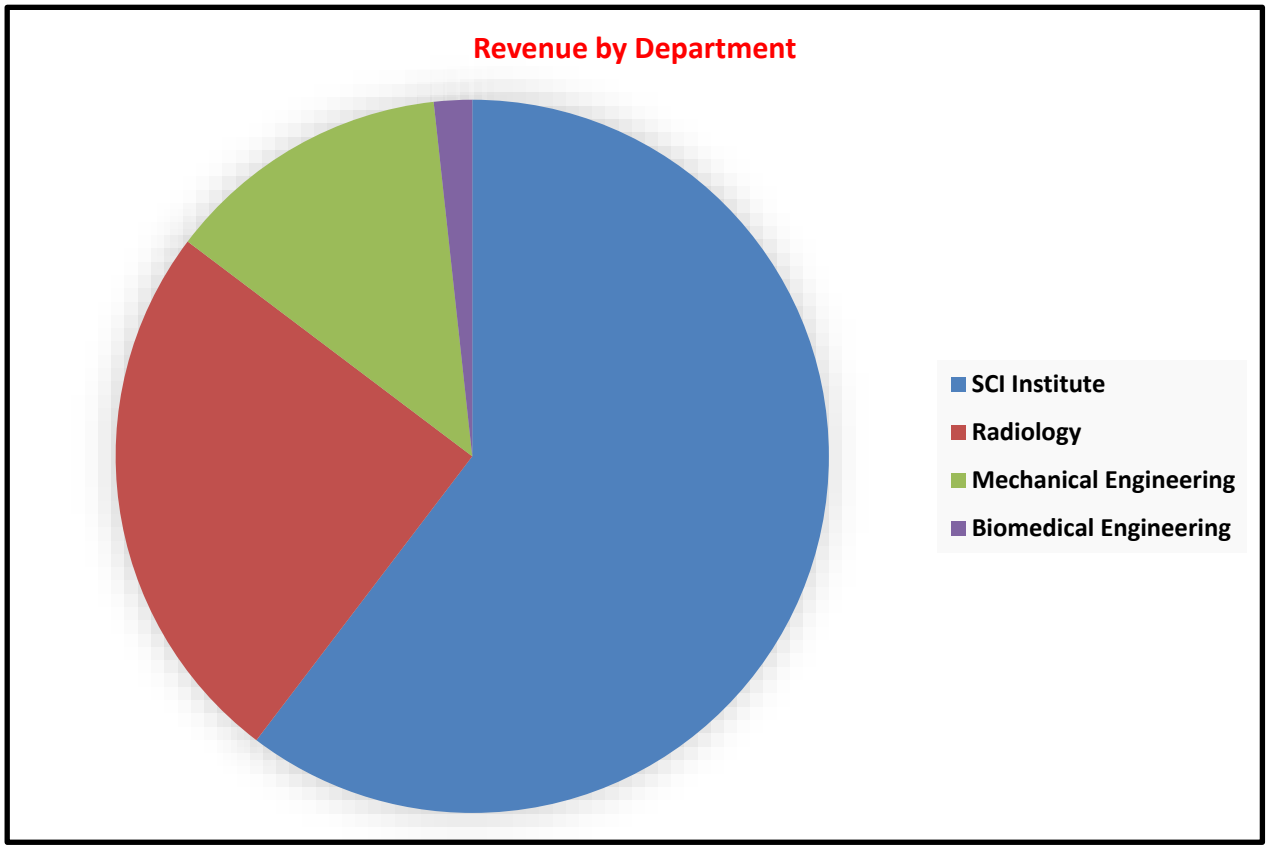
- Tolga Tasdizen, PhD, Associate Professor Electrical and Computer Engineering
- Edward DiBella, PhD, Prof. Radiology and Imaging Sciences, Director UCAIR
- Florian Solzbacher, PhD, Professor Electrical & Computer Engineering, Director CEI

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Tasdizen, Tolga	DHS
2	Genesis Innovation	Commercial
3	Monson, Ken	Henry Jackson Foundation
4	Schroeder, Joyce	Department
5	Lex, Alexander	ARUP
6	Minoshima, Satoshi	Department
7	RefloDx, LLC	Commercial
8	McNally, Scott	Department
9	Butson, Christopher	Department

Publications

1. Hanson, A. B., Lee, R. N., Vachet, C., Schwerdt, I. J., Tasdizen, T., & McDonald, L. W. t. (2019). Quantifying Impurity Effects on the Surface Morphology of alpha-U3O8. *Anal Chem*. doi:10.1021/acs.analchem.9b02013
2. Heffernan Sean, T., Ly, N.-C., Mower Brock, J., Vachet, C., Schwerdt Ian, J., Tasdizen, T., & McDonald, I. V. L. W. (2019). Identifying surface morphological characteristics to differentiate between mixtures of U3O8 synthesized from ammonium diuranate and uranyl peroxide. In *Radiochimica Acta* (Vol. 0).

Cell Imaging Facility

Overview

The Cell Imaging Facility provides training and consultation on the use of confocal microscopy, widefield automated microscopy, two-photon, and software analysis tools for quantitative analysis of image data. The facility has Zeiss 880 Airyscan confocal, a Leica SP8 White light laser confocal, a Leica SP8 405/488/561/633, Two Olympus FV1000 Spectral confocals, two Nikon A1 confocals, two Multi-photon confocals from Prairie/Bruker. In addition, two Nikon Ti automated microscope and a spinning disk confocal (CSUW1) are available for live cell imaging. A Zeiss Axioscan Z1 slide scanner is available for automated archiving of histology and fluorescence data. Automated microscopes with one of four different stage incubators are available (CO2, temperature, humidity, one with Hypoxia) and also available for live cell imaging. Nikon Elements, Metamorph, Imaris software are available for 2D and 3D analysis of image data.

Services

The training and equipment provided by the facility is aimed at reducing the startup time and degree of expertise necessary for an individual user to design and execute experiments requiring microscopy and image processing. Services are offered at multiple locations in an effort to provide the service within proximity to the user base.

Goals for FY 2020

Optimizing acknowledgement of the core for manuscripts published with data generated from the core is very important in developing a strategy to acquire additional equipment.

Equipment

HSC Location

- Nikon A1 Confocal Microscope
- Nikon A1R Confocal Microscope
- 2x Prairie Multi-Photon Confocal Microscope
- Zeiss Axioscan Z1 automated slide scanner with 100 slide loader
- EVOS FL Widefield Microscope
- Nikon Ti Automated Microscope

HCI Location

- Leica SP8 confocal with white light laser
- Leica SP8 confocal with 405, 488, 561, 633nm lasers
- Nikon Ti Automated Microscope
- Ibidi stage incubator with C02, temperature and hypoxia control

SMBB Location

- Olympus FV1000 Confocal Microscope

Biology ASB/Crocker Location

- Leica SP8 confocal with white light laser
- Olympus FV1000 confocal Microscope
- Zeiss 880 Airyscan Confocal
- Vutara super resolution and Optera Swept Field Confocal

Personnel

- Christopher Rodesch, Ph.D., Co-Director
- Xiang Wang, Ph.D, Co-Director
- Michael J. Bridge, Ph.D., Research Associate
- Isabelle Harward, Microscope Terchnician

2019 Annual Update

New Services

- Consultation is available at four locations, 230ASB in Biology, SMBB Nanofab Center, 5221 HCI and Building 585 HSC

New Equipment

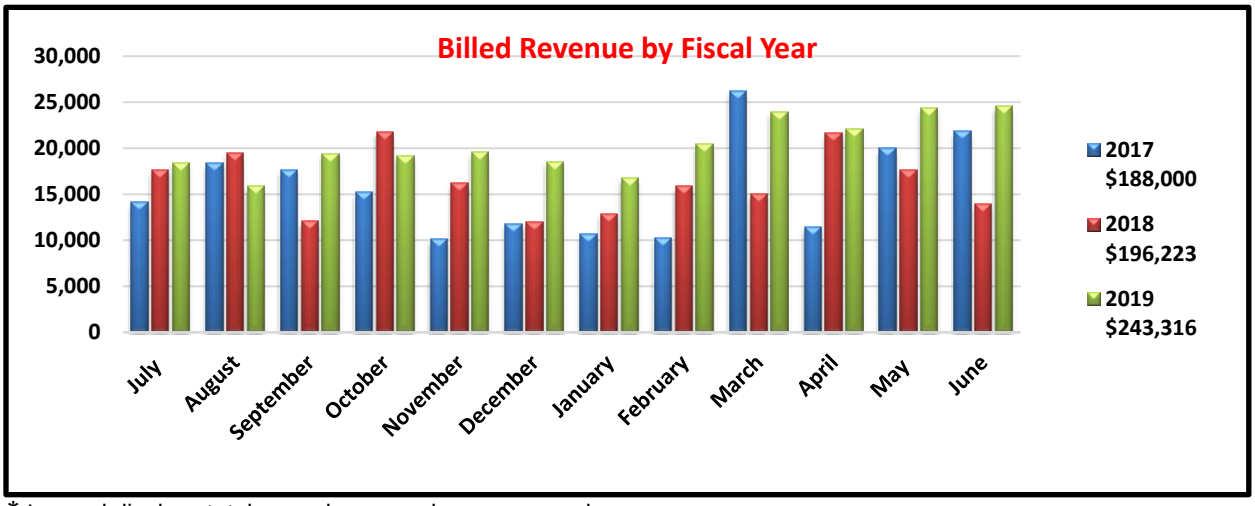
- Spinning disk confocal in Biochemistry, W1 from Visitek

Revenue/Expenses

FY19 Expenses: Total $367,758

FY19 Revenue: Total $478,316

- VP of Health Sciences Support: $235,000
- FY19 Revenue generated from services: $ 243,316



* Legend displays total annual revenue by year earned.

Advisory Board Committee

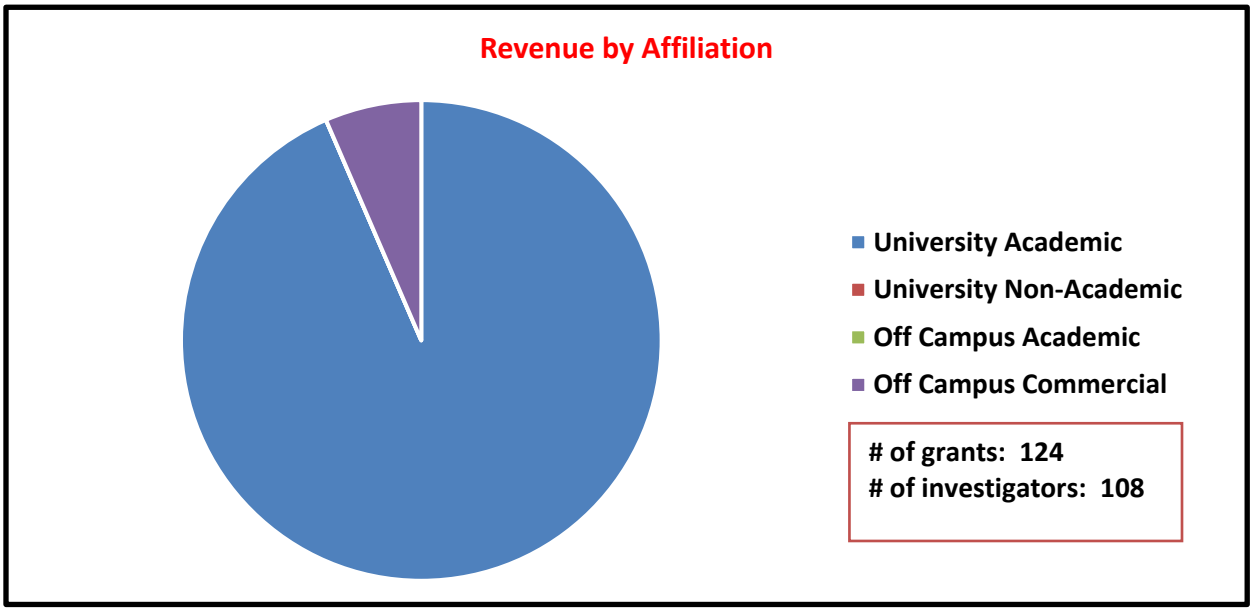
Last meeting date: June 6, 2018.

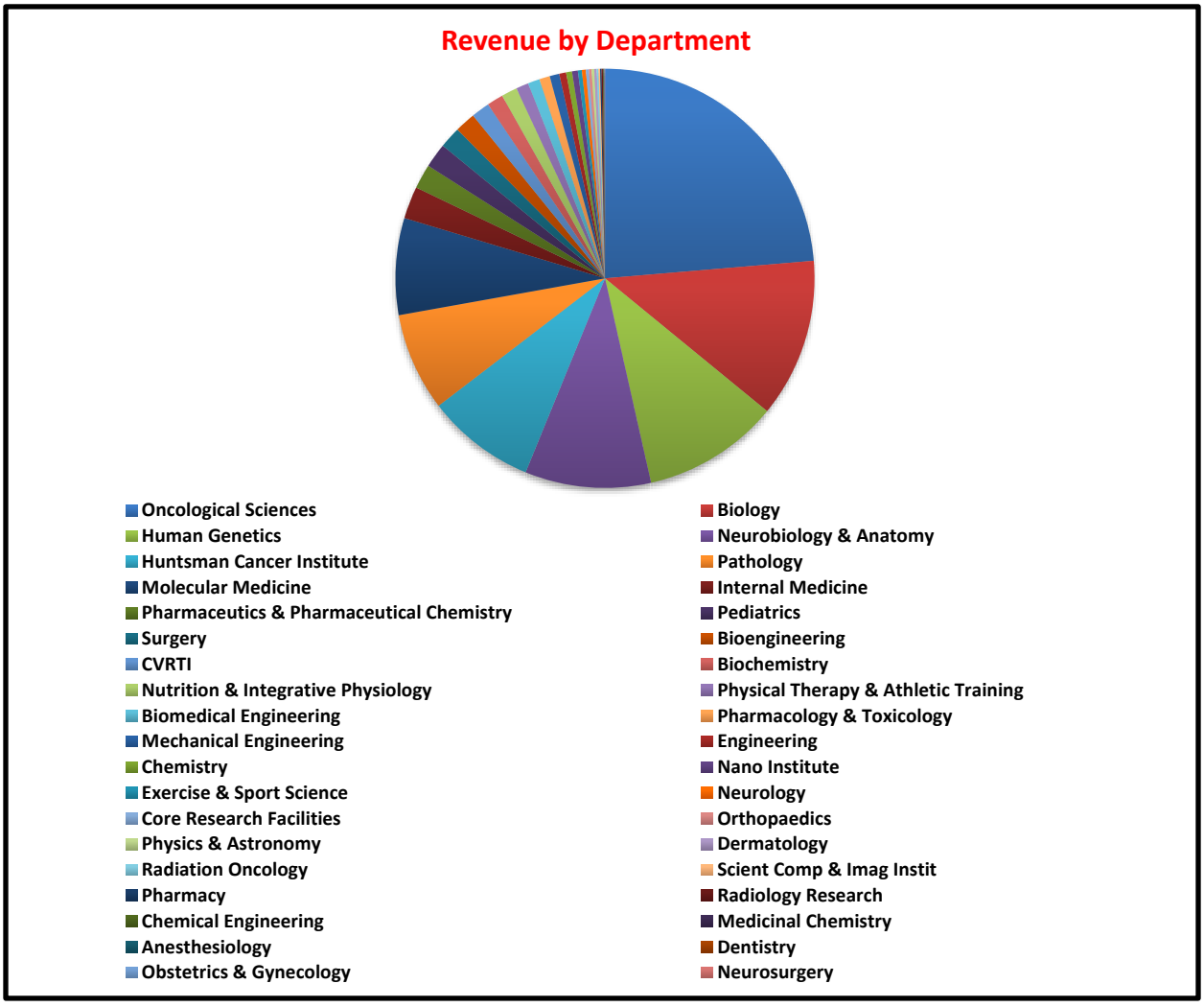
- Marcus Babst, Associate Professor, Biology
- Josh Bonkowsky, Associate Professor, Neurobiology and Anatomy
- Bruce Edgar, Professor, Oncological Sciences
- Kristen Kwan, Assistant Professor, Human Genetics
- Michelle Mendoza, Associate Professor, Oncological Sciences
- Minna Roh, Associate Professor, Biochemistry
- Yan-Ting Shi, Associate Professor, Nephrology
- Lukas Timmins, Associate Professor, Biomedical Engineering

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Yost, H Joseph	NIH, Department
2	Edgar, Bruce	NIH, HCI
3	Caron, Sophie	Department
4	Beckerle, Mary	NIH, Department
5	Jorde, Lynn	NIH
6	Shcheglovitov, Oleksandr	NIH, Department
7	Lamb, Tracey	NIH
8	Mulvey, Matthew	NIH, Department
9	Evason, Kimberly	NIH, Department
10	Shepherd, Jason	NIH

Publications

1. Abdul-Wajid, S., Demarest, B. L., & Yost, H. J. (2018). Loss of embryonic neural crest derived cardiomyocytes causes adult onset hypertrophic cardiomyopathy in zebrafish. *Nat Commun, 9*(1), 4603. doi:10.1038/s41467-018-07054-8
2. Chavez, D. R., Snow, A. K., Smith, J. R., & Stanfield, G. M. (2018). Soma-germ line interactions and a role for muscle in the regulation of C. elegans sperm motility. *Development, 145*(24). doi:10.1242/dev.167734
3. Klatt Shaw, D., Gunther, D., Jurynec, M. J., Chagovetz, A. A., Ritchie, E., & Grunwald, D. J. (2018). Intracellular Calcium Mobilization Is Required for Sonic Hedgehog Signaling. *Dev Cell, 45*(4), 512-525 e515. doi:10.1016/j.devcel.2018.04.013
4. Mimche, P. N., Lee, C. M., Mimche, S. M., Thapa, M., Grakoui, A., Henkemeyer, M., & Lamb, T. J. (2018). EphB2 receptor tyrosine kinase promotes hepatic fibrogenesis in mice via activation of hepatic stellate cells. *Sci Rep, 8*(1), 2532. doi:10.1038/s41598-018-20926-9
5. Reidy, P. T., McKenzie, A. I., Mahmassani, Z., Morrow, V. R., Yonemura, N. M., Hopkins, P. N., Drummond, M. J. (2018). Skeletal muscle ceramides and relationship with insulin sensitivity after 2 weeks of simulated sedentary behaviour and recovery in healthy older adults. *J Physiol, 596*(21), 5217-5236. doi:10.1113/JP276798
6. Reidy, P. T., McKenzie, A. I., Mahmassani, Z. S., Petrocelli, J. J., Nelson, D. B., Lindsay, C. C., Drummond, M. J. (2019). Aging impairs mouse skeletal muscle macrophage polarization and muscle-specific abundance during recovery from disuse. *Am J Physiol Endocrinol Metab, 317*(1), E85-E98. doi:10.1152/ajpendo.00422.2018
7. Samson, S. C., Elliott, A., Mueller, B. D., Kim, Y., Carney, K. R., Bergman, J. P., Mendoza, M. C. (2019). p90 ribosomal S6 kinase (RSK) phosphorylates myosin phosphatase and thereby controls edge dynamics during cell migration. *J Biol Chem, 294*(28), 10846-10862. doi:10.1074/jbc.RA119.007431
8. Sefton, E. M., Gallardo, M., & Kardon, G. (2018). Developmental origin and morphogenesis of the diaphragm, an essential mammalian muscle. *Dev Biol, 440*(2), 64-73. doi:10.1016/j.ydbio.2018.04.010
9. Yoo, J. H., Brady, S. W., Acosta-Alvarez, L., Rogers, A., Peng, J., Sorensen, L. K., Grossmann, A. H. (2019). The Small GTPase ARF6 Activates PI3K in Melanoma to Induce a Prometastatic State. *Cancer Res, 79*(11), 2892-2908. doi:10.1158/0008-5472.CAN-18-3026
10. Zhang, P., Holowatyj, A. N., Roy, T., Pronovost, S. M., Marchetti, M., Liu, H., Edgar, B. A. (2019). An SH3PX1-Dependent Endocytosis-Autophagy Network Restrains Intestinal Stem Cell Proliferation by Counteracting EGFR-ERK Signaling. *Dev Cell, 49*(4), 574-589 e575. doi:10.1016/j.devcel.2019.03.029
11. Zitnay, J. L., Reese, S. P., Tran, G., Farhang, N., Bowles, R. D., & Weiss, J. A. (2018). Fabrication of dense anisotropic collagen scaffolds using biaxial compression. *Acta Biomater, 65*, 76-87. doi:10.1016/j.actbio.2017.11.017
12. Zitnay, J. L., & Weiss, J. A. (2018). Load transfer, damage, and failure in ligaments and tendons. *J Orthop Res, 36*(12), 3093-3104. doi:10.1002/jor.24134

Centralized Zebrafish Animal Resource (CZAR) Facility

Overview

The CZAR Facility provides state-of-the-art systems for housing, breeding, and doing experiments with zebrafish, an emerging vertebrate model system. The CZAR currently houses approximately 6000 fish tanks with a capacity of 7750 tanks maintained on 5 independent recirculating water systems in the Health Sciences portion of campus. The CZAR also maintains and provides expertise and support services for a new 1000 tank capacity fish system installed in the Crocker Science Center building on main campus, named the "Crocker Science Research Zebrafish" (CBRZ, aka 'sea breeze') facility. The communal laboratory space in both locations provide areas for Zebrafish mating, embryo microinjection, and experimental procedures. The design encourages intellectual and experimental synergism among research groups, facilitating 1) large genetic screens carried out as collaborations between multiple laboratories; 2) collaborative research projects that require shared use of specific genetically marked or mutagenized animals; 3) development and distribution of resources and new technologies that advance the research efforts of all laboratories on campus; 4) a teaching environment in which the newest technologies and resources are disseminated quickly; and 5) training and experimental support for laboratories wishing to try pilot zebrafish experiments. These centralized communal spaces have been instrumental in the University's ability to attract and recruit new Zebrafish faculty members to the University. Currently, 10 laboratories that have large-scale commitments to zebrafish research and 12 additional smaller-scale groups use the CZAR and CBRZ.

The two facilities house approximately 125,000-150,000 fish, including a large number of wild type and mutant fish strains. The CZAR staff provides zebrafish husbandry services including monitoring and troubleshooting observed health issues, testing new diets, and addressing health concerns raised by users.

Services

The CZAR Core Facility is responsible for the daily care and maintenance of the fish and aquatic systems. The facility provides the following services:

- Housing and maintaining zebrafish, monitoring their health, and providing specialized nursery care and diets resulting in high survival rates of young fry.
- Establishing practices and providing oversight to ensure the safety and health of the animals in compliance with IACUC standards and regulations.
- Propagating wild type lines and providing animals from these lines to investigators
- Providing laboratory bench space and supplies to perform experiments
- Providing and maintaining shared-use equipment including 7-8 microinjection stations with bright field stereomicroscopes, and 3 fluorescence stereomicroscopes.
- Providing education and training to investigators and students on an individual basis
- Providing specialized centralized services performed by the permanent staff, such as *in vitro* fertilization, sperm cryopreservation and storage

- Providing Quarantine facilities to house fish from outside sources to generate clean lines to import into the facility.
- Monitoring husbandry success through mating success data and nursery survival rates.
- Propagating individual lab WT or transgenic lines for a nominal fee. This service can be requested through the Cores web site.
- Offering a “Fish School” course for new users to learn best practices in handling and caring for their fish, as well as how to tell male and female fish apart.

Equipment

- M205 FA Leica Fluorescence Microscope
- Zeiss Fluorescence Microscope with LED light source
- Olympus Fluorescence Microscope
- 7 microinjection stations with bright field stereomicroscopes
- Analog camera and monitor to facilitate teaching microinjection in real time
- Temperature sensors throughout facility to help monitor the quality of temperature control, and record deviations that could affect fish health.

Personnel

- Maurine Hobbs, PhD, Director
- Sharon Johnson, Senior Laboratory Specialist - Zebrafish Husbandry and WT line maintenance
- Talmage Long, Technician - Nursery Manager
- Nathan Baker, Lab Assistant, CBRZ Manager

2019 Annual Update

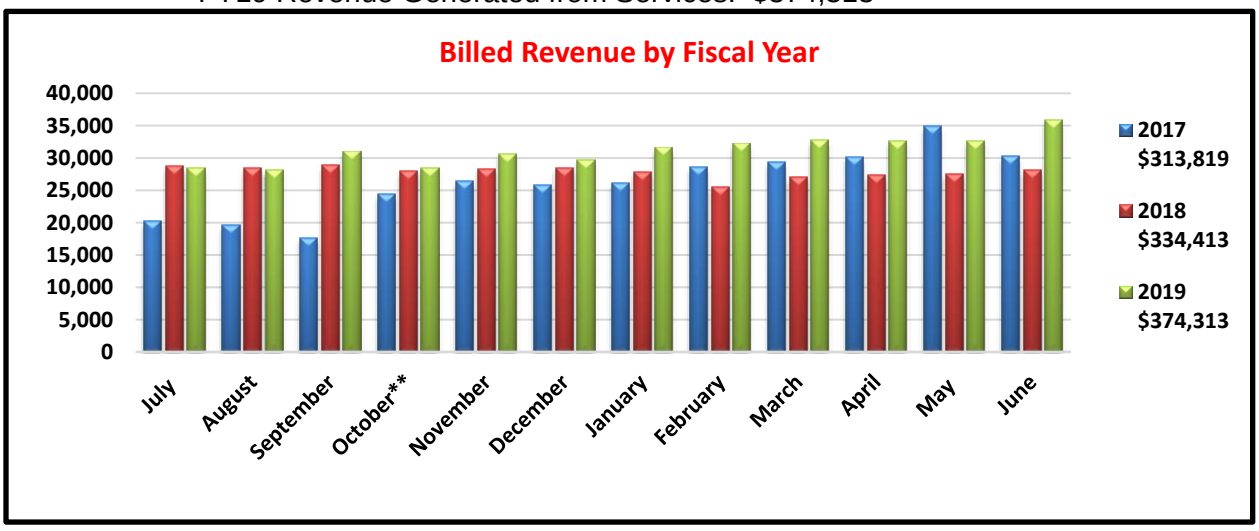
New Services – Full-time staffing of CBRZ

Revenue/Expenses

FY19 Expenses: Total $523,249

FY19 Revenue: Total $471,413

- VP of Health Sciences Support: $137,000
- VP of Research: $10,000
- FY19 Revenue Generated from Services: $374,313



* Legend displays total annual revenue. NOTE: Revenue for FY15 & FY16 is maximal due to facility limitations.
**Beginning in October 2016, the increased revenue shows the new tanks coming online

Advisory Board Committee

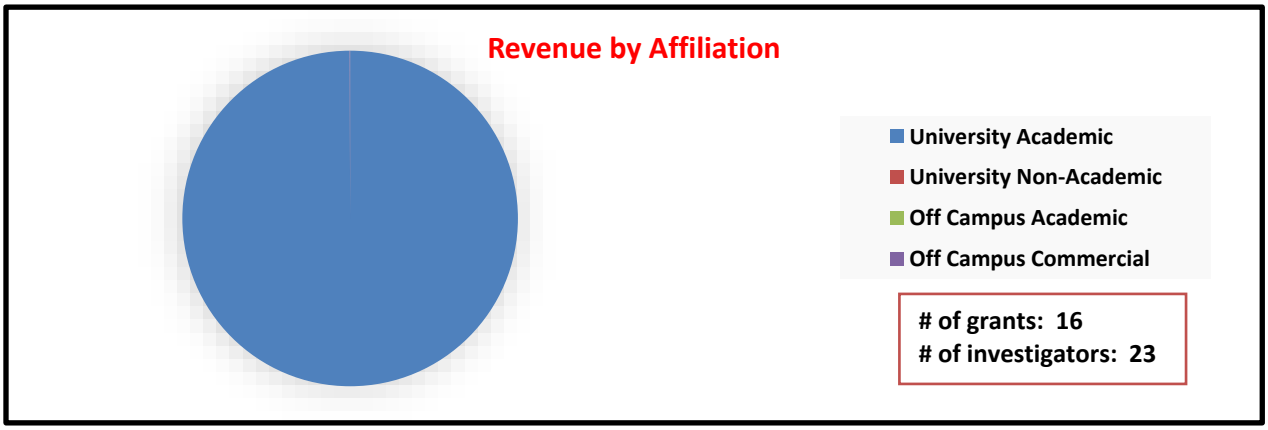
Last meeting date: October 11, 2018

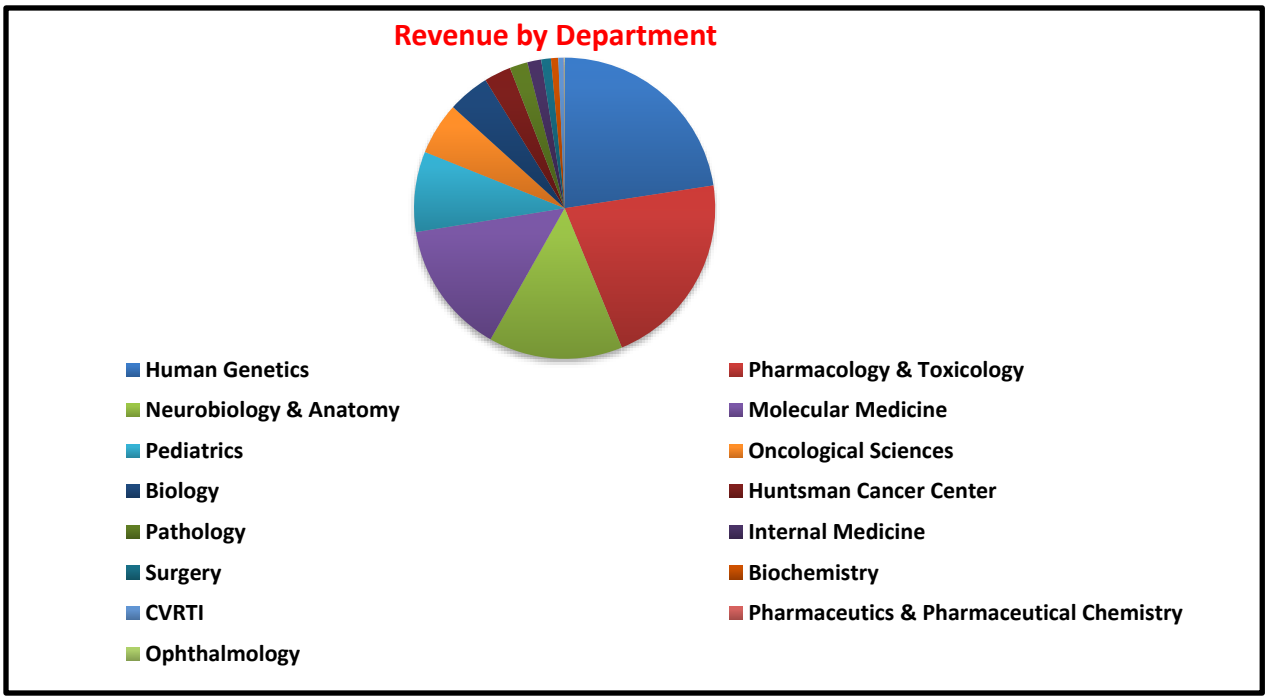
- Richard Dorsky, Associate Professor, Neurobiology and Anatomy- Chair
- David Jonah Grunwald, Professor, Human Genetics
- Joshua Bonkowsky, Associate Professor, Neurobiology and Anatomy and Pediatrics
- Kristen Kwan, Assistant Professor, Human Genetics
- Amnon Schlegel, Assistant Professor, Internal Medicine
- Rodney Stewart, Assistant Professor, Oncological Sciences
- Roger Van Andel, Director, Office of Comparative Medicine
- Randall Peterson, Dean, College of Pharmacy
- H. Joseph Yost, Professor, Neurobiology and Anatomy and Pediatrics

FY19 Scientific Impact

Research Support

- Grunwald, Title: Expansion of a Zebrafish Research Core Facility, Grunwald, 1G20OD018369-01, NIH, $500,000, 06/01/2014 – 05/31/2015.
- Grants supported by this core, as of July 2018, are listed as an appendix following this report





Top Users

1	Peterson, Randall	Department
2	Yost, H Joseph	NIH, Department
3	Kwan, Kristen	NIH
4	Grunwald, David	NIH
5	Bonkowsky, Josh	NIH, Department
6	Dorsky, Richard	Craig H Neilsen Foundation
7	Douglass, Adam	NIN,NSF
8	Gagnon, James	Department
9	Beckerle, Mary	NIH
10	Evason, Kimberly	NIH, Department

Publications

1. Abdul-Wajid, S., Demarest, B. L., & Yost, H. J. (2018). Loss of embryonic neural crest derived cardiomyocytes causes adult onset hypertrophic cardiomyopathy in zebrafish. *Nat Commun, 9*(1), 4603. doi:10.1038/s41467-018-07054-8
2. Ahorukomeye, P., Disotuar, M. M., Gajewiak, J., Karanth, S., Watkins, M., Robinson, S. D., Safavi-Hemami, H. (2019). Fish-hunting cone snail venoms are a rich source of minimized ligands of the vertebrate insulin receptor. *Elife, 8*. doi:10.7554/eLife.41574
3. Asnani, A., Zheng, B., Liu, Y., Wang, Y., Chen, H. H., Vohra, A., Peterson, R. T. (2018). Highly potent visnagin derivatives inhibit Cyp1 and prevent doxorubicin cardiotoxicity. *JCI Insight, 3*(1). doi:10.1172/jci.insight.96753
4. Chaturantabut, S., Shwartz, A., Evason, K. J., Cox, A. G., Labella, K., Schepers, A. G., Goessling, W. (2019). Estrogen Activation of G-Protein-Coupled Estrogen Receptor 1 Regulates Phosphoinositide 3-Kinase and mTOR Signaling to Promote Liver Growth in Zebrafish and Proliferation of Human Hepatocytes. *Gastroenterology, 156*(6), 1788-1804 e1713. doi:10.1053/j.gastro.2019.01.010
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11. Lam, P. Y., & Peterson, R. T. (2019). Developing zebrafish disease models for in vivo small molecule screens. *Curr Opin Chem Biol, 50*, 37-44. doi:10.1016/j.cbpa.2019.02.005
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Active Grant Support of Zebrafish Research

Associated with the UofU CZAR Core Facility FY18

Zebrafish Investigator	Grant Title	Funding Source	Annual Amount of Direct Cost Funding
Bonkowsky	Trans-Cellular Activation Of Transcription To Analyze Dopaminergic Axon Reorganization	NIH/NIMH	$300,000
Bonkowsky	Characterization Of Genetic Pathways Regulating Connectivity Disruption In Hypoxic Injury	March Of Dimes	$88,000
Cairns	Howard Hughes Medical Institute	HHMI	$619,981
Dorsky	Regulation Of Hypothalamic Radial Glia By Wnt Signaling	NIH/NINKS	$250,000
Grunwald	Expansion of a Zebrafish Research Core Facility	NIH Office of the Director	$500,000
Grunwald	Gene targeting in zebrafish: building models to assay disease genes	NIH NTNL INST CHILD	$182,525
Grunwald	A toolkit for gene-targeting in zebrafish	NIH NTNL INST CHILD	$383,170
Kwan	Hedgehog Signaling and Cilia in Choroid Fissure Morphogenesis and Coloboma	NIH NTNL EYE INSTITUTE	$335,250
Li	Endothelial Toll-Like Receptor Signaling and Inflammation		$366,912
Mulvey	Bacterial Invasion And Trafficking Within The Bladder	NIH/NIAIDIA BETE	$250,000
Rosenblatt	The Role Of Extrusion In Controlling Epithelial Homeostasis	NIH/NIGMED	$207,475
Rosenblatt	The Role Of Extrusion In Controlling Epithelial Homeostasis	NIH/NIGMED	$75,000
Schlegel	Molecular Genetics Of Lipid Metabolism	NIH/NIDDIAB ETE	$209,888

Stewart	Foxd3-Dependent Pathways In Neural Crest Migration And Metastasis	American Cancer Society	$150,000
Tavtigian	Classifying DNA Mismatch Repair Gene Variants of Unknown Significance	NCI	$520,565
Tristani-Firouzi	“Zebrafish Model Organism Core For The Cardiovascular	NIH	$164,000
Yost	Genome-Wide Analysis Of Cardiac Development In Zebrafish	NIH/NHLBI	$1,570,415
Yost	Developmental Biology Training Grant	NIH/NICHD	$253,526
		Total Current Grants, Annual Direct Costs:	**$7,130,167**

DNA Peptide Facility

Overview

The DNA Peptide Facility provides researchers with chemical synthesis of custom oligonucleotides and oligopeptides. The facility synthesizes standard DNA/RNA oligos and peptides with multiple purity options, ranging from crude to HPLC. This Core has the ability to incorporate a wide array of specialty modifications, including fluorophore-labeling and functional group derivatization via amino-, thiol-, and modifications compatible with click chemistry. The goal of the facility is to provide quality service with speedy turnaround times.

Services

- Routine and custom DNA synthesis
- Routine and custom RNA synthesis
- Routine and custom Peptide synthesis
- Peptide Purification
- Amino Acid Analysis

Equipment

- Dr. Oligo 192 DNA Synthesizer
- ABI 3900 DNA Synthesizer
- ABI 394 DNA Synthesizer (2)
- ABI 433 Peptide Synthesizer
- ABI 433 Peptide Synthesizer
- Beckman Coulter System Gold 125P HPLC System
- Beckman Coulter System Gold 126 HPLC System
- Hewlett Packard Series 1100 HPLC system (2)
- Beckman Coulter DU800 Spectrophotometer
- BioTek Epoch Plate Reader Spectrophotometer

Personnel

- Mike Hanson, Ph.D., Director
- Jan Mees, Lab Aide
- Meredith Ford, Lab Technician
- Evan Shaw, Lab Technician

2019 Annual Update

New Equipment

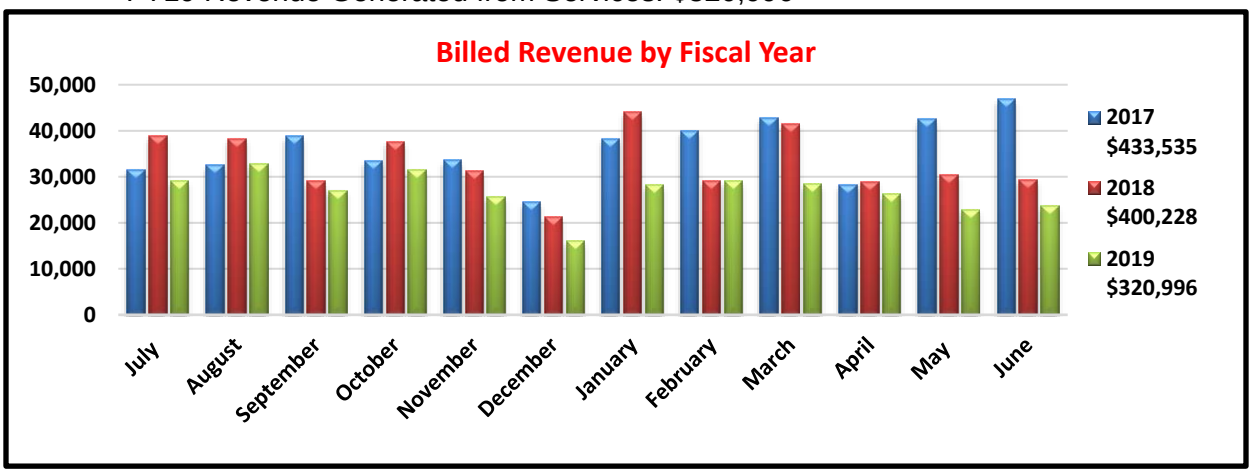
- The DNA Peptide Facility now offers a 25 nmole DNA Synthesis service. These prices make the facility much more competitive with commercial vendors.

Revenue/Expenses

FY19 Expenses: Total $353,831

FY19 Revenue: Total $320,996

- VP of Health Sciences Support: $0
- FY19 Revenue Generated from Services: $320,996



* Total billed annual revenue displayed in legend.

Advisory Board Committee

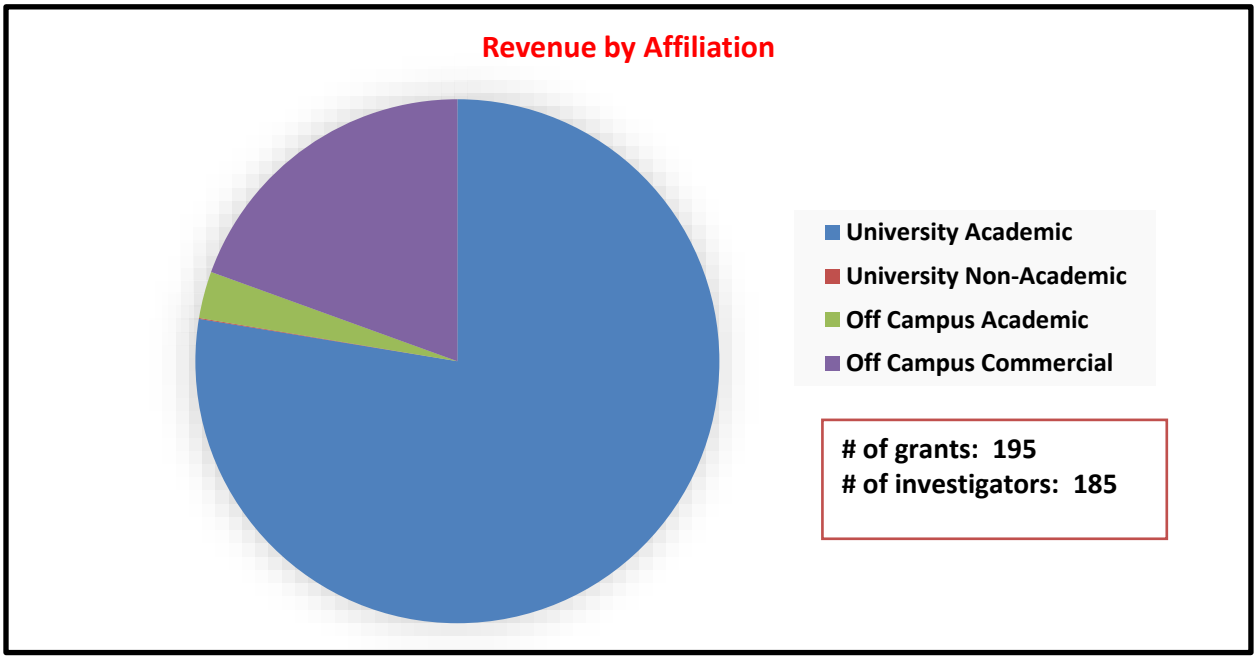
Last meeting date: August 2014

- Mahesh Chandrasekharan, Professor, Huntsman Cancer Institute
- Raphael Franzini, Professor, College of Pharmacy
- Ming Hammond, Professor, Chemistry

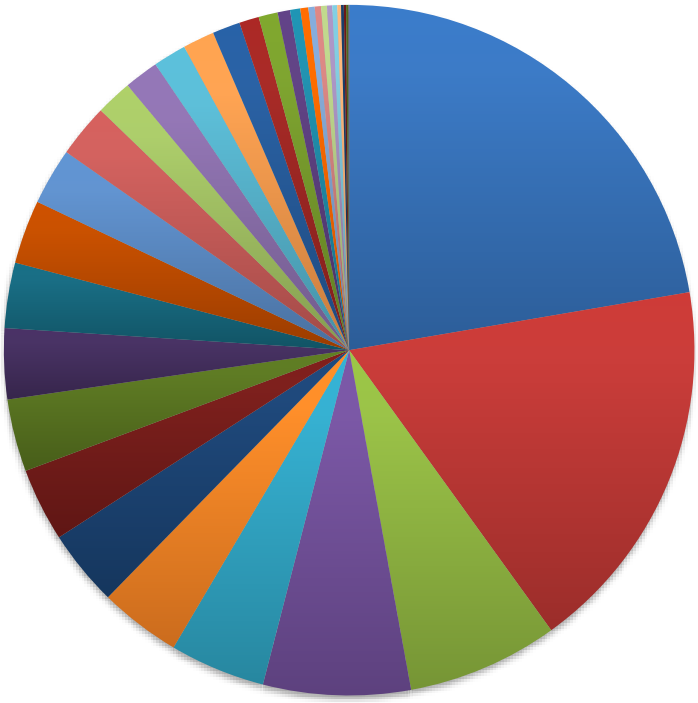
FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):



Revenue by Department



- Biochemistry
- Chemistry
- Internal Medicine
- Pathology
- Human Genetics
- Biology
- Molecular Medicine
- Neurobiology & Anatomy
- Pediatrics
- Oncological Sciences
- Bioengineering
- Huntsman Cancer Institute
- Medicinal Chemistry
- Core Research Facilities
- Orthopaedics
- Neurology
- Pharmacology & Toxicology
- Nutrition & Integrative Physiology
- Dentistry
- Ophthalmology & Visual Sciences
- Engineering
- Pharmaceutics & Pharmaceutical Chemistry
- Chemical Engineering
- Surgery
- Exercise & Sport Science
- Neurosurgery
- Biomedical Engineering
- Dermatology
- Psychiatry
- Mechanical Engineering
- Infectious Diseases
- Physical Therapy & Athletic Training
- Nano Institute
- Anesthesiology
- CVRTI
- Population Health Sciences

Top Users

1	BioFire Diagnostics	Commercial
2	Burrows, Cynthia	NIH
3	Sundquist, Wesley	NIH, DHHS
4	Rutter, Jared	HHMI
5	Heemstra, Jennifer	Department, NIH, NSF, RCSA, Sonata Biosciences
6	Davey Hicks, Crystal	HSC Cores
7	Deans, Tara	NSF, Office of Naval Research
8	Yang, Tianxin	NIH
9	University of California-Davis	Off Campus Academic
10	Schmidt, Eric	NIH, Department

Publications

1. Ding, Y., Fleming, A. M., & Burrows, C. J. (2018). Case studies on potential G-quadruplex-forming sequences from the bacterial orders Deinococcales and Thermales derived from a survey of published genomes. *Sci Rep, 8*(1), 15679. doi:10.1038/s41598-018-33944-4
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4. Morris, F. D., Peterson, E. M., Heemstra, J. M., & Harris, J. M. (2018). Single-Molecule Kinetic Investigation of Cocaine-Dependent Split-Aptamer Assembly. *Anal Chem, 90*(21), 12964-12970. doi:10.1021/acs.analchem.8b03637
5. Peterson, E. M., & Harris, J. M. (2018). Identification of Individual Immobilized DNA Molecules by Their Hybridization Kinetics Using Single-Molecule Fluorescence Imaging. *Anal Chem, 90*(8), 5007-5014. doi:10.1021/acs.analchem.7b04512
6. Redstone, S. C. J., Fleming, A. M., & Burrows, C. J. (2019). Oxidative Modification of the Potential G-Quadruplex Sequence in the PCNA Gene Promoter Can Turn on Transcription. *Chem Res Toxicol, 32*(3), 437-446. doi:10.1021/acs.chemrestox.8b00332
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10. Zhu, J., Fleming, A. M., & Burrows, C. J. (2018). The RAD17 Promoter Sequence Contains a Potential Tail-Dependent G-Quadruplex That Downregulates Gene Expression upon Oxidative Modification. *ACS Chem Biol, 13*(9), 2577-2584. doi:10.1021/acschembio.8b00522

DNA Sequencing Facility

Overview

The DNA Sequencing Facility provides DNA sequencing services and employs the latest technologies to generate high quality data with the goal of rapid sample turnaround at competitive prices. DNA sequencing is accomplished with the use of state-of-the-art DNA sequencers and lab robotics such as the Ion Torrent Proton, the Qiagen Q24 Pyrosequencer, 10x Genomics and the Biomek FX for liquid handling needs. Data from standard DNA sequencing services are typically reported to customers the same day as they are run. Sample information can be submitted online and sequencing data files are available online for download using a simple and secure interface. The next generation sequencing platform used has many advantages over other services, including price and sample turnover. We also have the capability of sending samples out for Illumina sequencing with approximately 3 week turnaround time.

Services

DNA Sequencing

- Standard Sanger DNA sequencing
- Primer walking on clones
- Mutation detection and resequencing custom projects
- Ion Torrent NGS sequencing
- Pyrosequencing
- 10x Genomics libraries for both single cell and phasing
- Illumina Sequencing with 3 week turnaround

Cell Line Authentication

- Human Cell Line Authentication by STR

Robotics

- Biomek FX with Span-8 and 96 head

Fragment Analysis

- RNA quality determination (RIN equivalents)
- Fragment sizing and concentrations

Other Services

- Lab consumables for sample submission
- Life Technologies freezer program

Equipment

Sequencers

- Ion Torrent Proton
- Qiagen Q24 Pyrosequencer
- Applied Biosystems 3730xl

Liquid Handlers

- 1 Biomek FX programmable liquid sample dispenser

Fragment Analysis

- AATI Fragment Analyzer

Personnel

- Derek Warner, Director
- Michael Powers, Senior Laboratory Specialist

2019 Annual Update

New Equipment

- 10x Genomics instrument for single cell and phased sequencing.

New Services

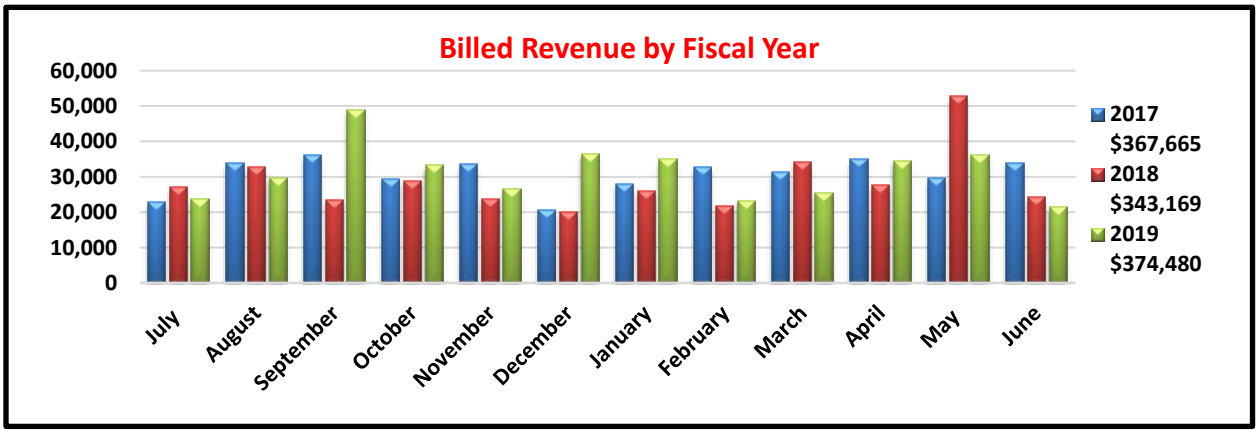
- 10x Library construction and sequencing on request.

Revenue/Expenses

FY19 Expenses: Total $355,439

FY19 Revenue: Total $374,480

- VP of Health Sciences Support: $0
- FY19 Revenue generated from services: $374,480



* Total annual revenue displayed in legend

Advisory Board Committee

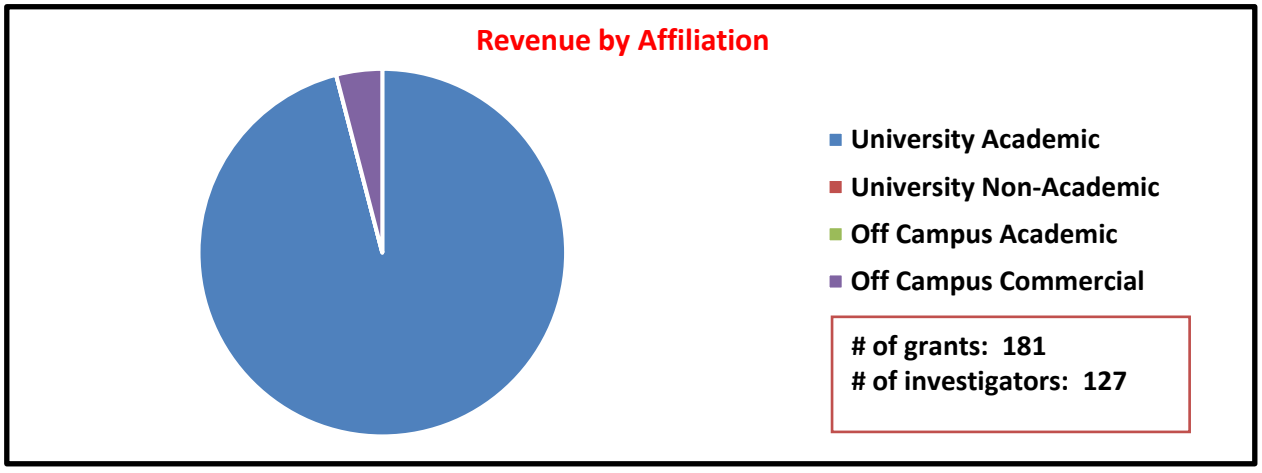
Last meeting date: August 16, 2018

- Lynn Jorde, Professor, Human Genetics
- Colin Dale, Associate Professor, Biology
- Robert Weiss, Professor, Human Genetics

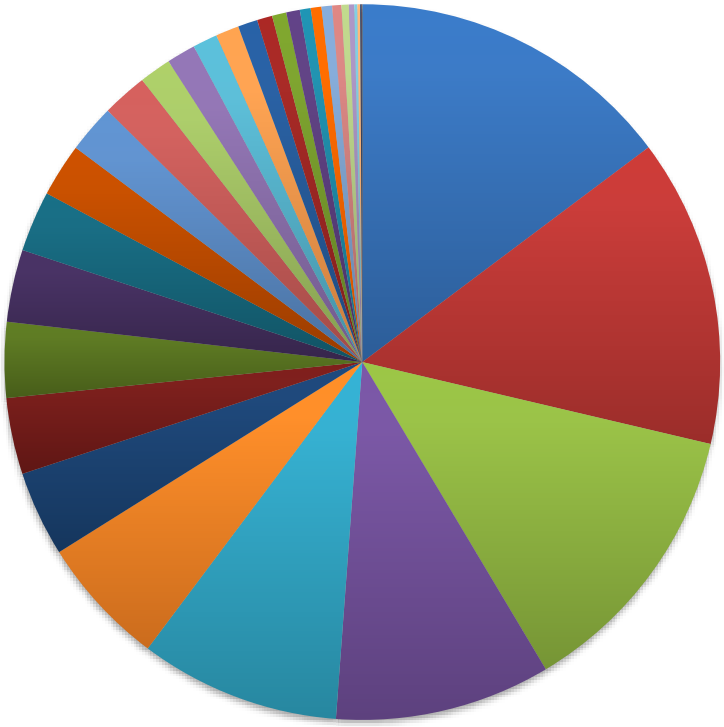
FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):



Revenue by Department



- Human Genetics
- Biochemistry
- Biology
- Pediatrics
- Internal Medicine
- Oncological Sciences
- Molecular Medicine
- Chemistry
- Neurobiology & Anatomy
- Neurology
- Huntsman Cancer Center
- Pathology
- Pharmacology & Toxicology
- Ophthalmology & Visual Sciences
- Surgery
- Orthopaedics
- Core Research Facilities
- Anthropology
- Mechancial Engineering
- Neurosurgery
- Dermatology
- Bioengineering
- Psychiatry
- Nutrition & Integrative Physiology
- Biomedical Engineering
- Anesthesiology
- Dentistry
- Pharmaceutics & Pharmaceutical Chemistry
- Nano Institute
- Physical Therapy & Athletic Training
- Exercise & Sport Science
- Civil & Environmental Engineering
- Medicinal Chemistry

Top Users

1	Marth, Gabor	NIH
2	Sundquist, Wesley	NIH, Department
3	Jorde, Lynn	NIH, Department, Geneuro
4	Keenan, Heather	NIH
5	Parkinson, John S	NIH
6	Penovich, Wanda	Department
7	Tavtigian, Sean	NIH, Department
8	Grunwald, David	NIH, Department
9	Hill, Christopher	NIH, Department
10	Tristani, Martin	NIH, Department

Publications

1. Ahorukomeye, P., Disotuar, M. M., Gajewiak, J., Karanth, S., Watkins, M., Robinson, S. D., Safavi-Hemami, H. (2019). Fish-hunting cone snail venoms are a rich source of minimized ligands of the vertebrate insulin receptor. *Elife, 8*. doi:10.7554/eLife.41574
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4. Anderson, S. R., Zhang, J., Steele, M. R., Romero, C. O., Kautzman, A. G., Schafer, D. P., & Vetter, M. L. (2019). Complement Targets Newborn Retinal Ganglion Cells for Phagocytic Elimination by Microglia. *J Neurosci, 39*(11), 2025-2040. doi:10.1523/JNEUROSCI.1854-18.2018
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9. Bohm, K., Porwollik, S., Chu, W., Dover, J. A., Gilcrease, E. B., Casjens, S. R., Parent, K. N. (2018). Genes affecting progression of bacteriophage P22 infection in Salmonella identified by transposon and single gene deletion screens. *Mol Microbiol, 108*(3), 288-305. doi:10.1111/mmi.13936
10. Bosco, A., Anderson, S. R., Breen, K. T., Romero, C. O., Steele, M. R., Chiodo, V. A., Vetter, M. L. (2018). Complement C3-Targeted Gene Therapy Restricts Onset and Progression of Neurodegeneration in Chronic Mouse Glaucoma. *Mol Ther, 26*(10), 2379-2396. doi:10.1016/j.ymthe.2018.08.017
11. Campbell, R. A., Schwertz, H., Hottz, E. D., Rowley, J. W., Manne, B. K., Washington, A. V., Rondina, M. T. (2019). Human megakaryocytes possess intrinsic antiviral immunity through regulated induction of IFITM3. *Blood, 133*(19), 2013-2026. doi:10.1182/blood-2018-09-873984
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13. Deng, W. T., Li, J., Zhu, P., Chiodo, V. A., Smith, W. C., Freedman, B., Hauswirth, W. W. (2018). Human L- and M-opsins restore M-cone function in a mouse model for human blue cone monochromacy. *Mol Vis, 24*, 17-28. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/29386880
14. Di Gioia, S. A., Connors, S., Matsunami, N., Cannavino, J., Rose, M. F., Gilette, N. M., Engle, E. C. (2017). A defect in myoblast fusion underlies Carey-Fineman-Ziter syndrome. *Nat Commun, 8*, 16077. doi:10.1038/ncomms16077
15. Figueroa, K. P., Coon, H., Santos, N., Velazquez, L., Mederos, L. A., & Pulst, S. M. (2017). Genetic analysis of age at onset variation in spinocerebellar ataxia type 2. *Neurol Genet, 3*(3), e155. doi:10.1212/NXG.0000000000000155
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23. Hanke-Gogokhia, C., Frederick, J. M., Zhang, H., & Baehr, W. (2018). Binary Function of ARL3-GTP Revealed by Gene Knockouts. *Adv Exp Med Biol, 1074*, 317-325. doi:10.1007/978-3-319-75402-4_39
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Drug Discovery Facility

Overview

The Drug Discovery Facility provides compound collections for screening. The facility delivers low-cost and efficient access to chemical libraries for screening, to equipment for automation, and to synthetic chemistry support for the characterization and validation of compounds for potential use as therapeutics, diagnostics and biological tools.

Uniqueness

The University of Utah possesses the scientific and medical talent, innovation research culture, and state-of-the-art research facilities to contribute substantially to the discovery of small molecule drugs. However, significant challenges still remain in translation of basic scientific discoveries into potential human therapeutics. The uniqueness of the Drug Discovery Facility is it coordinates the cooperative efforts of individual research groups in a wide variety of different drug discovery stuides, ultimately leading to discover novel chemical probes and new pharmaceutical lead compounds.

The most valuable assets at the facility are the private/proprietary chemical collections that could result in new intellectual property. These unique molecules of therapeutic potential offer the facility to assist in the translation of fundamental discoveries in biology into novel therapeutics and commercial opportunities. It's anticipated that the discovery of candidate lead compounds from the facility will stimulate interest in commercial development of technology at the University of Utah through licensing agreements with pharmaceutical industry partners and the production of new start-up biotechnology companies.

Services

- High-throughput screening
- Small molecule chemical libraries
- Pooled CRISPR-Cas9 libraries/Screening
- Assay development
- Consultation on target identification/validation, hit to lead optimization, PK/PD/Efficacy
- Chemical support for drug discovery
- CRISPR Knockout Cell Line Production

Viral Packaging Service

- Small/large scale viral (lentivirus, adenovirus, adeno-associated virus) packaging, titrations, concentrations and transductions of cells of interest.
- Lentivirus delivery of Cas9 and sgRNA

Equipment/Compound Collection

Automated Liquid Handling Stations:

- Tecan EVO100/MCA96 Liquid Handler with sterile bio-hoods
- Tecan EVO100/MCA384 Liquid Handler with sterile bio-hoods
- HP D300 Digital Dispenser
- Axygen Platemax semi-automatic plate sealer
- KingFisher Duo Prime System – Automated DNA/RNA Extraction and Protein/Cell Purification

Automated Detection Systems:

- Molecular Devices ImageXpress XLS Automated High-Content System
- Bio-tek Plate Neo 2 Plate Reader with stacker

CRISPR Libraries:

- The genome-scale CRISPR-Cas9 knockout (GeCKO) v2 library
- The human CRISPR Brunello lentiviral pooled libraries
- Subset CRISPR libraries: a) human Lentiviral sgRNA library-kinases, and b) human Lentiviral sgRNA library-nuclear proteins

Commercial Compound Libraries:

- Chembridge Diverset EXP(50K) and CL (50K)
- Microsource Spectrum Collection
- NIH Clinical Collection
- Epigenetics Screening Library
- Kinase Inhibitor Library
- NCI Diversity Set IV
- Natural Products Set III
- Enamine 3D Diversity Set (50K)
- NIH Approved Oncology Drugs Set II
- NIH Natural Products Set IV
- Mechanistic Set III
- University of Utah metabolite library v1.0

Private/Proprietary Chemical Collections:

- UUPCC – University of Utah Private Chemical Collection
- Dept. of Chemistry Library
- Ireland Natural Product Collection

Personnel

- Bai Luo, Ph.D., Director

2019 Annual Update

New Service:

- **CRISPR Knockout Cell Line Production** – In collaboration with the Mutation Generation and Detection Core, we started to offer services of genomic deletions in cell lines. Specifically, we create two double strand breaks (DSBs) in target gene by cellular delivery of a pair of single guide RNAs (sgRNAs), which results in large segment deletion in targeted gene by non-homologous end joining (NHEJ) repair. Deletions have potential advantages as compared to single-site small indels given the efficiency of biallelic modification, ease of rapid identification by PCR, predictability of loss-of-function, and utility for the study of non-coding elements.

New Compound Collection:

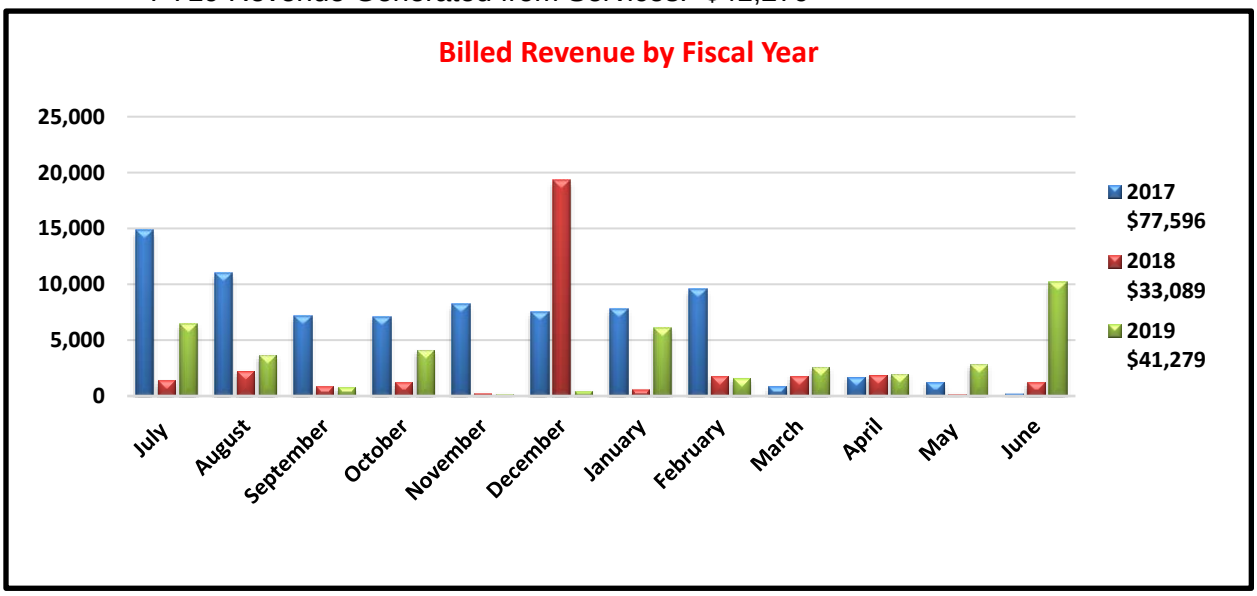
- **Bryan Welm Lab Oncology Library:** The Bryan Welm Lab at HCI transferred their oncology-focused collection to the Core. The Core maintains and dispenses this library.

Revenue/Expenses

FY19 Expenses*:* Total $143,700

FY19 Revenue: Total $121,279

- VP of Health Sciences Support: $80,000
- FY19 Revenue Generated from Services: $41,279



* Total annual revenue displayed in legend.

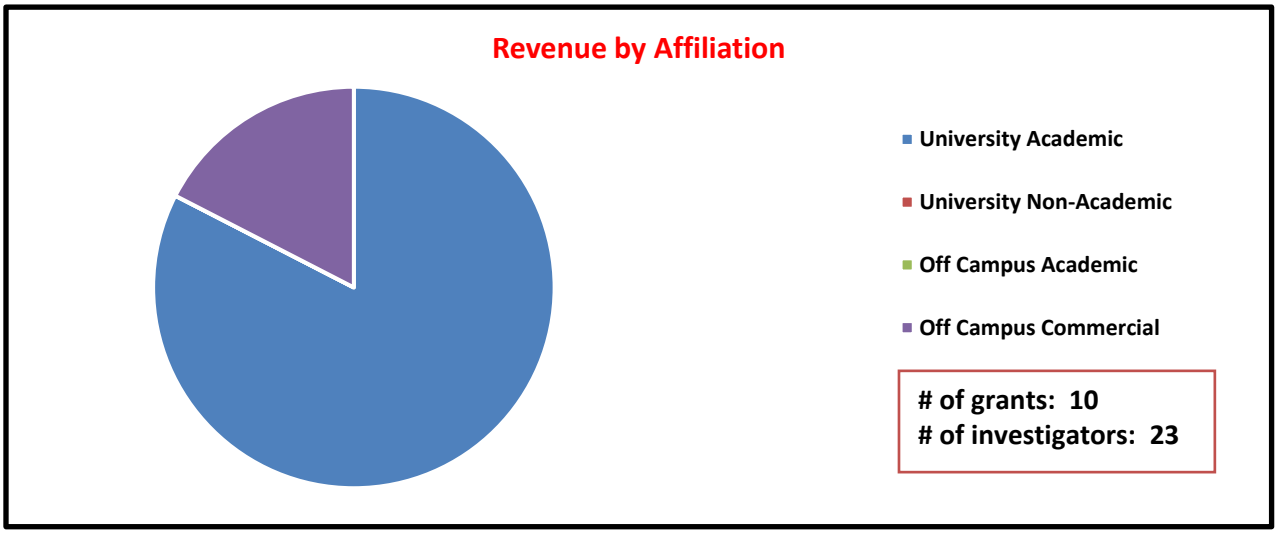
Advisory Board Committee

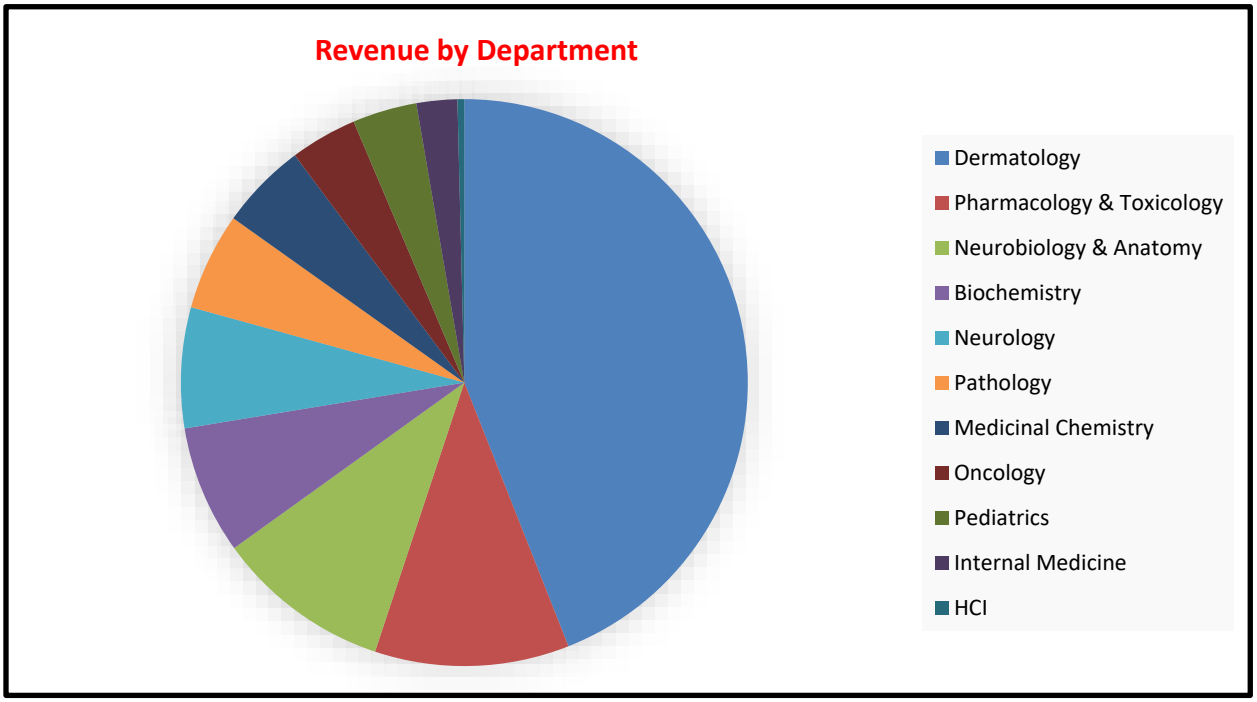
- Darrell Davis, Professor, College of Pharmacy
- Ryan Looper, Associate Professor, Chemistry Department
- John Phillips, Professor, Internal Medicine
- Jared Rutter, Professor, Department of Biochemistry
- Bryan Welm, Associate Professor, HCI

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	McMahon, Martin	Department
2	Vettore, Bio	Commercial
3	Shepherd, Jason	Matilda Ziegler Foundation
4	Villanueva, Claudio	Miller Diabetes Initiative
5	Bortolato, Marco	Department
6	Ward, Diane	NIH, Friedreich's Ataxia Research
7	Gertz, Jay	NIH
8	Welm, Bryan	NIH
9	Constance, Jonathan	Department
10	Penovich, Wanda	Department

Goals for FY2020

- Expand CRISPR screening Service
- Make a selective/proprietary UUPCC library (2000 compounds)
- Increase user base/revenue
- Present services in various department seminar series

Publications

1. Yuen, L. H., Dana, S., Liu, Y., Bloom, S. I., Thorsell, A. G., Neri, D., . . . Franzini, R. M. (2019). A Focused DNA-Encoded Chemical Library for the Discovery of Inhibitors of NAD(+)-Dependent Enzymes. *J Am Chem Soc, 141*(13), 5169-5181. doi:10.1021/jacs.8b08039

Electron Microscopy

Overview

The Electron Microscopy (EM) Core Laboratory utilizes transmission electron microscopy (TEM) and scanning electron microscopy (SEM) imaging to determine cellular structures, the morphology of biological macromolecules, the three-dimensional structures of biological macromolecules, and the size and structure of nanoparticles and other small particles. The EM facility also prepares specimens for the microscope. The EM facility has four spatially distinct locations to serve the needs of the clinical and research groups. The main facility is in SMBB, and two TEMs are located there. Two TEMs are also located in CSC. RB LAB and BIOL each house one TEM. Experiments requiring SEM are done in collaboration with the microscopes owned by the Surface Analysis Laboratory located in SMBB.

Services

Clinical Services:

- Thin-section electron microscopy of tissue biopsies (technical portion of clinical EM)

Research Services:

- Training on the TEMs, microtomes, sample preparation, and 3D image reconstruction
- Sections ("thick" and "thin") cut on microtome and ultramicrotome
- Record images on transmission or scanning electron microscopes
- Prepare and image tissues and cellular specimens via embedding, drying, osmification, and thin-sectioning
- Prepare and image particulate and macromolecular samples by staining, metal coating, drying, and cryogenic TEM
- Image specimens via three-dimensional electron microscopy
- Remote access to TEMs

Equipment

- ThermoFisher Tecnai 12, transmission electron microscope
- JEOL JEM-1400 Plus, transmission electron microscope
- Two Hitachi 7100, transmission electron microscopes
- ThermoFisher Tecnai F20, transmission electron microscope
- ThermoFisher Titan Krios, transmission electron microscope
- Leica (UC7, UC6, and UCT) and Reichert (Ultracut E), ultramicrotomes
- Leica JUNG RM2055, microtome
- ThermoFisher Vitrobot, vitrification robot
- Gatan K2 Summit, direct electron detector (Tecnai F20)
- Gatan K2/K3, direct electron detector (Titan Krios)
- Gatan BioQuantum energy filter (Titan Krios)
- Two automatic tissue processors
- Laboratory microwave oven
- Sputter coater
- Glow discharger
- High-pressure freezer
- Freeze substitution machine
- Critical-point dryer

- Access to high-performance computing nodes (CHPC)

Personnel

- David Belnap, Ph.D., Director
- Nancy Chandler, Senior Laboratory Specialist
- Bryan Gustafson, Laboratory Technician
- Willisa Liou, Ph.D., Senior Laboratory Specialist
- Linda Nikolova, Senior Laboratory Specialist
- David Timm, Ph.D., Director of Cryo-EM

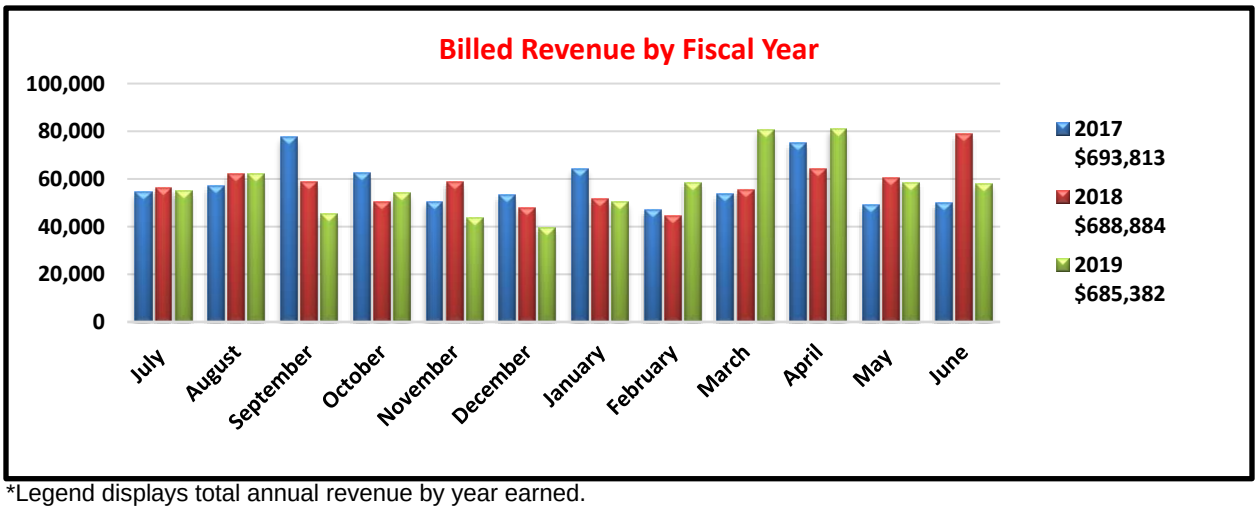
2019 Annual Update

Revenue/Expenses

FY19 Expenses: Total $641,503

FY19 Revenue: Total $755,382

- VP of Health Sciences Support: $20,000
- VP of Research Support : $50,000
- FY19 Revenue generated from services: $685,382



*Legend displays total annual revenue by year earned.

Advisory Board Committee

Last meeting date: March 2, 2017.

- Erik Jorgensen, Distinguished Professor, Department of Biology
- Patricia Revelo, Professor, Department of Pathology
- Erhu Cao, Assistant Professor, Department of Biochemistry
- Richard Rabbitt, Professor, Department of Bioengineering

Cryo-EM Implementation Committee

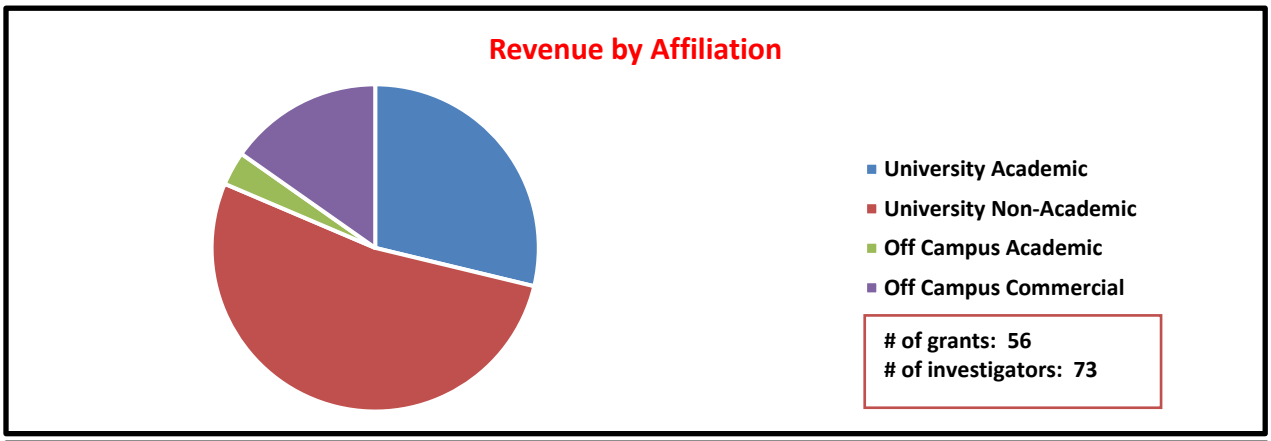
Last meeting date: July 1, 2019.

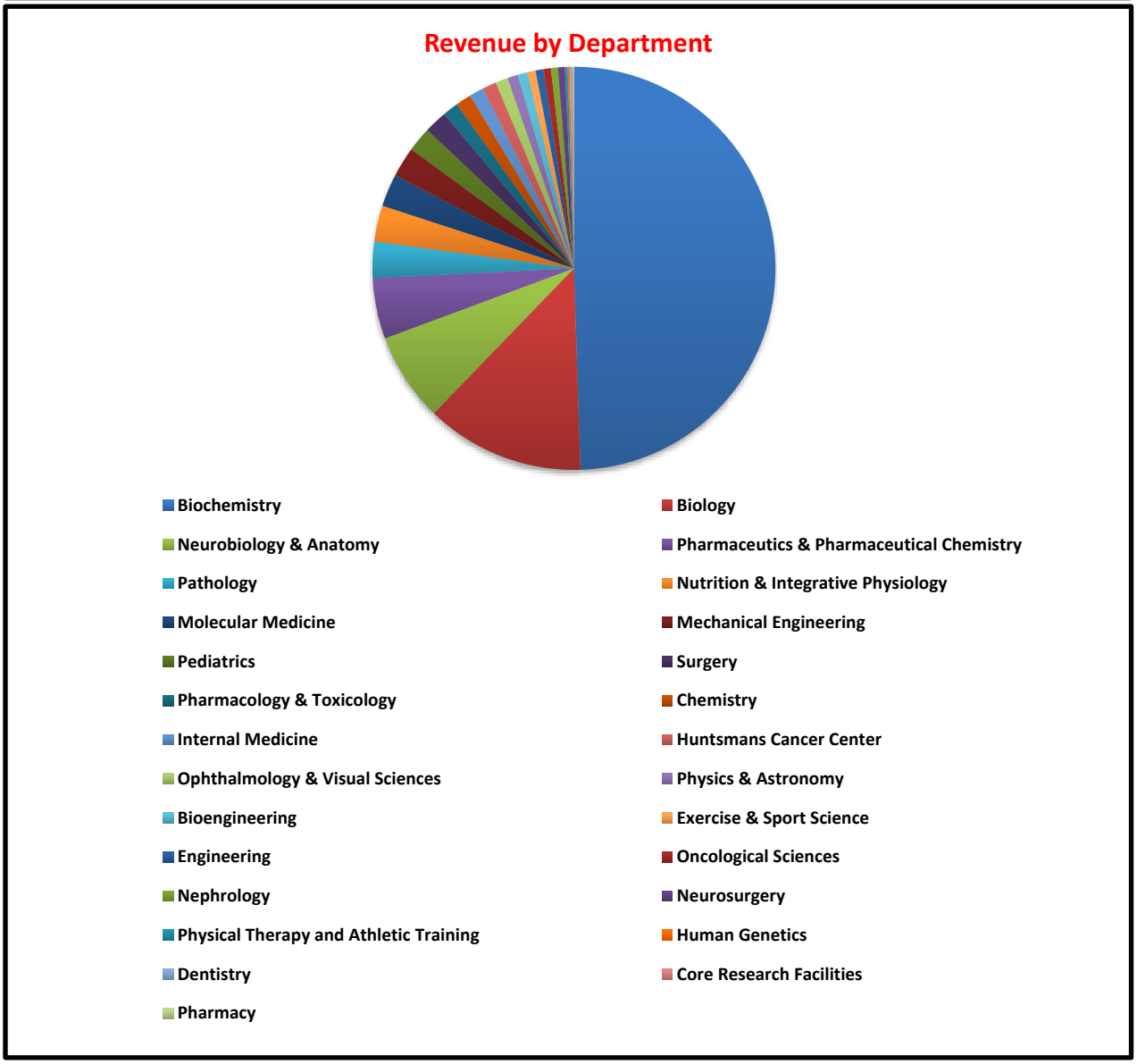
- Christopher Hill, Distinguished Professor and Co-Chair, Department of Biochemistry
- Wesley Sundquist, Distinguished Professor and Co-Chair, Department of Biochemistry
- Erhu Cao, Assistant Professor, Department of Biochemistry
- Peter Shen, Assistant Professor, Department of Biochemistry
- Heidi Schubert, Research Associate Professor, Department of Biochemistry

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	ARUP	University Non-Academic
2	Saint John's	Off Campus Commercial
3	Primary Children's Medical Center	Off Campus Commercial
4	Shen, Peter	Department
5	Hill, Christopher	Department, NIH
6	Sundquist, Wesley	Department, NIH
7	Jorgensen, Erik	HHMI
8	Utah State University	Off Campus Academic
9	Cao, Erhu	Department, NIH, Army Medical Research
10	Poplar Healthcare	Off Campus Commercial

Goals for FY2020

- Obtain high-quality TEM data from new Titan Krios microscope
- Maintain high-quality clinical services
- Increase research usage
- Increase usage of microscopes
- With opening of CSC, improve efficiency of labs by consolidation or other means

Publications

No known publications acknowledged this facility in FY 19.

Flow Cytometry Facility

Overview

The Flow Cytometry Facility offers quantitative, multi-parameter fluorescence analysis, and cell sorting services that assists over 90 investigators including a subset of industry clients. The expertise and instrumentation to perform most flow cytometric assays that have been described in the literature are available within the expertise of the collective personnel and the physical resources of the Flow Cytometry Facility. The facility offers investigators the entire spectrum of cytometric experiment management, if desired, all the way from initial design consultation to the creation of graphics for publication.

Uniqueness

The Flow Cytometry facility is recognized for the most part as an instrumentation based service lab. However, we believe that education is a crucial component for the growth and sustainability of the facility. First, facility staffs are encouraged to maintain state of the art knowledge in order to pass this information along to the users. Secondly, we believe that education in the field of flow cytometry for users will lead to more successful experimental outcomes that will in turn increase overall usage. To this end, we provide multiple levels of education from one on one consultation to routine seminars covering a variety of topics. Although this may not be unique when compared to other Core facilities, it is a noticeable quality of our services when compared to other non-centralized instrumentation on campus.

Services

The assays offered by the facility range from routine cell cycle analysis and immunophenotyping to complex multi-laser applications and high speed cell sorting. Examples of the assays available include, but are not limited to the following:

- DNA content/cell cycle measurement
- Immunofluorescence analyses
- Characterization of cell populations based on scattered light intensity measurements and autofluorescence
- Cell sorting including viable, sterile cell sorting
- Intracellular calcium flux
- A range of apoptosis assays
- Fluorescence Resonance Energy Transfer (FRET)
- Nanoparticle characterization
- Bivariate and univariate chromosome analysis
- Receptor-ligand interactions
- Cell proliferation studies including BrdU incorporation and CFSE tracking
- Viability assays (membrane exclusion and metabolic viability)
- Various function assays including oxidative metabolism, neutrophil function (oxidative burst, phagocytosis) cytoplasmic pH, membrane potential
- Kinetic analyses
- Signal transduction pathway analyses (simultaneous assessment of multiple intracellular phosphorylated epitopes combined in complex multi-color assays)
- Sample preparation and staining

Consultation and training is provided in order to define projects in the early stages of development to make optimal and efficient use of flow cytometry. The staff will prepare samples including staining, data collection, quality control, data analysis/interpretation, and creation of graphics. Alternatively, if the investigator chooses, the facility can provide consultation only on any of the above services so that the research is entirely in the hands of the investigator.

Equipment

Sorters

- BD FACSAria-5 laser
- Propel Labs Avalon-2 laser
- BD FACSAria-4 laser

Analyzers

- BD FACSCanto
- BD LSRFortessa
- Beckman Coulter Cytoflex LX
- Beckman Coulter Cytoflex S
- Beckman Coulter Cytoflex
- BD Celesta
- Cytek DxP

Personnel

- James Marvin, Director
- Tessa Galland, Senior Lab Technician
- Nidhi Choksi, Senior Lab Technician
- Kirk Heitpas, Lab Technician
- Gabriel DeNiro, Lab Technician

FY19 Annual Update

New Equipment

The Flow Cytometry Core has continued to provide instrumentation oversight including training and quality control measures for the Pathology department. A ThermoFischer Attune NxT flow cytometer was added in FY19 which brings the total up to 4 additional instruments managed by the flow core. FY19 also saw the arrival of another Beckman Coulter Cytoflex instrument that was placed at HCI. This is a 4 laser instrument with the ability to activate 2 more lasers.

Staffing

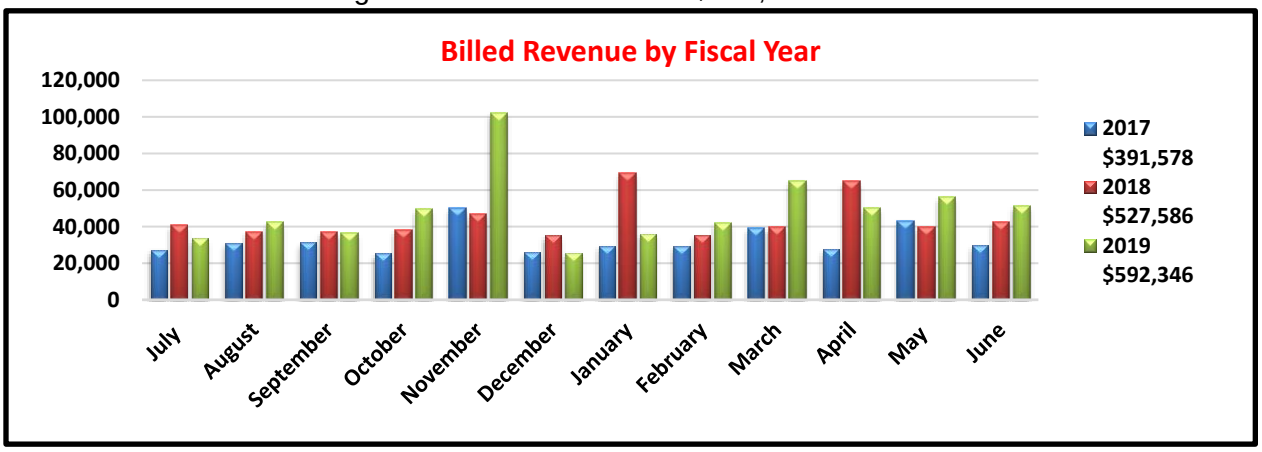
Both Tessa Galland and Nidhi Choksi are continuing their education and training in the flow cytometry facility. They both attended the yearly flow cytometry course that was held in Madison, Wisconsin in June 2019. We also added one more technician. Kirk Heitpas was hired in September 2018 to fill this role. Gabriel DeNiro is continuing in the lab and primarily working on quality control of instrumentation. In order to address some comments related to a shared instrumentation grant review, we have also elevated Matthew Williams to be the chair of the advisory board in addition to serving as the “Faculty Advisor”.

Revenue/Expenses

FY19 Expenses: Total $503,334

FY19 Revenue: Total $592,346

- VP of Research Support (RIF): $0
- FY19 Revenue generated from services: $592,346



***** Total annual revenue displayed in legend.

Advisory Board Committee

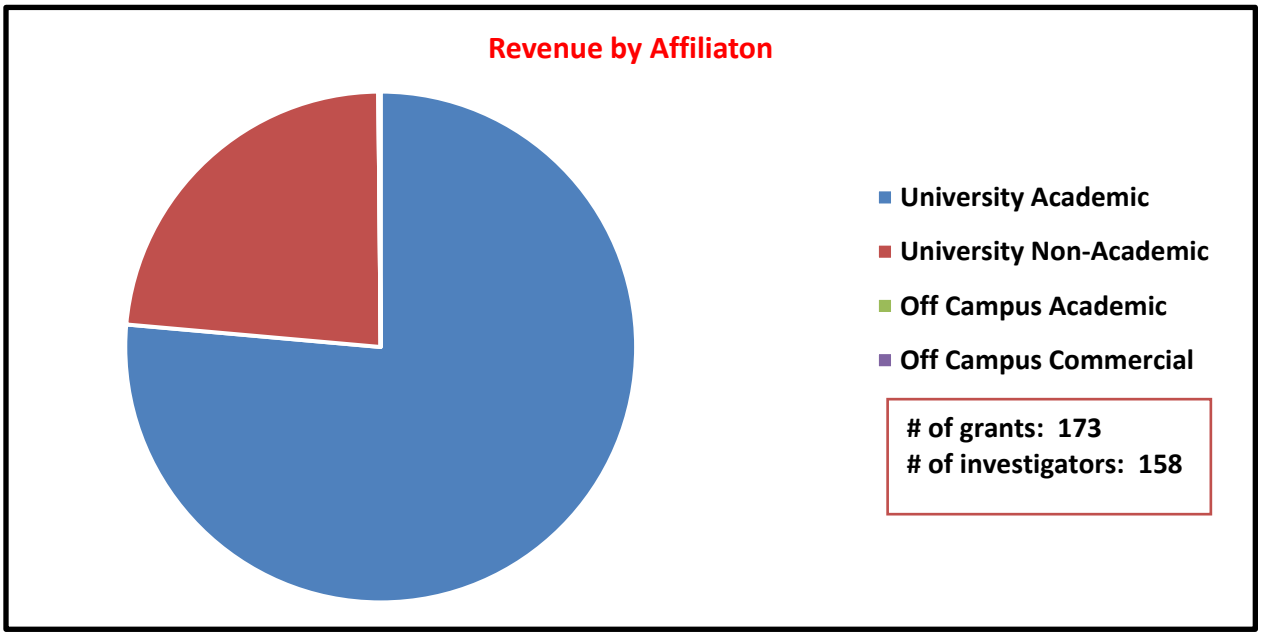
Last meeting date: November 29, 2018

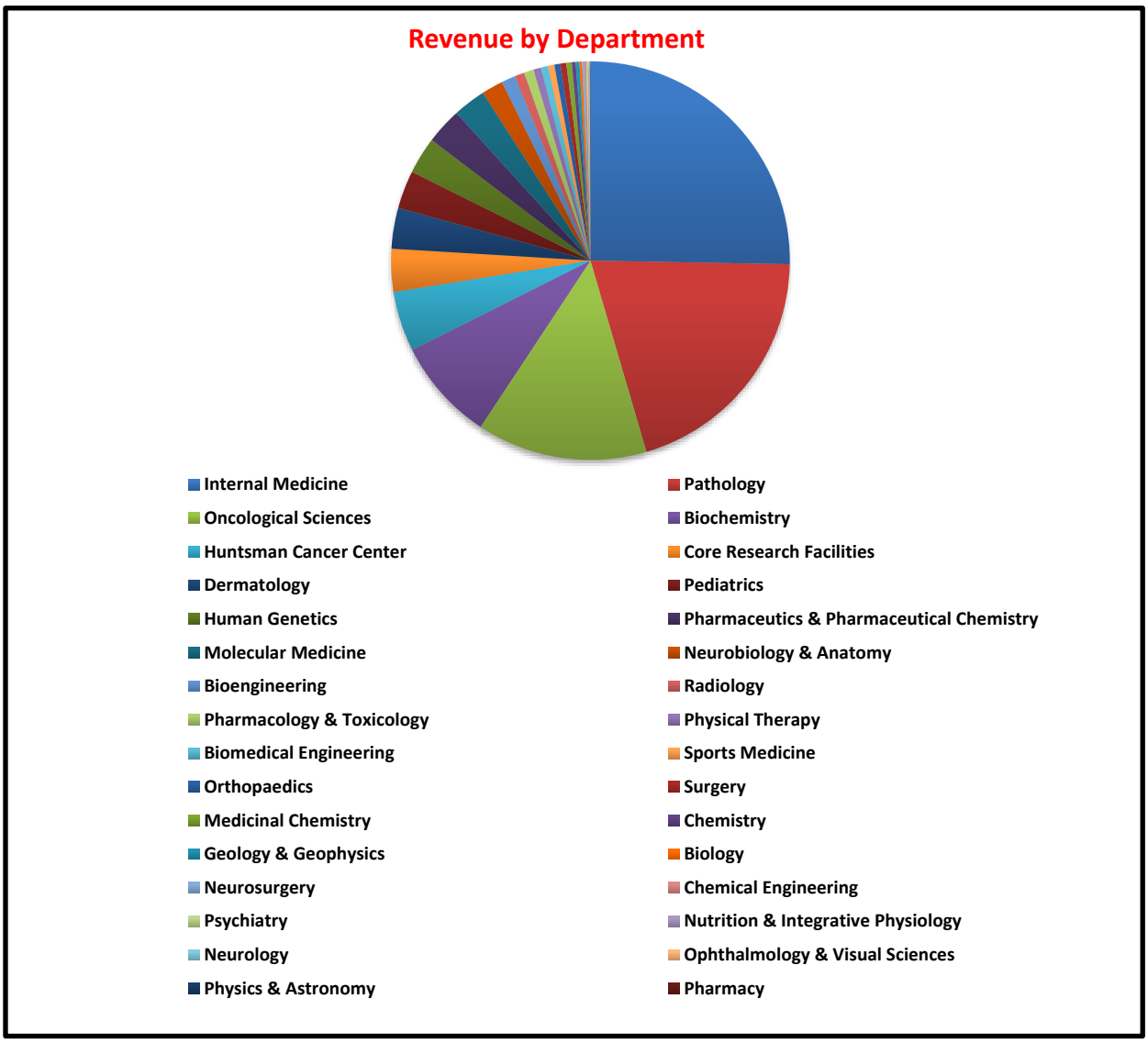
- Matthew Williams, Assistant Professor, Pathology Advisory Board Chair
- Ryan O'Connell, Assistant Professor, Pathology
- Thomas O'Hare, Associate Professor, Hematology
- Daniel Leung, Assistant Professor, Internal Medicine

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	ARUP	Off Campus
2	Camp, Nicola	Department
3	Atanackovic, Djordje	Department, HCI, Sanofi US Services Inc.
4	Schlichter, Alisha	HHMI
5	McMahon, Martin	Department, NIH, Melanoma Research Alliance
6	Leung, Daniel	Army Medical Research Acquisition
7	Evavold, Brian	Department, NIH
8	Williams, Matthew	Department, NIH
9	Schiffman, Joshua	Department, Hyundai, Sarcoma Alliance for Research
10	Deininger, Michael	NIH, HCI, Foundation for Cancer Research

Goals for FY2020

We are anticipating in FY20 the arrival of a new Cytek Aurora. This instrument is different than most traditional instruments and is capable of detecting over 30 colors at once. This instrument will involve a large amount of training and consultation. We anticipate developing some complex phenotypic panels in order to better customize training and support for this instrument. The flow core is also gathering information to determine if a new cell sorter is needed. We would likely be looking at a 4-laser low end instrument that can easily be set up for self-run usage. A leading example of this would be the Sony SH800. Additionally, the flow lab is considering an instrument that is specifically designed for small particle detection. Similar to previous years, we are continuing to focus on user and staff education through increased seminars and sample prep projects.

Publications

1. Abdel-Mohsen, M., Kuri-Cervantes, L., Grau-Exposito, J., Spivak, A. M., Nell, R. A., Tomescu, C., Montaner, L. J. (2018). CD32 is expressed on cells with transcriptionally active HIV but does not enrich for HIV DNA in resting T cells. *Sci Transl Med, 10*(437). doi:10.1126/scitranslmed.aar6759
2. Anderson, S. R., Roberts, J. M., Zhang, J., Steele, M. R., Romero, C. O., Bosco, A., & Vetter, M. L. (2019). Developmental Apoptosis Promotes a Disease-Related Gene Signature and Independence from CSF1R Signaling in Retinal Microglia. *Cell Rep, 27*(7), 2002-2013 e2005. doi:10.1016/j.celrep.2019.04.062
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14. Li, L., Yang, J., Wang, J., & Kopecek, J. (2018). Drug-Free Macromolecular Therapeutics Induce Apoptosis via Calcium Influx and Mitochondrial Signaling Pathway. *Macromol Biosci, 18*(1). doi:10.1002/mabi.201700196
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Genomics Facility

Overview

The Genomics Facility offers a variety of genetic analysis services including full service genotyping, from PCR setup through analysis, and assistance to researchers performing genotyping projects. The facility has commercial and custom sets of fluorescently labeled microsatellite markers that can be used for whole genome linkage studies and fine mapping projects. Researchers can select genes or regions of interest and the facility designs and optimizes the PCR primers, performs the initial PCR, runs the sequencing reactions, and analyzes the data using SoftGenetics Mutation Surveyor software.

Services

Fragment Analysis

- Full service genotyping from PCR setup through analysis
- Capillary Runs
- Microsatellite Instability
- Loss of Heterozygosity
- Multiplex Ligation Dependent Amplification

SNP Genotyping

- Taqman SNP Genotyping
- Illumina Whole-Genome Genotyping and Copy Number Variation Analysis
- Methylation Analysis
- Open Array Genotyping

Real Time PCR

- Gene Expression

Equipment

- One AB 7900HT system
- Illumina iScan
- Quantstudio 12k Flex Real-Time PCR System

Personnel

- Derek Warner, Director
- Michael Klein, Manager

2019 Annual Update

New Equipment

No new instrumentation for FY19.

New Services

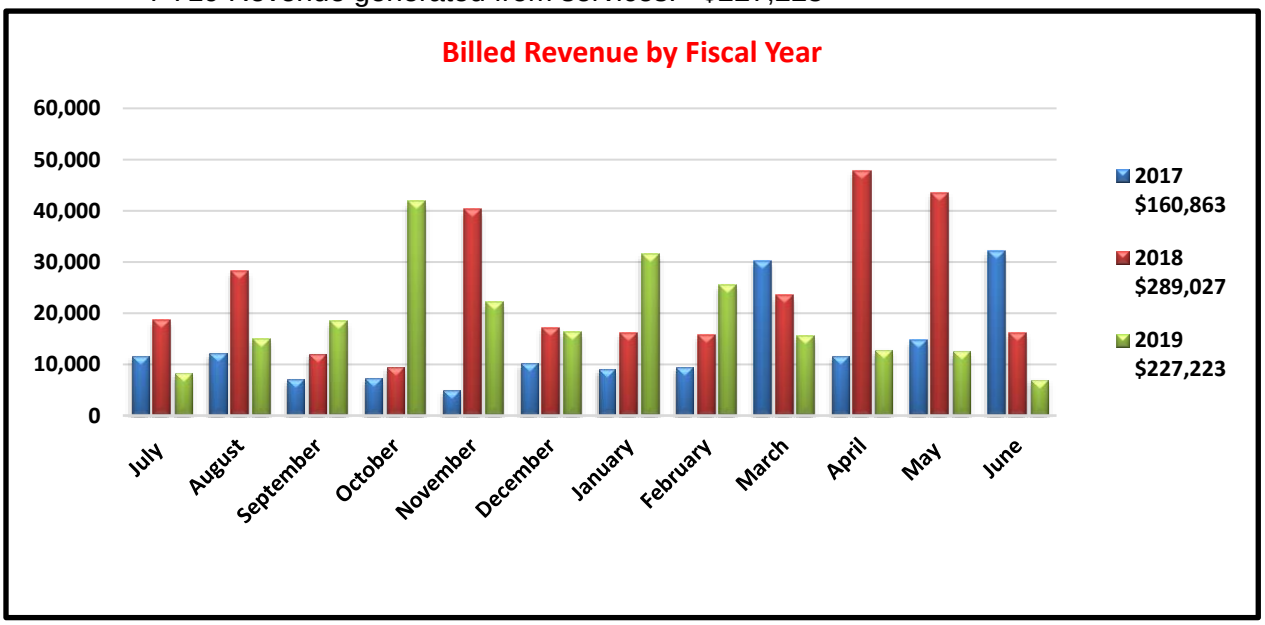
No new services for FY19.

Revenue/Expenses

FY19 Expenses: Total $207,472

FY19 Revenue: **Total $227,223**

- VP of Health Sciences Support: 0
- FY19 Revenue generated from services: $227,223



***** Legend displays total annual billed revenue by year.

Advisory Board Committee

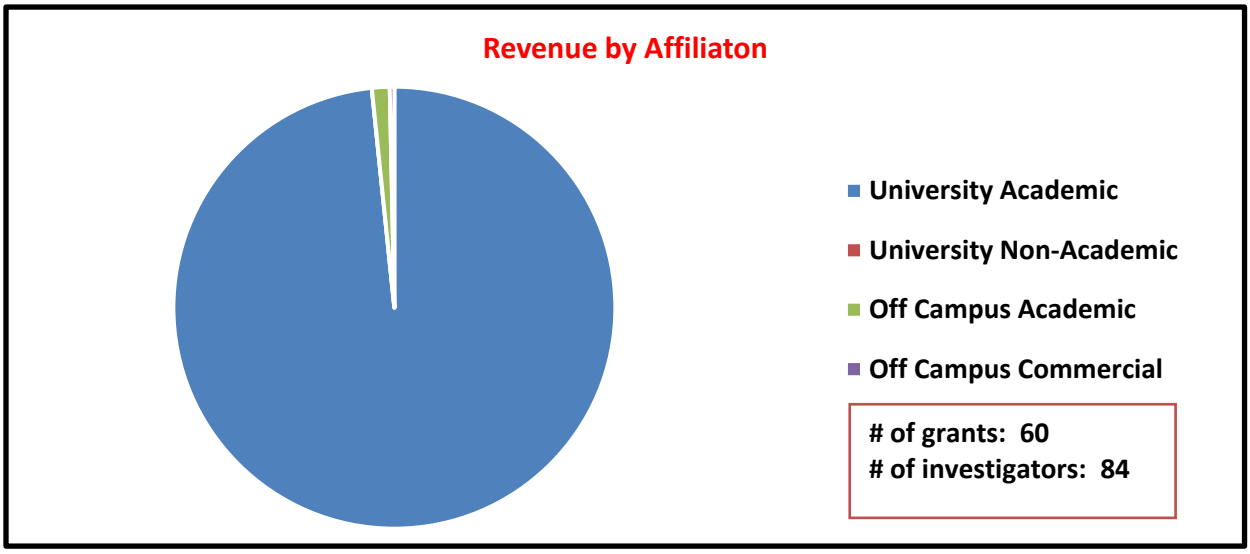
Last meeting date: February 21, 2017

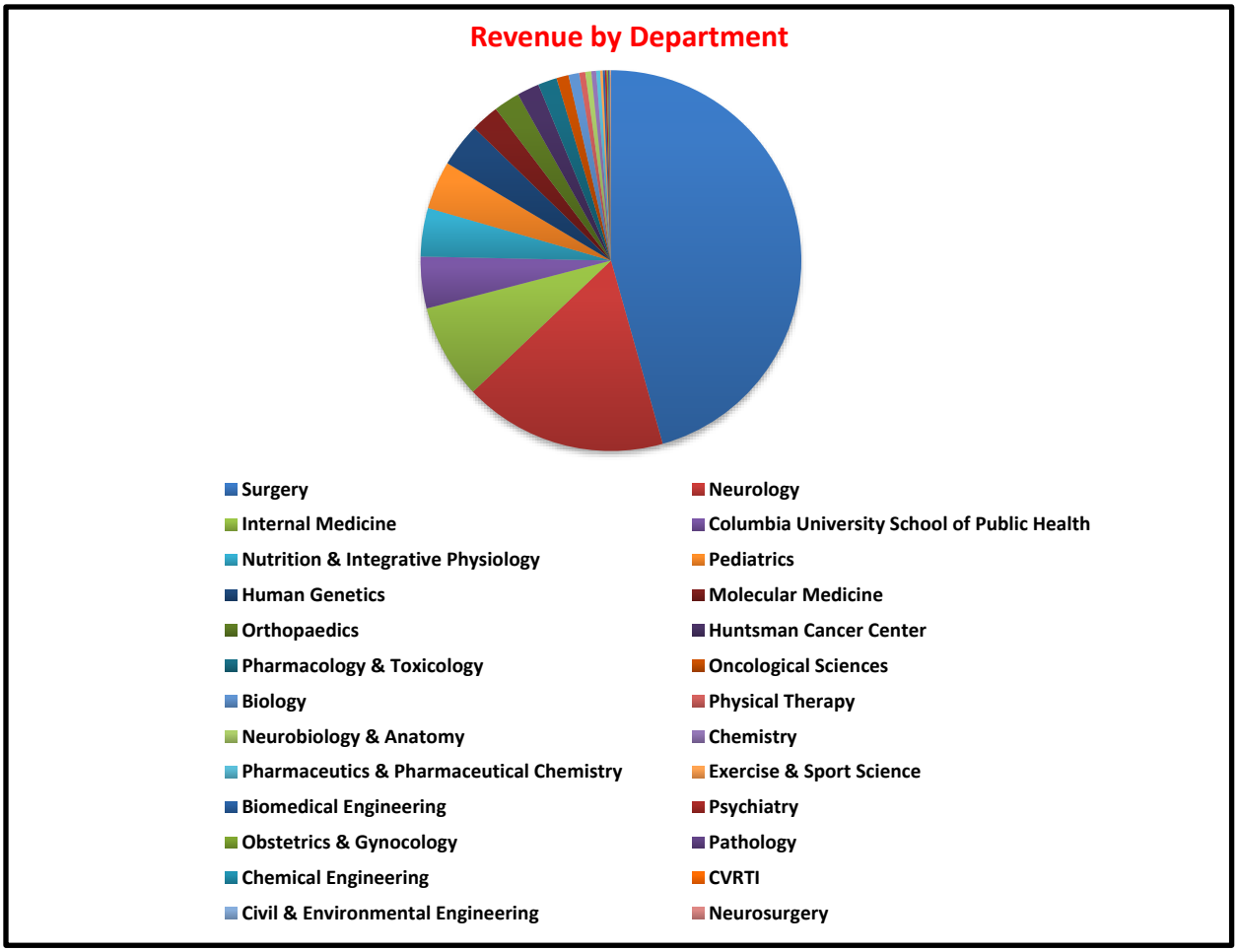
- Gerald Krueger, Professor, Dermatology
- Deborah Neklason, Research Associate Professor, Huntsman Cancer Institute
- Nicola Camp, Professor, Department of Medicine/Human Genetics

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Carrell, Douglas	Department
2	Penovich, Wanda	Department
3	Columbia University	Off Campus Academic
4	Holland, William	Department, NIH
5	Johnson, Nicholas	WYCK Foundation
6	Pezzolesi, Deborah	Janssen Pharmaceutical, Inc.
7	Neklason, Deborah	NCI
8	Weiss, Robert	Department, NIH
9	Welm, Bryan	Department, NIH
10	Peterson, Randall	Department

Publications

1. Anderson, S. R., Roberts, J. M., Zhang, J., Steele, M. R., Romero, C. O., Bosco, A., & Vetter, M. L. (2019). Developmental Apoptosis Promotes a Disease-Related Gene Signature and Independence from CSF1R Signaling in Retinal Microglia. *Cell Rep, 27*(7), 2002-2013 e2005. doi:10.1016/j.celrep.2019.04.062

2. Anderson, S. R., Zhang, J., Steele, M. R., Romero, C. O., Kautzman, A. G., Schafer, D. P., & Vetter, M. L. (2019). Complement Targets Newborn Retinal Ganglion Cells for Phagocytic Elimination by Microglia. *J Neurosci, 39*(11), 2025-2040. doi:10.1523/JNEUROSCI.1854-18.2018
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10. Farhang, N., Brunger, J. M., Stover, J. D., Thakore, P. I., Lawrence, B., Guilak, F., Bowles, R. D. (2017). (*) CRISPR-Based Epigenome Editing of Cytokine Receptors for the Promotion of Cell Survival and Tissue Deposition in Inflammatory Environments. *Tissue Eng Part A, 23*(15-16), 738-749. doi:10.1089/ten.TEA.2016.0441
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Machine Shop

Overview

The Machine Shop Facility is equipped with a full complement of lathes, drills, mills, welders, grinders, and CNC Lathe and Milling systems, staffed by experienced CNC machinists and engineers capable of turning an idea into reality. The Shop Staff provide consultation to assist with the design process for products ranging from precise surgical instruments to large-scale testing equipment. They also fabricate as well as repair devices and parts made from carbon-steel, stainless steel, brass, copper, plastics, and other materials depending upon the requirements of design specifications. We provide microscope parts, stages and assemblies, surgery tool modifications, replications, alterations and reverse engineering.

Services

- Device Design/Engineering from basic concept to finished product
- CNC and Manual 3 axis Milling machines 2D and 3D machining
- CNC and manual Lathes up to
- Drilling
- Grinding
- Silver Soldering, Brazing
- MIG, TIG, Welding of steel, aluminum, and other types of fabrication
- Sawing, shearing and bending brakes
- Repair and Maintenance of most types of mechanical work
- The Machine Shop Facility supplies fast plastic fabrication using technology developed in the shop.

Equipment

- Two CNC Mills
- Two Traditional Mills
- Four Manual Lathes
- Grinders
- MIG, TIG, Gas, Arc, and Spot welders
- Wood Working Equipment
- Band & Table Saws
- Sharpening Equipment
- Polishing Equipment

Personnel

- Shawn Colby, Machinist, Director
- Kim Slusser, Machinist, Surgical Tool Expert
- Mike Sanches, Machine Operator, Research Specialist, Graphic Artist
- Mr. Barry Evans has retired as of April 2019. He is replaced by Mr. Colby as the director of the machine shop.

2019 Annual Update

New Equipment

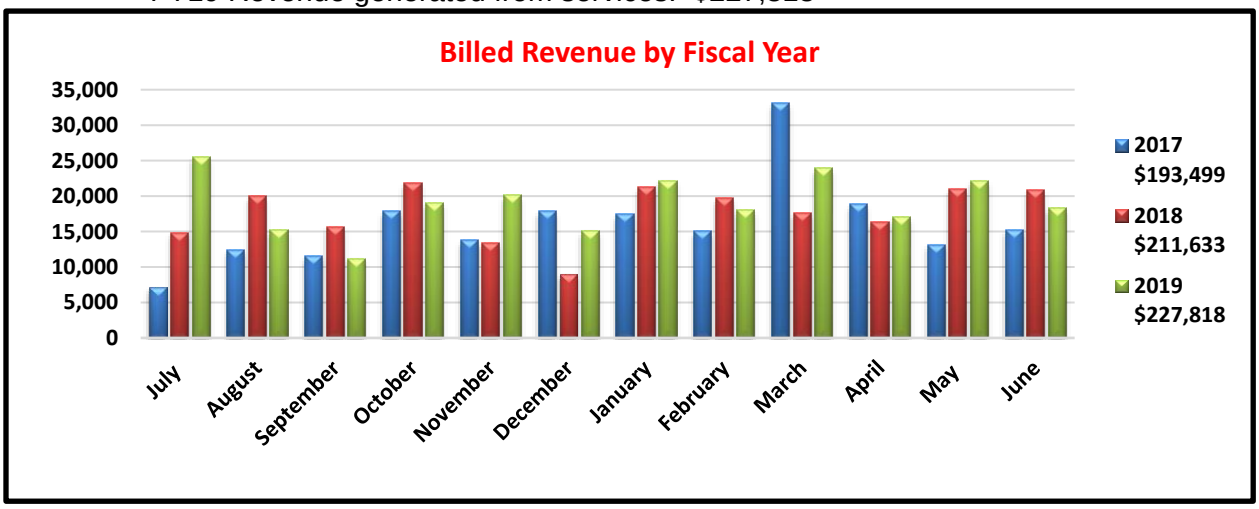
- New 3 axis Tree CNC Vertical Mill with Fanuc Controller

Revenue/Expenses

FY19 Expenses: Total $297,130

FY19 Revenue: Total $315,368

- VP of Health Sciences Support: $87,550
- FY19 Revenue generated from services: $227,818



* Legend displays total annual revenue by year generated.

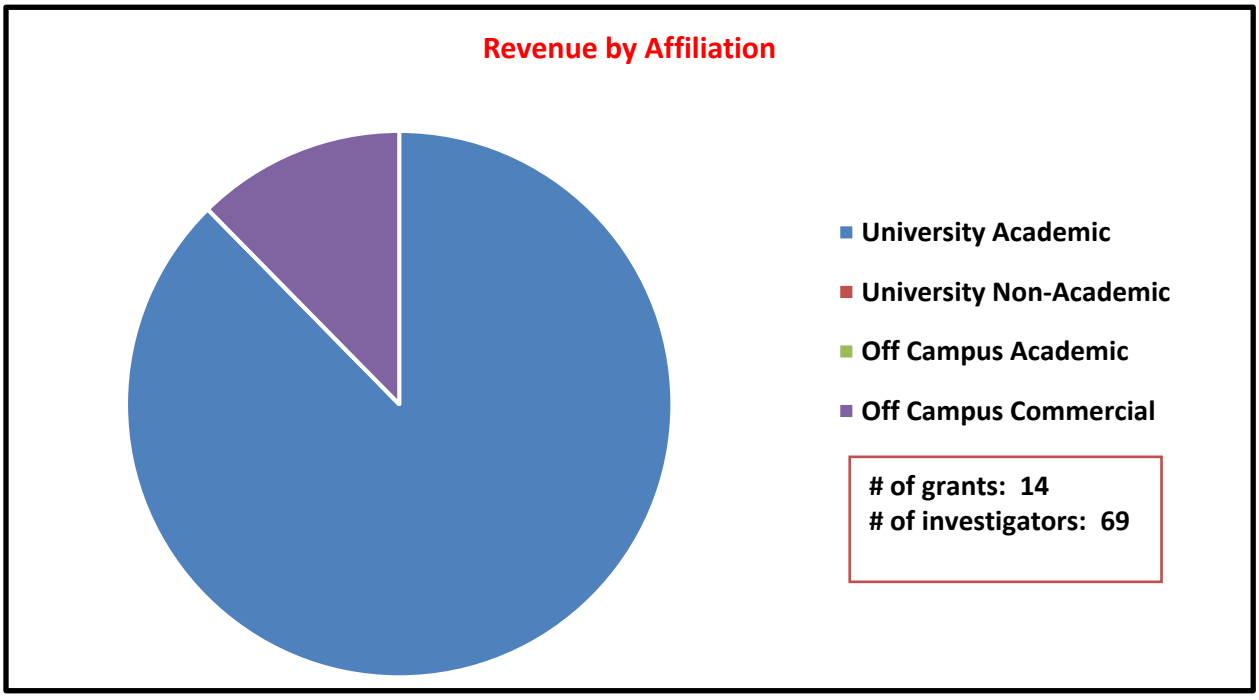
Advisory Board Committee

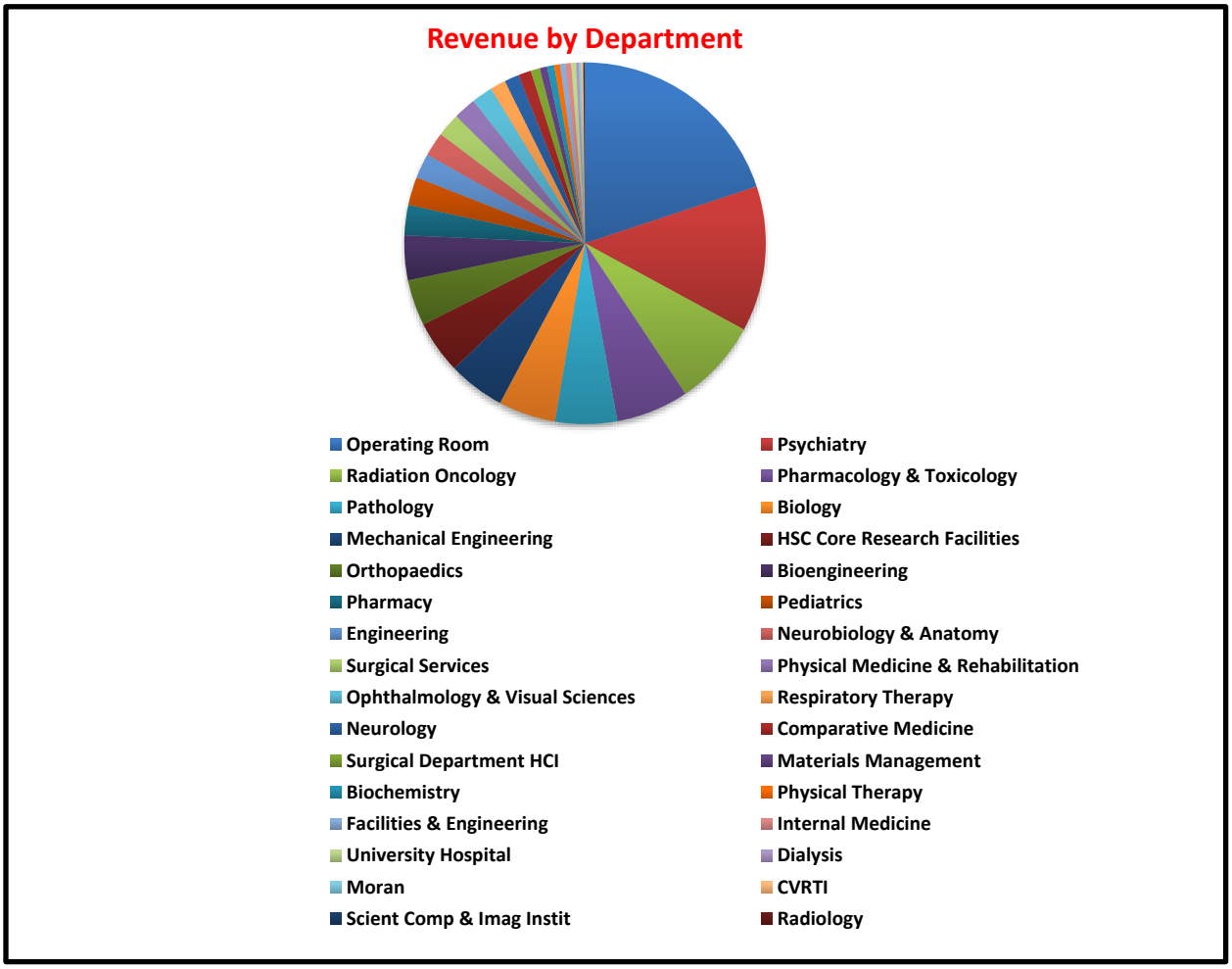
- Perry Renshaw, Professor, Psychiatry
- Michelle Ford, Materials Management Facilitator, Facilities Engineering
- Kyle Thomson, Researcher, Add Program

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Ford, Michelle	Department
2	Renshaw, Perry	VA
3	Meisner, Steve	Department
4	Wilcox, Karen	NIH
5	Stevens, Peter	Commercial
6	Clausing, Alishia	Department
7	Goldenberg, David	Department
8	Evavold, Brian	Department
9	Kanekar, Shami	Department
10	Minor, Mark	NSF

Publications

No publications acknowledged this facility in FY19.

Mass Spectrometry & Proteomics

Overview

The Mass Spectrometry & Proteomics Facility is geared toward supporting proteomics research as well as providing basic mass spectrometry (MS) support for a broad range of research and sample types, such as polymers, natural products, small synthetic molecules, peptides, large intact proteins, and nucleic acids. The facility is equipped with several high-performance mass spectrometers, including a state-of-the-art FTMS instrument (LTQ-FT; ThermoElectron) with nano-LC and nano-ESI ionization, and a state-of-the-art Maldi/ToF/ToF instrument (UltrafleXtreme; Bruker Daltonics) with tissue-imaging capabilities. LC/MS/MS instruments in the lab are equipped with nano-LC for ultimate sensitivity and chromatographic performance. The mission of this facility is to provide the highest quality mass spectrometry analyses for protein and other biomolecule investigations.

Services

A range of proteomics, FTMS, and general and tissue-imaging MS services are available. In addition, the facility periodically participates in an international proteomics proficiency evaluation conducted by the Association of Bimolecular Resource Facilities (ABRF) to ensure the competency of the facility compared with other leading proteomics laboratories for the structural analysis of proteins and peptides. The following services are provided to investigators:

Proteomics Services:

- Protein ID from SDS Gel
- Protein ID from Solution
- Protein ID from Complex Isolates in Solution and IP Pull-down Experiments
- Identification of Protein Modifications/Post-translational Modifications
- Intact Protein MW Analysis
- Peptide Screening with MS/MS (FTMS) and accurate mass de novo sequencing
- Disulfide Linkage Characterization
- Identification of Sulfur-containing peptides
- “Top-Down” and “Bottom-Up” Proteomics
- Protein Expression/Quantification Analysis
- Custom Database Searching
- FTMS Services
- Accurate mass measurement-external calibration (Positive Ion)
- Accurate mass measurement-internal calibration (Positive Ion)
- Accurate mass measurement (Negative Ion)
- Peptide Sequencing with MS/MS and accurate mass de novo sequencing
- Identification of Sulfur-containing peptides
- High-resolution mass spectrometry (HR-MS) analysis

General MS Services

- ESI/MS
- ESI/MS/MS
- Nucleic Acids
- LC/MS

- LC/MS/MS
- Maldi/ToF/ToF
- Special Project/Method Development

Tissue-Imaging MS Services

- Cryostat Tissue Sectioning and Maldi Plate Setup
- Tissue Section Preparation and Setup
- Maldi/ToF Imaging of Tissue Sections
- Software Data Processing and Image Generation
- Software Data Processing and Image Generation-by User

Equipment

Mass Spectrometers

- New! Thermo QExactive HF
- Bruker UltrafleXtreme
- Waters Q-ToF-2
- Bruker Maxis II HD for high mass accuracy intact protein analysis.

HPLC Systems

- Two Eksigent 1D nanoLC systems
- One Eksigent 2D-Ultra system
- One Shimadzu 10AD system
- One Leica CM1950 cryostat system

Personnel

- James Cox, Ph.D., Director
- Krishna Parsawar, Ph.D., Assistant Director
- Sandra Osburn, PhD., Research Associate

Advisory Board Committee

- Darrell Davis, Professor, Medicinal Chemistry
- Wes Sundquist, Professor, Biochemistry
- Michael Kay, Professor, Biochemistry

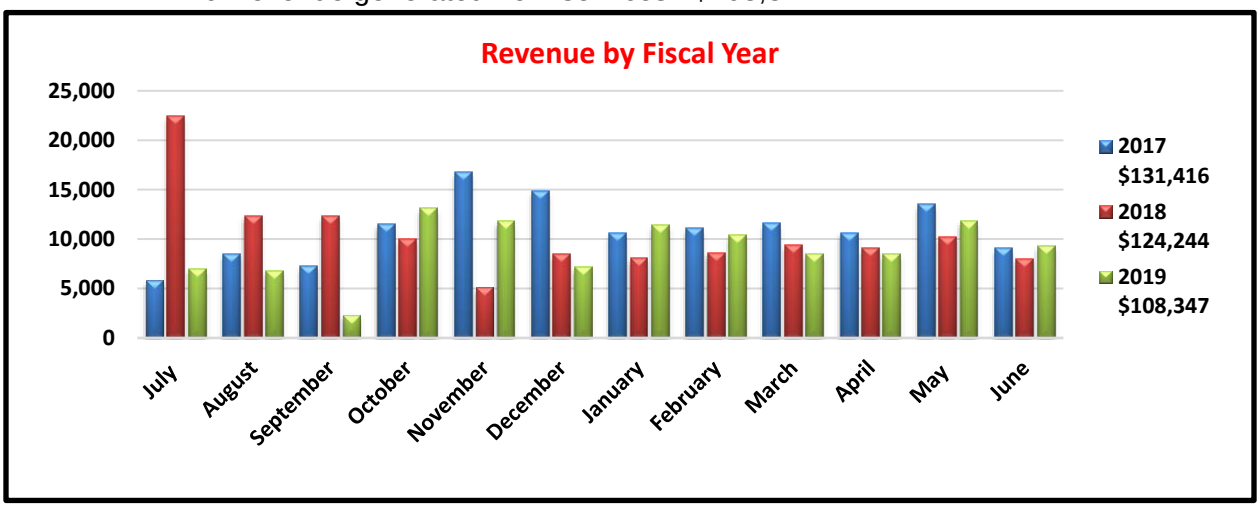
2019 Annual Update

Revenue/Expenses

FY19 Expenses: **Total $686,016**

FY19 Revenue: **Total $667,347**

- VP of Health Sciences Support: $145,000
- VP of Health Sciences DMCR Support: $414,000 (for equipment purchase)
- FY19 Revenue generated from services: $108,347

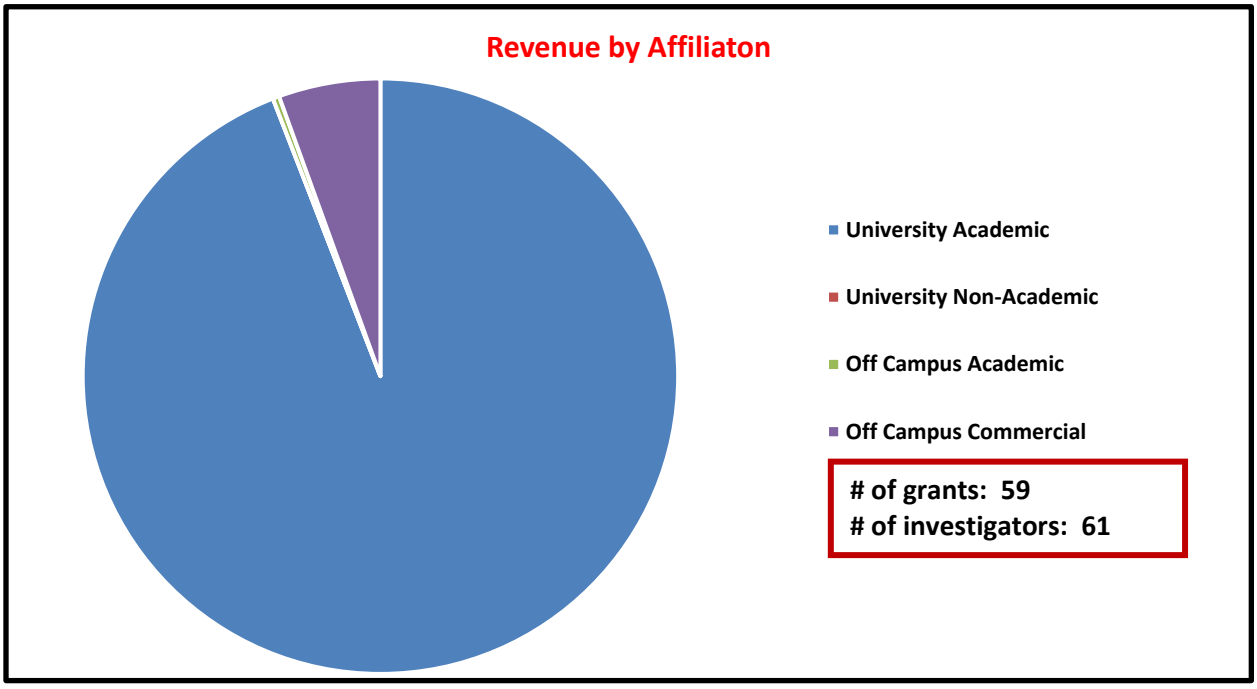


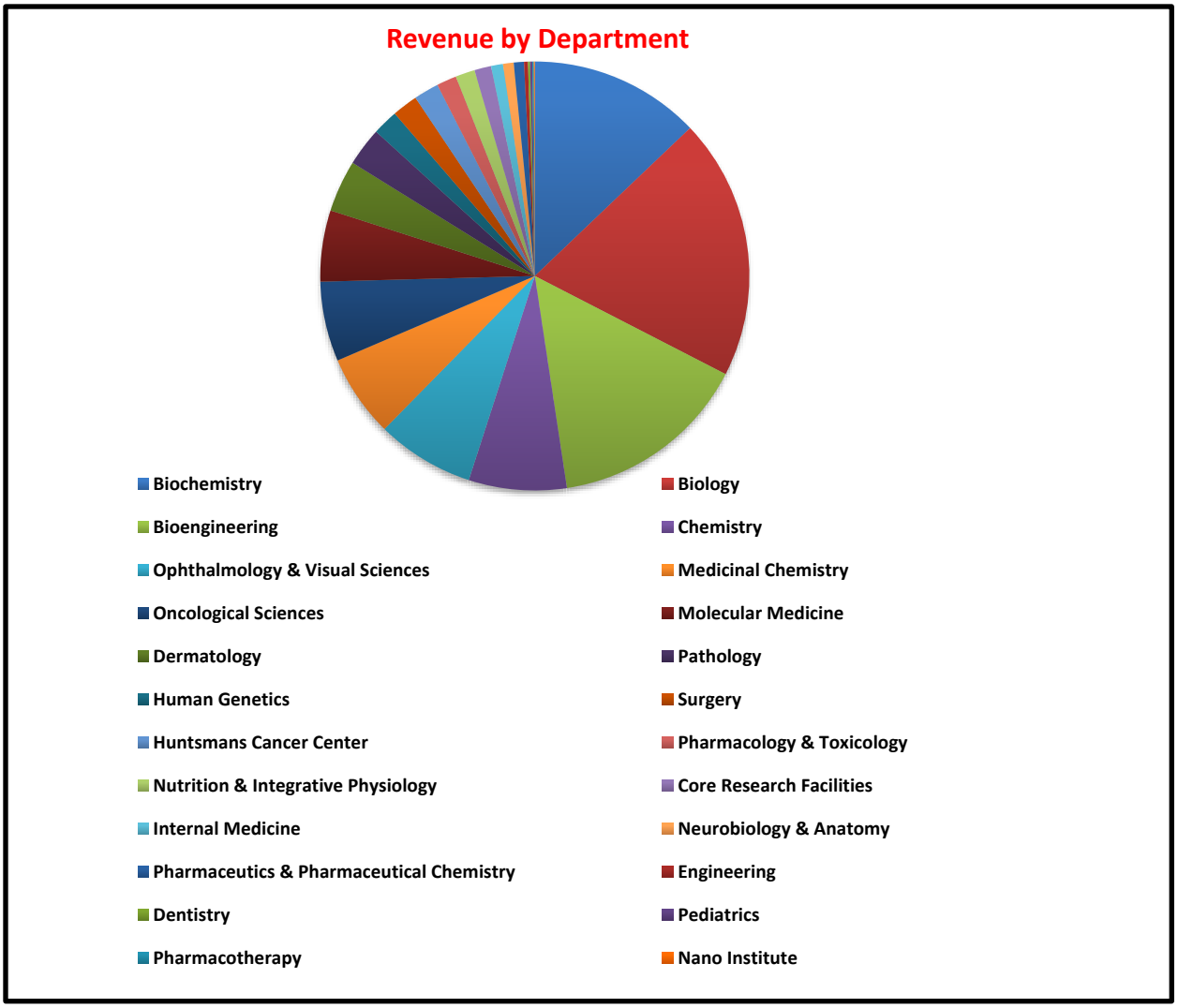
* Legend displays total annual revenue by year earned.

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Yu, Michael	NIH
2	Olivera, Baldomero	Department
3	Yandell, Mark	NIH
4	Sundquist, Wesley	Department
5	Hageman, Gregory	Department
6	Feng, Bingjian	Pfizer
7	Beckerle, Mary	Department
8	Minteer, Shelley	US Department of Defense Army
9	Weyrich, Andy	NIH
10	Hill, Christopher	Department

Publications

1. Ahorukomeye, P., Disotuar, M. M., Gajewiak, J., Karanth, S., Watkins, M., Robinson, S. D., Safavi-Hemami, H. (2019). Fish-hunting cone snail venoms are a rich source of minimized ligands of the vertebrate insulin receptor. *Elife, 8*. doi:10.7554/eLife.41574
2. Bennink, L. L., Li, Y., Kim, B., Shin, I. J., San, B. H., Zangari, M., Yu, S. M. (2018). Visualizing collagen proteolysis by peptide hybridization: From 3D cell culture to in vivo imaging. *Biomaterials, 183*, 67-76. doi:10.1016/j.biomaterials.2018.08.039
3. O'Brien, H., Kanemura, S., Okumura, M., Baskin, R. P., Bandyopadhyay, P. K., Olivera, B. M., Safavi-Hemami, H. (2018). Ero1-Mediated Reoxidation of Protein Disulfide Isomerase Accelerates the Folding of Cone Snail Toxins. *Int J Mol Sci, 19*(11). doi:10.3390/ijms19113418
4. Sadler, J. B. A., Wenzel, D. M., Williams, L. K., Guindo-Martinez, M., Alam, S. L., Mercader, J. M., Martin-Serrano, J. (2018). A cancer-associated polymorphism in ESCRT-III disrupts the abscission checkpoint and promotes genome instability. *Proc Natl Acad Sci U S A, 115*(38), E8900-E8908. doi:10.1073/pnas.1805504115

Metabolic Phenotyping

Overview

The Metabolic Phenotyping Core (MPC) offers several standardized and high quality metabolic and physiologic tests for phenotypic characterization of animal models of diabetes and other metabolic disorders. These metabolic and physiologic phenotyping tests include determination of whole body glucose metabolism and insulin sensitivity of animals by glucose and insulin tolerance tests and glucose clamps, assessment of whole animal energy expenditure using the Columbus Instrument's Oxymax Lab Animal Monitoring System, determination of body composition by Bruker Minispec NMR and determination of circulating hormones, growth factors and cytokine concentrations using the Luminex xMAP multiplex systems (MAGPIX and Luminex 200), measurement of analyte (metabolites, ions, gases, enzymes) concentration in the body fluids such as serum, plasma, urine and cerebrospinal fluid using Vitros 350 chemistry analyzer. In addition, MPC performs tests to map the metabolic phenotype of different cell types and tissues using Agilent-Seahorse XF24 and XF^{e}96 analyzers. The MPC also helps the scientists to optimize phenotyping tests. The overall goal of MPC is to expedite medical and biological research efforts by providing academic and non-academic researchers access to advanced metabolic phenotyping tests at a reasonable price.

Services

- Mitochondrial Bioenergetics Agilent-Seahorse XF^{e}96 extracellular flux analyzers
- Cellular energy metabolism using Agilent-Seahorse XF24 and XF^{e}96 extracellular flux analyzers
- Assessment of energy balance in mice using CLAMS Metabolic chambers
- Body Composition (lean mass, fat mass and water content) using Bruker Minispec NMR
- High throughput biomarker screening and quantification using Luminex technology
- Multiplexed protein analyte (hormone, growth factors, cytokines, adipokines, myokines and signaling molecules) quantification using MagPix and Luminex-200
- Multiplexed high throughput quantification of metabolites in body fluids such as serum, plasma, urine and cerebrospinal fluid using Vitros 350 chemistry analyzer
- Whole body glucose metabolism and insulin sensitivity- Glucose and insulin tolerance tests
- Isolation of Pancreatic islets
- Beta cell mass, cell proliferation and cell death
- Chronic exposure of mice to cold/warm temperature
- Radiometric enzyme assays- glycogen synthase and phosphorylase activities in metabolic tissues

Equipment

- Seahorse Flux Analyzer XF24
- Seahorse Flux Analyzer XF^{e}96
- Eight Columbus Instruments metabolic chambers equipped with temperature-controlled enclosure.
- Eight Columbus Instruments CLAMS metabolic chambers equipped with running wheels and with the capability to measure core body temperature and heart rate.
- Bruker Minispec NMR
- Luminex MAGPIX
- Luminex 200 System
- Ortho Clinical Vitros 350 chemistry analyzer
- Powers Scientific rodent incubators

Personnel

- Anil Laxman, Ph.D., Director
- Jennie Pham, Laboratory Technician

2019 Annual Update

Equipment

- Ortho Clinical Vitros 350 chemistry analyzer to measure circulating analyte (metabolites, ions, gases, enzymes) concentration in body fluids

New Services

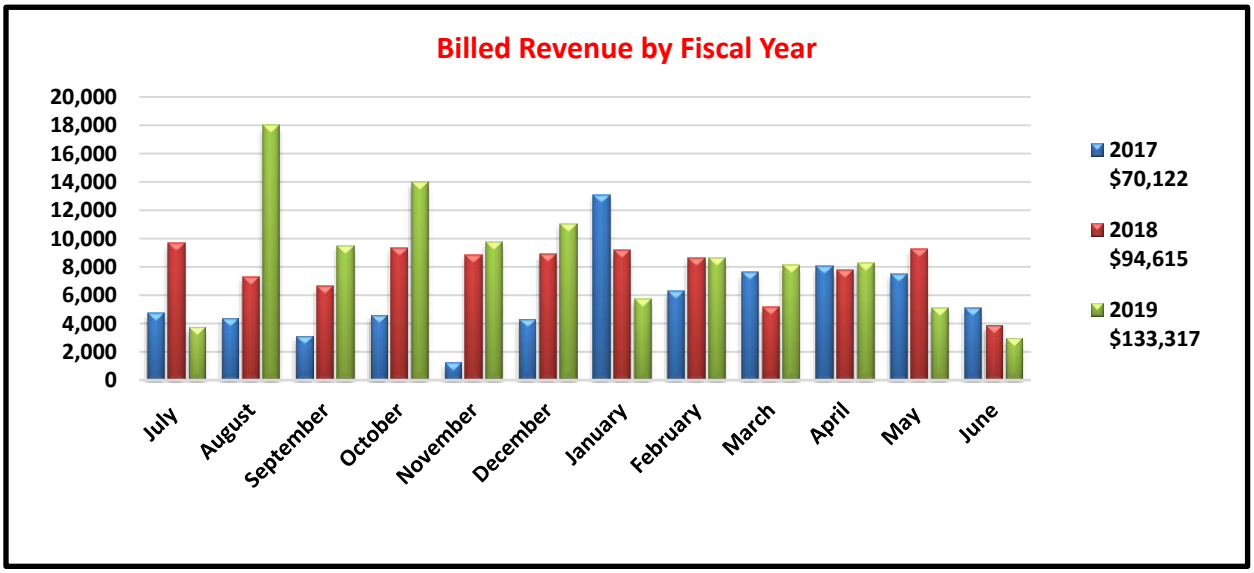
MPC has recently purchased an Ortho Clinical Vitros 350 chemistry analyzer using funds provided by University of Utah VP of Health Sciences support. This instrument uses solid state chemistry to quantify the concentration of analytes in body fluids such as serum, plasma, urine and cerebrospinal fluid. The Vitros MicroSlide technology used in this analyzer requires a small (5-11ul) amount of sample per test. When the sample comes into contact with the dry chemical layers in the Vitros microslide, a spectral reaction occurs, which is measured by the system. Ortho Clinical currently offers Vitros MicroSlide assays for 40 different analytes. The Vitros 350 analyzer can perform up to 40 colorimetric tests/hour. MPC will perform multiplex assay panels on Vitros 350 system and will include diabetes-Obesity panel (glucose, lactate, triglyceride, LDH, creatinine, Cholesterol, dHDLC, LDL); Cardiovascular disease panel (Cholesterol, triglyceride, direct HDL and derived LDL, CO_2, Na^+, Cl^-, K+); Nephrology panel (Creatinine, Uric acid, BUN, glucose, total protein, CO_2, Na^+, Cl^-, K+, ammonia, albumin); Liver function panel (AST, ALT, albumin, bilirubin); Hematology Panel (Iron, Total Iron-Binding Capacity, bilirubin, Total Bilirubin).

Revenue/Expenses

FY19 Expenses: Total $214,181

FY19 Revenue: Total $254,615

- VP of Health Sciences Support: $75,000
- FY19 Revenue generated from services: $227,932



* Legend displays total annual revenue by year earned.

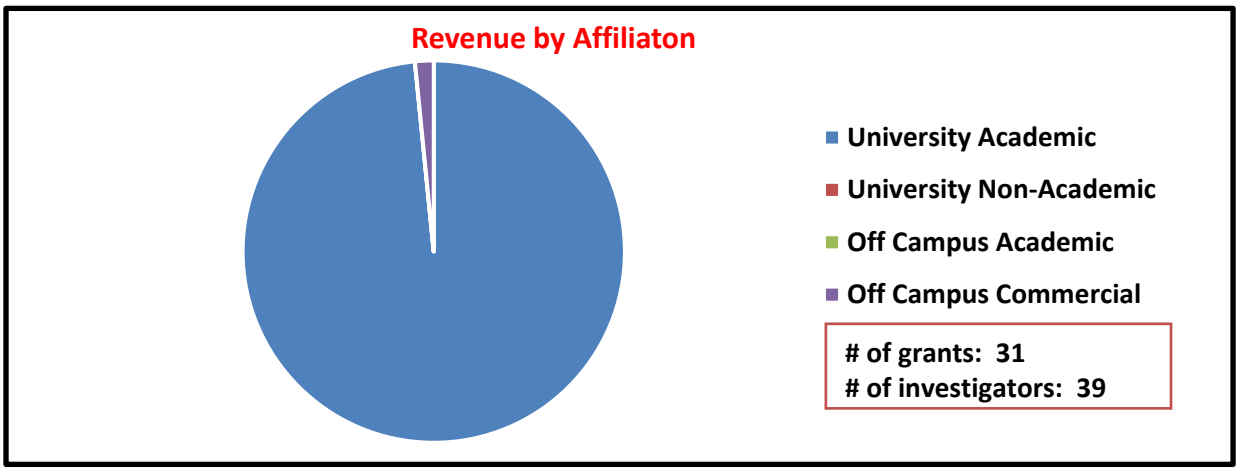
Advisory Board Committee
Last meeting date: March 8, 2019

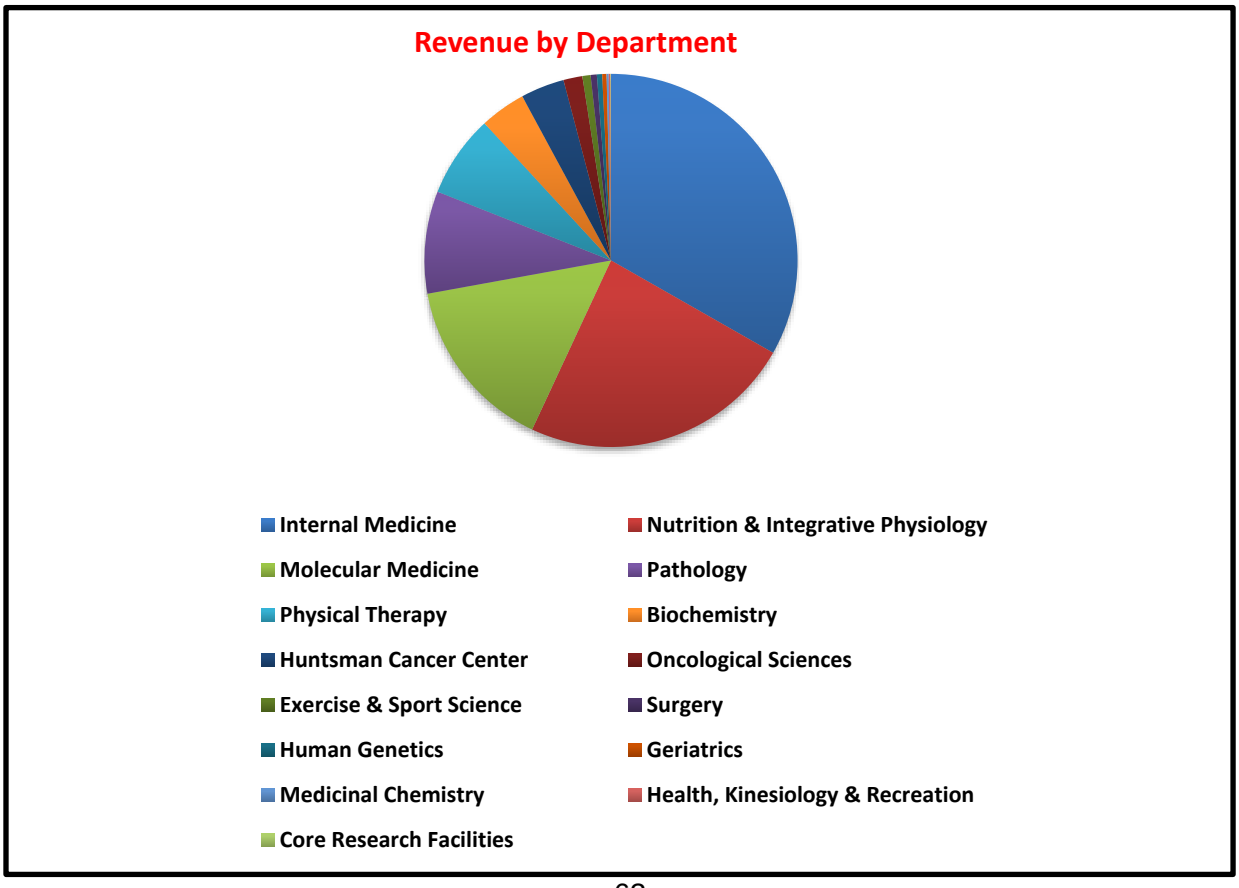
- Jared Rutter, Professor, Biochemistry
- Scott Summers, Professor, Nutrition and Integrative Physiology
- William Holland, Assistant Professor, Nutrition and Integrative Physiology
- Katsuhiko Funai, Assistant Professor, Physical Therapy and Athletic Training
- John Phillips, Professor, Director of University of Utah HSC Cores

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Henry, Nora	Department
2	Funai, Katsuhiko	Department, NIDDK
3	Summers, Scott	NIH
4	Chaurasia, Bhagirath	Department
5	Round, June	NIH, American Asthma Foundation
6	Drummond, Micah	Department, NIH
7	Snyder, Eric	NIH, HCI
8	O'Connell, Ryan	Department, NIH
9	Deininger, Michael	Department, Foundation for Cancer Research
10	Pon Velayutham, Anandh	Department

Letter of Support for grant applications:

1. Diane Ward's R01 grant application to the NIH entitled "The Role of Abcb10 in arginine metabolism and mitochondrial homeostasis."
2. Hilary Coon's grant application to 2019 Utah Genome Project Functional Analysis Pilot Grant Program entitled "Mitochondrial dysfunction: a possible biomarker for risk of suicide."
3. Christopher Greg's NIH R01 proposal to identify important mammalian regulatory elements shaping metabolic traits and brain aging from hibernating mammals.
4. Junco Warren's NIH R01 grant application to the National Institute of Health entitled "A Novel Role of Perm1 in Mitochondrial Bioenergetics and Heart Failure."
5. Eric Snyder's Research Scholar grant application to the American Cancer Society entitled "HNF4a regulates pancreatic cancer growth, metabolism and molecular subtype."

Publications

1. Warren JS, Tracy CM, Miller MR, Makaju A, Szulik MW, Oka SI, Yuzyuk TN, Cox JE, Kumar A, Lozier BK, Wang L, Llana JG, Sabry AD, Cawley KM, Barton DW, Han YH, Boudina S, Fiehn O, Tucker HO, Zaitsev AV, Franklin S. Histone methyltransferase Smyd1 regulates mitochondrial energetics in the heart. Proc Natl Acad Sci U S A. 2018 Aug 14;115 (33): E7871-E7880.
2. Runtsch MC, Nelson MC, Lee SH, Voth W, Alexander M, Hu R, Wallace J,Petersen C, Panic V, Villanueva CJ, Evason KJ, Bauer KM, Mosbruger T, Boudina S, Bronner M, Round JL, Drummond MJ,O'Connell RM. Anti-inflammatory microRNA-146a protects mice from diet-induced metabolic disease. PLoS Genet. 2019 Feb 15;15 (2): e1007970.
3. Pearson S, Loft A, Rajbhandari P, Simcox J, Lee S, Tontonoz P, Mandrup S, Villanueva CJ. Loss of TLE3 promotes the mitochondrial program in beige adipocytes and improves glucose metabolism. Genes Dev. 2019 Jul 1; 33 (13-14):747-762.

Metabolomics Facility

Overview

The Metabolomics facility provides analysis of metabolites found within a tissue, biological fluid, whole organism, culture, or other biological source. Currently metabolomics is a comparative science; the facility usually analyzes the differences found between biological samples that have been subjected to a treatment. This can be a genetic mutation, drug treatment, etc. Most analyses are relative; therefore, the facility can only make judgments on individual metabolites such as comparing the relative amounts of succinate between a mutant and a wild type but not compare the levels of succinate and fumarate within the same group or between groups. No one method is fully capable of completely profiling the metabolome. To maximize the number of metabolites observed, the facility is equipped with three chemical analysis platforms, GC-MS, LC-MS, and NMR.

Services

The primary mission of the facility is the metabolomics profiling of biological samples including serum, urine, tissues, *Drosophila*, *C. elegans*, yeast, and bacteria. The following metabolites can be analyzed from many biochemical pathways:

- Amino acids
- TCA cycle intermediates
- Organic acids including lactic acid and pyruvate
- Carbohydrates
- Nucleotides
- Lipids including sterols
- Di and tri peptides including glutathione
- Full lipid profiling by LC-MS
- Stable isotope label flux analysis by GC-MS

The facility processes every sample using two distinct but overlapping procedures, a targeted analysis and a non-targeted analysis. The targeted analysis is used to search every chromatogram for known metabolites. The non-targeted analysis uses data mining software to detect chromatographic peaks that are altered in two different conditions. This procedure is done with Principle Components Analysis (PCA) and Partial Least Squares-Discriminate Analysis (PLS-DA).

Equipment

Chemical Analysis Platforms

- Agilent 5977B gas chromatograph-quadrupole mass spectrometer (GC-MS).
- Agilent 5973 gas chromatograph-quadrupole mass spectrometer (GC-MS)
- Agilent 6530 Ultrapressure liquid chromatograph-quadrupole time of flight mass-spectrometer (UPLC-QTOF-MS)
- Agilent 6550 Ultrapressure liquid chromatograph-quadrupole time of flight mass-spectrometer (UPLC-QTOF-MS)
- Agilent 6490 Triple quadrupole UPLC-MS for the targeted quantification of metabolites, lipids and peptides
- Agilent 7200 gas chromatograph-quadrupole time of flight mass spectrometer (GC-QTOF)
- Sciex 6500 QTRAP Triple quadrupole UPLC-MS for the targeted quantification of metabolites, lipids and peptides

Personnel

- James Cox, Ph.D., Director
- Alan Maschek, Ph.D., Research Associate
- Leon Catrow, Ph.D., Research Associate
- Tyler Van Ry, B.S. Technician
- Brad Naylor, Ph.D. Post-Doc

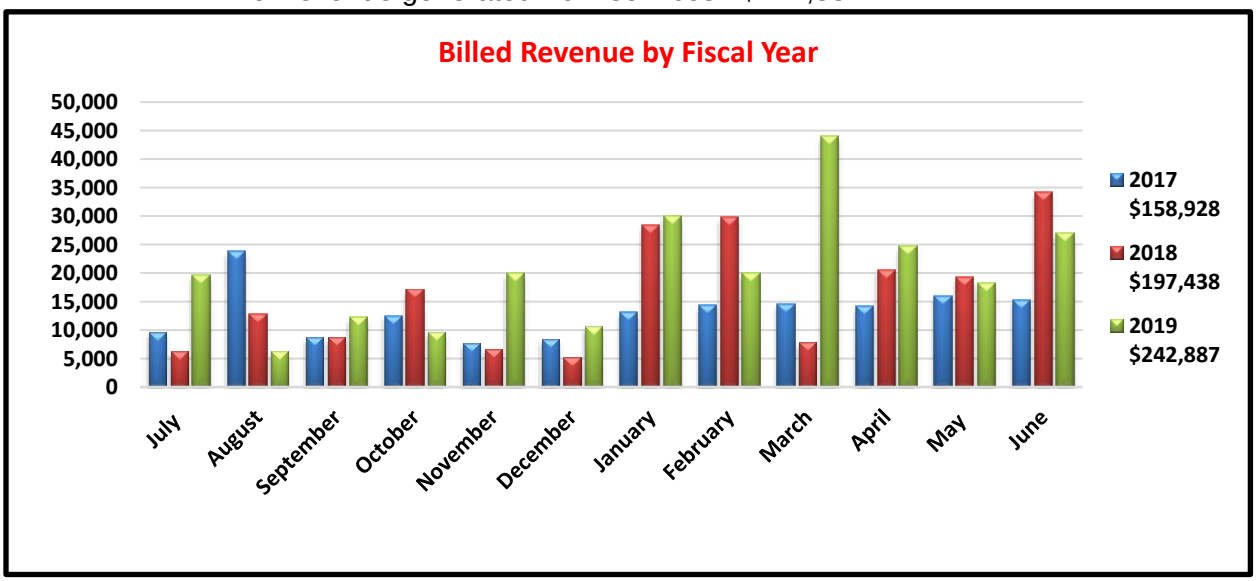
2019 Annual Update

Revenue/Expenses

FY19 Expenses: Total $657,310

FY19 Revenue: Total $569,939

- VP of Health Sciences Support : $240,000
- VP for Research: $21,702
- Baylor Grant: $65,350
- FY19 Revenue generated from services: $242,887



* Legend displays total annual revenue by year earned.

Advisory Board Committee

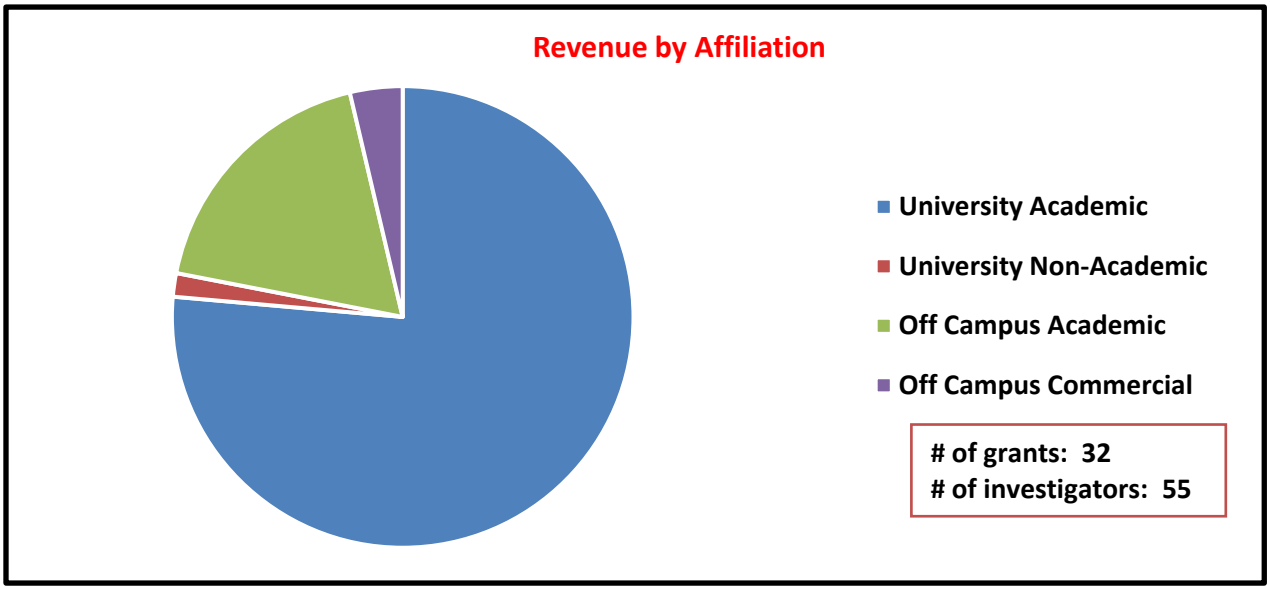
Last meeting date: May 21, 2018

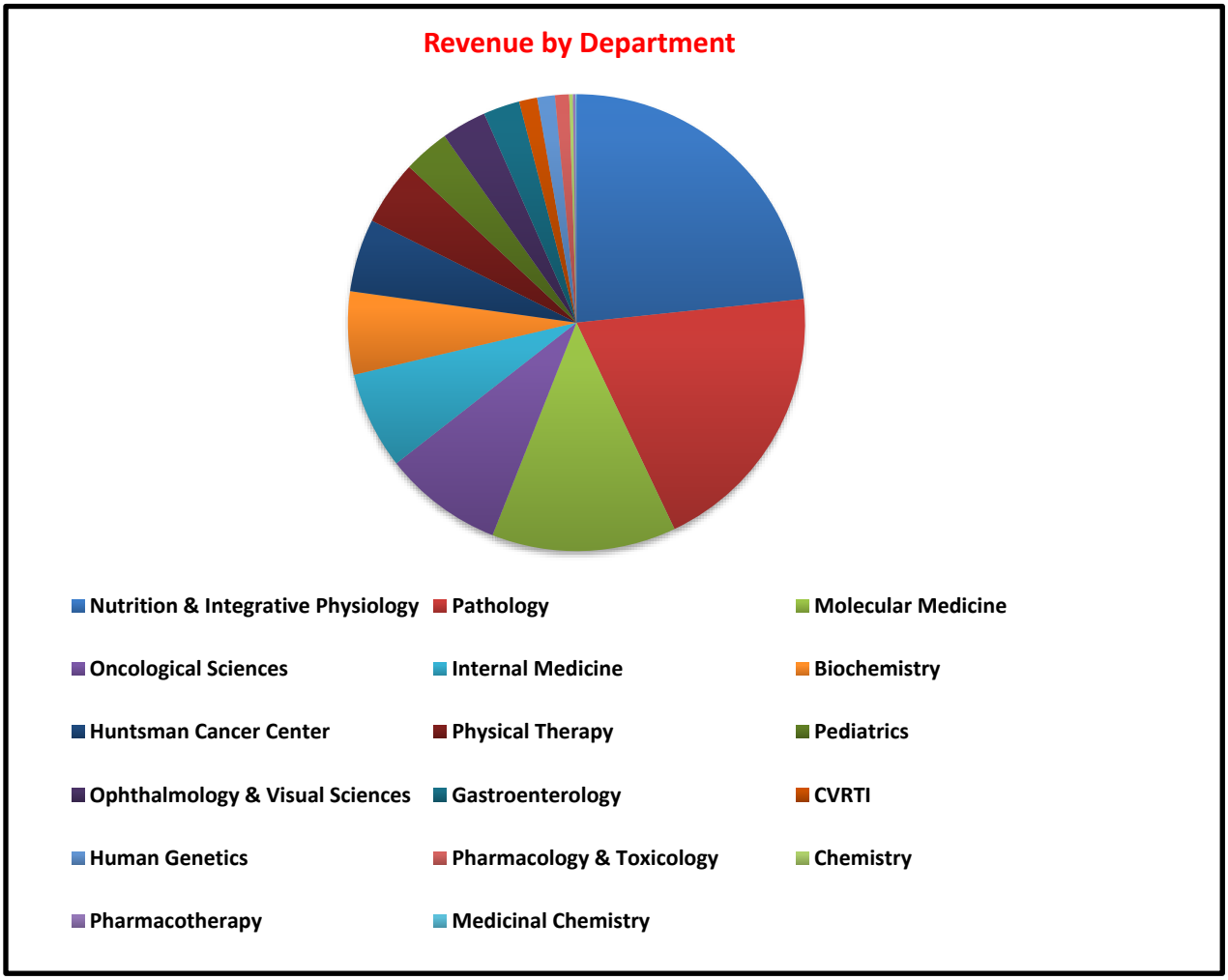
- Dennis Winge, Professor, Department of Hematology
- Carl Thummel, Professor, Department of Human Genetics
- William Holland, Assistant Professor, Department of Nutrition & Integrative Physiology
- Jared Rutter, Professor, Department of Biochemistry

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Summers, Scott	NIH, Department
2	Fairfax, Keke	NIH, Department
3	University of California SFO	Off Campus Academic
4	University of Delaware	Off Campus Academic
5	Funai, Katsuhiko	Department, NIDDK
6	Holland, William	NIH
7	Drakos, Stavros	Doris Duke Foundation
8	Phillips, John	Department, NIH, Univ. of California-Irvine
9	Ward, Diane	NIH
10	Welm, Alana	Alsan Pharmaceuitcals, LTD

Publications

1. Burch, J. S., Marcero, J. R., Maschek, J. A., Cox, J. E., Jackson, L. K., Medlock, A. E., Dailey, H. A., Jr. (2018). Glutamine via alpha-ketoglutarate dehydrogenase provides succinyl-CoA for heme synthesis during erythropoiesis. *Blood, 132*(10), 987-998. doi:10.1182/blood-2018-01-829036
2. Deering-Rice, C. E., Memon, T., Lu, Z., Romero, E. G., Cox, J., Taylor-Clark, T., Reilly, C. A. (2019). Differential Activation of TRPA1 by Diesel Exhaust Particles: Relationships between Chemical Composition, Potency, and Lung Toxicity. *Chem Res Toxicol, 32*(6), 1040-1050. doi:10.1021/acs.chemrestox.8b00375
3. Ganeshan, K., Nikkanen, J., Man, K., Leong, Y. A., Sogawa, Y., Maschek, J. A., Chawla, A. (2019). Energetic Trade-Offs and Hypometabolic States Promote Disease Tolerance. *Cell, 177*(2), 399-413 e312. doi:10.1016/j.cell.2019.01.050
4. Kumar, D., Rahman, H., Tyagi, E., Liu, T., Li, C., Lu, R., Grossman, D. (2018). Aspirin Suppresses PGE2 and Activates AMP Kinase to Inhibit Melanoma Cell Motility, Pigmentation, and Selective Tumor Growth In Vivo. *Cancer Prev Res (Phila), 11*(10), 629-642. doi:10.1158/1940-6207.CAPR-18-0087
5. Nakamura, M., Liu, T., Husain, S., Zhai, P., Warren, J. S., Hsu, C. P., Sadoshima, J. (2019). Glycogen Synthase Kinase-3alpha Promotes Fatty Acid Uptake and Lipotoxic Cardiomyopathy. *Cell Metab, 29*(5), 1119-1134 e1112. doi:10.1016/j.cmet.2019.01.005
6. Speirs, M. M. P., Swensen, A. C., Chan, T. Y., Jones, P. M., Holman, J. C., Harris, M. B., Price, J. C. (2019). Imbalanced sphingolipid signaling is maintained as a core proponent of a cancerous phenotype in spite of metabolic pressure and epigenetic drift. *Oncotarget, 10*(4), 449-479. doi:10.18632/oncotarget.26533
7. Warren, J. S., Tracy, C. M., Miller, M. R., Makaju, A., Szulik, M. W., Oka, S. I., Franklin, S. (2018). Histone methyltransferase Smyd1 regulates mitochondrial energetics in the heart. *Proc Natl Acad Sci U S A, 115*(33), E7871-E7880. doi:10.1073/pnas.1800680115
8. Washburn, R. L., Cox, J. E., Muhlestein, J. B., May, H. T., Carlquist, J. F., Le, V. T., Horne, B. D. (2019). Pilot Study of Novel Intermittent Fasting Effects on Metabolomic and Trimethylamine N-oxide Changes During 24-hour Water-Only Fasting in the FEELGOOD Trial. *Nutrients, 11*(2). doi:10.3390/nu11020246

Mutation Generation & Detection Facility

Overview

The Mutation Generation & Detection (MGD) Core Facility supports researchers by securing, developing, and optimizing the latest DNA nuclease technologies, reagents, and protocols for targeted genome modification. Currently, the MGD core specializes in providing customized CRISPR-Cas9 reagents for gene editing in multiple model systems, including but not limited to *D. rerio*, *D. melanogaster*, *C. elegans*, *P. falciparum*, *S. cerevisiae*, *T. castaneum*, mammalian cell lines, *A. aegypti*, and *M. Musculus*. The MGD Core also offers services to identify induced genomic modifications using High Resolution Melt Analysis (HRMA). Our support includes hardware, reagents, and expert advice for optimizing and performing HRMA. Beyond these two main services, the MGD Core has established partnerships with the Mouse Transgenic Facility and the Centralized Zebrafish Resource Center to create engineered mouse and zebrafish models, respectfully. The MGD Cores also provides custom HRMA genotyping services, CRISPR validation services, homology directed repair donor template synthesis and custom genotyping services. To date the MGD Core has helped further the research of over 100 different laboratories around the world by providing more than 500 unique reagents. The MGD Core is also a member of the Utah Center for Iron and Heme Disorders.

Main Services

CRISPR Services

- 1X CRISPR plasmid design and construction
- 2X CRISPR plasmid design and construction
- 1X CRISPR sgRNA RNA production
- Control non-targeting CRISPR plasmid

High Resolution Melt Analysis

- BioFire LightScanner Access Fee
- HRMA PCR plates (10 pack)
- HRMA PCR sealing film (10 pack)
- BioFire LightScanner MasterMix 100 rxns
- BioFire LightScanner MasterMix 500 rxns
- Mineral Oil (500ml bottle)
- HRMA Training
- Help with optimization and analysis of HRMA assays
- Custom Mutation Detection upon request

TALEN Services

- TALEN plasmid pair design and construction
- 2X TALEN plasmid pair design and construction (same gene)
- 0.5X TALEN effector plasmid design and construction
- Different Destination Vector

Additional Services

- Mouse Transgenic Injection (partnership with Mouse Transgenic Facility)
- Blastocyst Validation of CRISPR reagents (partnership with Mouse Transgenic Facility)
- Short ssDNA donor design and production
- Long ssDNA design and production
- dsDNA donor design and production
- Custom RFLP genotyping of mutant and transgenic mice
- Custom HRMA genotyping in *D. rerio*, *D. melanogaster*, and mouse embryos
- Sequence verification of genome edits
- Production of transgenic *D. rerio* using CRISPR reagents
- Production of CRISPR and donor constructs for generating transgenic *D. melanogaster*

Equipment

- BioFire LightScanner
- 3X Eppendorf Mastercycler ProS
- Eppendorf Centrifuge 5430
- 2X Eppendorf 5424 Microcentrifuges
- 27” Apple iMac Desktop with QWC Mercury Elite-Al Pro External Hard drive
- Illumina Eco
- Innova 43 bacterial Shaker
- Innova 42 bacterial Shaker
- Frigidaire -20°C Freezer
- Lonza 4D Nucleofector system:
  - 4D-Nucleofector Core Unit
  - 4D-Nucleofector X Unit
  - 4D-Nucleofector Y Unit
  - 4D-Nucleofector 96-well Shuttle
- CCI Biological Safety Cabinet
- NapCo Model 6300 CO2 Incubator
- ThermoFisher TSX600 -80C Freezer
- Sorvall RT 6300 Centrifuge
- ASUS ZenBook 3 Deluxe Laptop

Personnel

- Crystal Davey, Ph.D., Director
- Lindsay Mortensen, Lab Technician

New Services

The MGD Core has continued to increase the functionality of its current services by expanding the CRISPR-Cas9 reagent catalog with new variations of standard reagents.

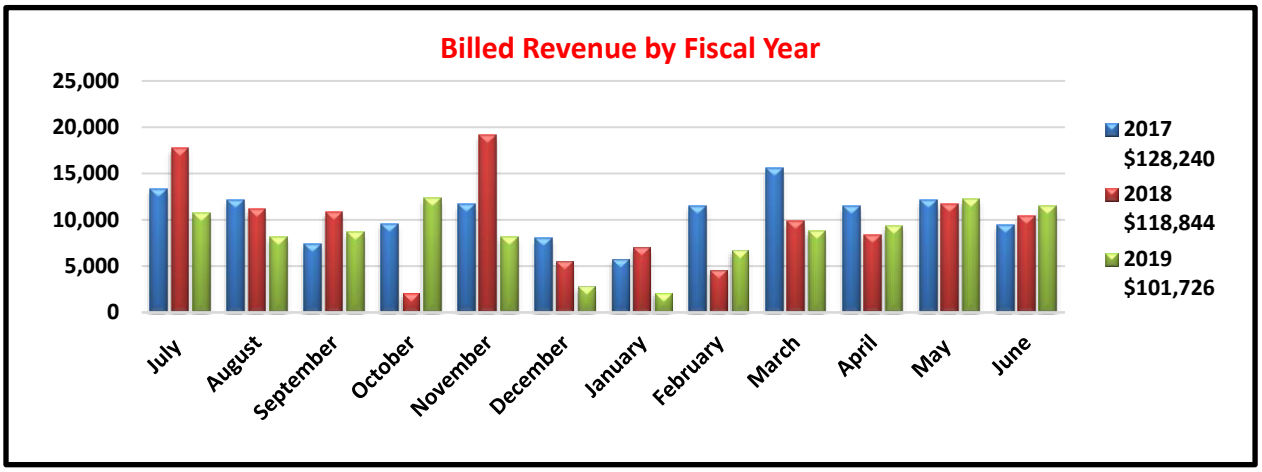
- CRISPR adeno-associated viral vectors (AAV) for *in vivo* gene editing
- Unmodified and modified synthetic sgRNAs

Revenue/Expenses

FY19 Expenses: Total $134,797

FY19 Revenue: Total $116,726

- VP of Health Sciences Support: $15,000
- FY19 Revenue generated from services: $101,726



* Legend displays total annual revenue by year earned.

Advisory Board Committee

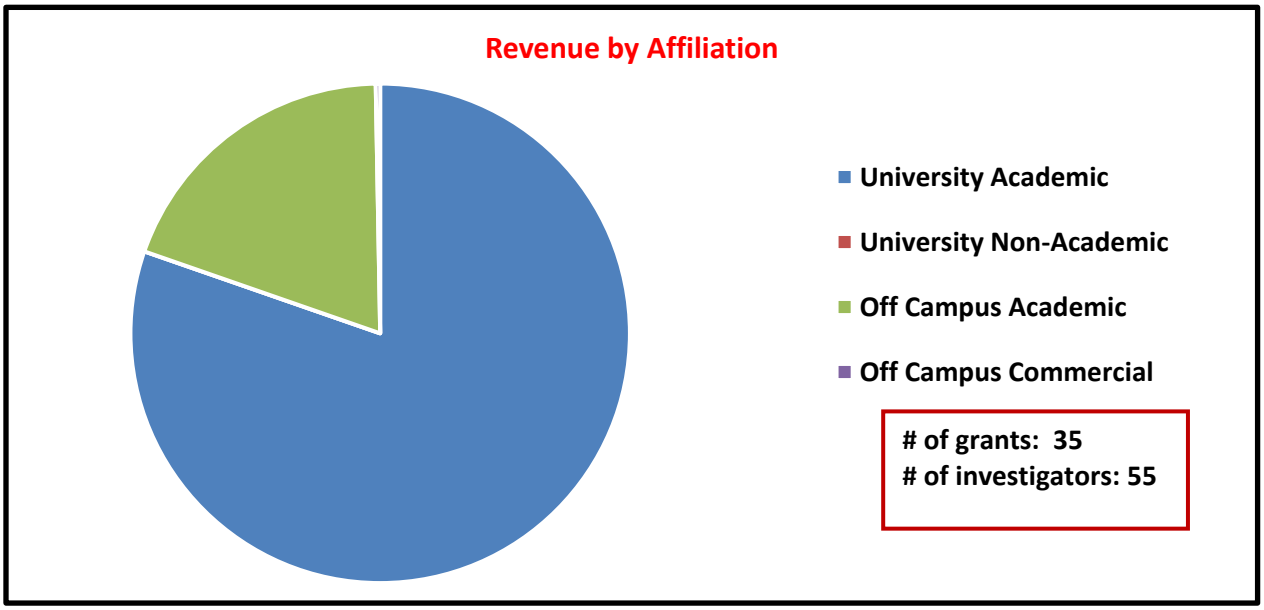
Last meeting date: September 29, 2018

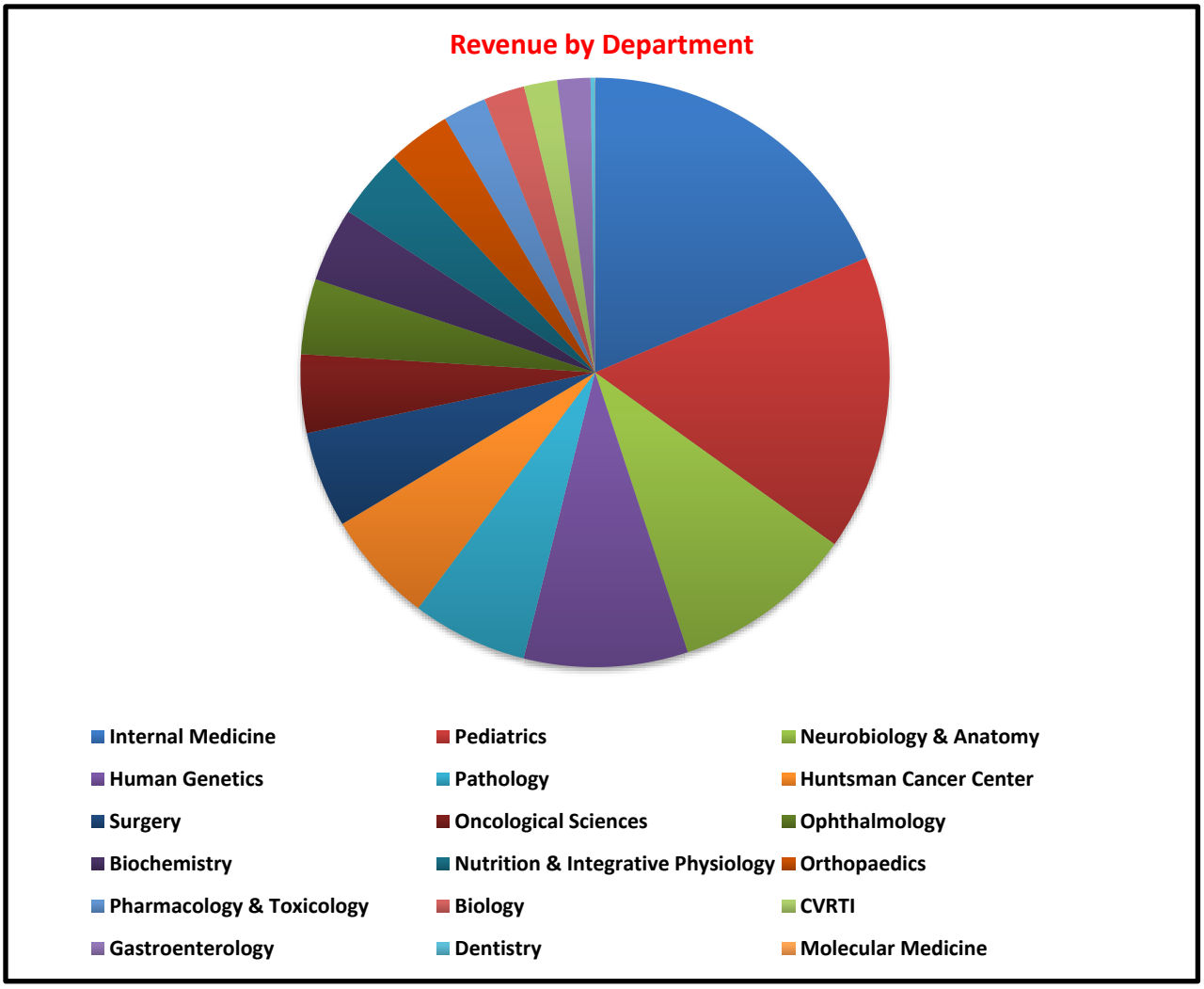
- David Grunwald, Department of Human Genetics (Senior Faculty Advisor)
- Dana Carroll, Department of Biochemistry
- Ryan O'Connell, Department of Pathology
- Lewis Charles Murtaugh, Department of Human Genetics

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Bonkowsky, Josh	Department, NINDS
2	Evason, Kimberley	NIH, HCI
3	Phillips, John	HCI, ICAHN School Of Medicine
4	Gregg, Christopher	Department, NIH
5	Kwan, Kristen	NIH
6	Baylor College of Medicine	Off Campus Academic
7	University of Pennsylvania	Off Campus Academic
8	Ohio State University	Off Campus Academic
9	Oldelberg, Shannon	NIH
10	University of Leeds	Off Campus Academic

Collaboration and Support of Other HSC and University Facilities:

Center for Iron and Heme Disorders

The MGD is one of three Cores that are part of the Utah Center for Iron and Heme Disorders (CIHD). The CIHD provides 10% of the MGD Core Director's salary requirements and covers 45% of the MGD Core's full time Laboratory Technician salary requirements.

DNA Sequencing Facility

The MGD Core spent $3,876 with the DNA Sequencing Core in FY19.

DNA Peptide Facility

The MGD Core spent $5,786 with the DNA/Peptide Synthesis Core in FY19.

Mouse Transgenic Facility

During FY19 the MGD Core's partnership with the Mouse Transgenic Facility to produce transgenic mouse models brought in 26 different projects to the Mouse Transgenic Facility totaling at least $81,750 in chargebacks for that facility.

Total chargeback impact of the MGD Core on other University Core Research facilities is $91,412.

Non-billable Invoice Hours

One of the central purposes of the MGD Facility is to be a resource of education for researchers on the University of Utah campus. The MGD Core achieves this aim in official ways such as seminars given directly to different departments on campus. However, the central avenue of education by the MGD Core is informal one-on-one, in person communication with researchers. In the past, the MGD Core has tracked these interactions, but due to the number and randomness of these interactions in FY'16, the MGD Core stopped tracking them. Based on previous numbers the MGD Core estimates that it spends around 250-300 hours per year in direct interaction with researchers.

Publications

1. Balakrishnan, B., Verheijen, J., Lupo, A., Raymond, K., Turgeon, C., Yang, Y., Lai, K. (2019). A novel phosphoglucomutase-deficient mouse model reveals aberrant glycosylation and early embryonic lethality. *J Inherit Metab Dis*. doi:10.1002/jimd.12110
2. Downie, J. M., Gibson, S. B., Tsetsou, S., Russell, K. L., Keefe, M. D., Figueroa, K. P., Jorde, L. B. (2019). Loss of TP73 function contributes to amyotrophic lateral sclerosis pathogenesis. *bioRxiv*, 451419. doi:10.1101/451419
3. Fadul, J., Slattum, G. M., Redd, N. M., Jin, M. F., Redd, M. J., Daetwyler, S., Rosenblatt, J. (2018). Basal extrusion drives cell invasion and mechanical stripping of E-cadherin. *bioRxiv*, 463646. doi:10.1101/463646
4. Fitzgerald, M., Gibbs, C., & Deans, T. L. (2019). Rosa26 docking sites for investigating genetic circuit silencing in stem cells. *bioRxiv*, 575266. doi:10.1101/575266
5. Gordon, H. B., Lusk, S., Carney, K. R., Wirick, E. O., Murray, B. F., & Kwan, K. M. (2018). Hedgehog signaling regulates cell motility and optic fissure and stalk formation during vertebrate eye morphogenesis. *Development, 145*(22). doi:10.1242/dev.165068
6. Kim, B. J., Kim, D.-K., Han, J. H., Oh, J., Kim, A. R., Lee, C., Choi, B. Y. (2019). Clarification of glycosylphosphatidylinositol anchorage of OTOANCORIN and human OTOA variants associated with deafness. *Human Mutation, 40*(5), 525-531. doi:10.1002/humu.23719
7. Lakshmipathi, J., Wheatley, W., Kumar, A., Mercenne, G., Rodan, A. R., & Kohan, D. E. (2019). Identification of NFAT5 as a transcriptional regulator of the EDN1 gene in collecting duct. *Am J Physiol Renal Physiol, 316*(3), F481-F487. doi:10.1152/ajprenal.00509.2018
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11. Samson, S. C., Elliott, A., Mueller, B. D., Kim, Y., Carney, K. R., Bergman, J. P., Mendoza, M. C. (2019). p90 ribosomal S6 kinase (RSK) phosphorylates myosin phosphatase and thereby controls edge dynamics during cell migration. *J Biol Chem, 294*(28), 10846-10862. doi:10.1074/jbc.RA119.007431
12. Shen, Z., Formosa, T., & Tantin, D. (2018). FACT Inhibition Blocks Induction But Not Maintenance of Pluripotency. *Stem Cells Dev, 27*(24), 1693-1701. doi:10.1089/scd.2018.0150
13. Zelinka, C. P., Sotolongo-Lopez, M., & Fadool, J. M. (2018). Targeted disruption of the endogenous zebrafish rhodopsin locus as models of rapid rod photoreceptor degeneration. *Mol Vis, 24*, 587-602. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/30210230

Letters of Support

Written and provided to faculty for support of grant applications:

1. LOS for Dr. My N. Helms' R03 proposal, October 2018
2. LOS for Dr. Janis J. Weis' Global Lyme Alliance proposal: "Myostatin is a mediator and potential target in Lyme disease." July 2018
3. LOS for Dr. Bruce Edgar's RO1 proposal: "Mechanisms of intestinal epithelial regeneration." June 2019
4. LOS for Dr. Kimberly Evason's ACS Research Scholar Grant proposal: "Serotonin signaling in liver development and cancer." October 2018
5. LOS for Dr. Linda Resar's NIDDK-Collaborative Pilot and Feasibility Proposal, October 2018
6. LOS for Dr. Harry A. Dailey's R01 proposal: "Metabolomics of erythropoietic ALA synthesis." May 2019

Nuclear Magnetic Resonance Core Facility

Overview

This core provides NMR services for the research community at the University of Utah, outside academic institutions and for profit companies. We provide access to five different high field NMR spectrometers (400, 500, 600, 800 and 900 MHz instruments; see Equipment below) located on the University of Utah Health Sciences campus and the University of Colorado Boulder and Denver campuses. The 600, 800 and 900 instruments are equipped with state of art consoles and high sensitivity cryogenic HCN probes ideal for protein and natural products research. The 400 and 500 are equipped with Mercury and Inova consoles respectively and conventional probes making them ideal for small molecule and natural products research. For data processing and analysis, we have a central server and five Linux workstations at the Structural Biology Computing Center (SBCC; Department of Biochemistry) with full access to SBGrid (www.sbgrid.org), a suite of structural biology software for NMR and XRAY data processing, analysis and structure determination.

Our staff has substantial experience characterizing small molecules, natural products, nucleic acids, carbohydrates and proteins using NMR spectroscopy. Our business model stresses user based data collection and analysis and thus we provide practical NMR training for individuals and groups on an as needed basis and teach formal NMR spectroscopy courses.

Services

- NMR data collection and analysis with/without staff
- NMR training for individuals and groups
- Formal courses in NMR spectroscopy

Equipment

- Varian Mercury 400 MHz NMR (University of Utah, Skaggs Hall)
- Varian Inova 500 MHz NMR (University of Utah, BPRB)
- Varian Inova 600 MHz NMR with HCN cryogenic probe (University of Utah, BPRB)
- DD2 800 MHz NMR with HCN cryogenic probe (University of Colorado-Boulder)
- DD2 900 MHz NMR with HCN cryogenic probe (University of Colorado-Denver)

Personnel

- Jack Skalicky, Ph.D., NMR Core Director and Res. Associate Professor of Biochemistry
- Dennis Edwards, RF Technician; 35+ years of NMR hardware repair

2019 Annual Update

New Equipment

- The Closed Cycle Chiller (CCC) cold head was replaced in FY 2018 (this service is required every 2-3 years for optimal operation of the 600 cryoprobe)
- Facilities added a new cooling loop in BPRB. This upgrade now provides reliable cooling water for more stable operation of the CCC helium compressor.

New Services

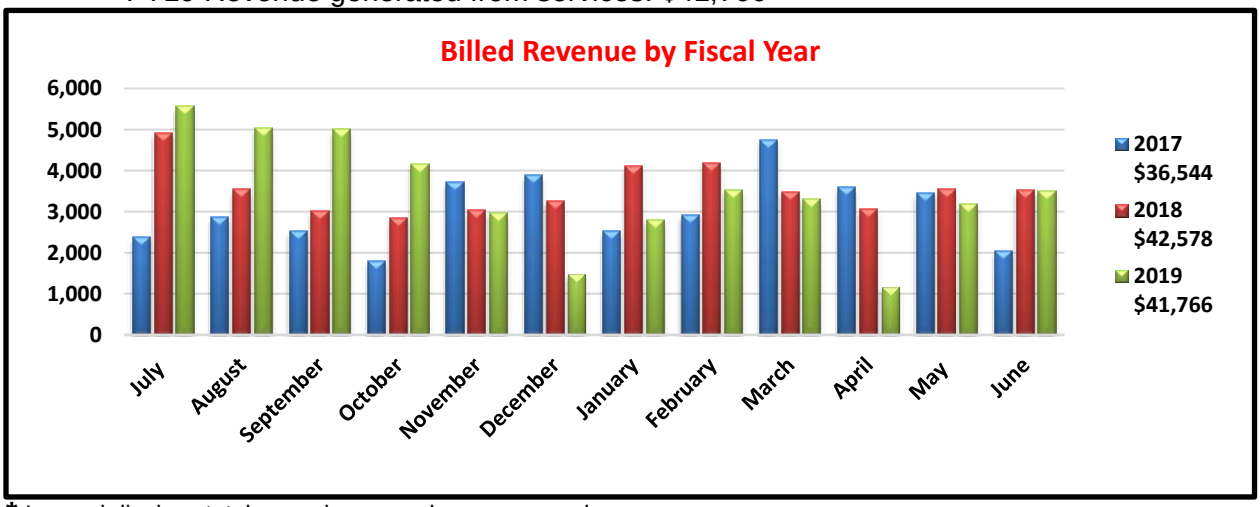
- The NMR Facility did not implement additional services in FY19

Revenues/Expenses

FY19 Expenses: Total $106,606

FY19 Revenue: Total $141,766

- VP of Health Sciences Support: $100,000
- FY19 Revenue generated from services: $41,766



* Legend displays total annual revenue by year earned.

Advisory Board Committee

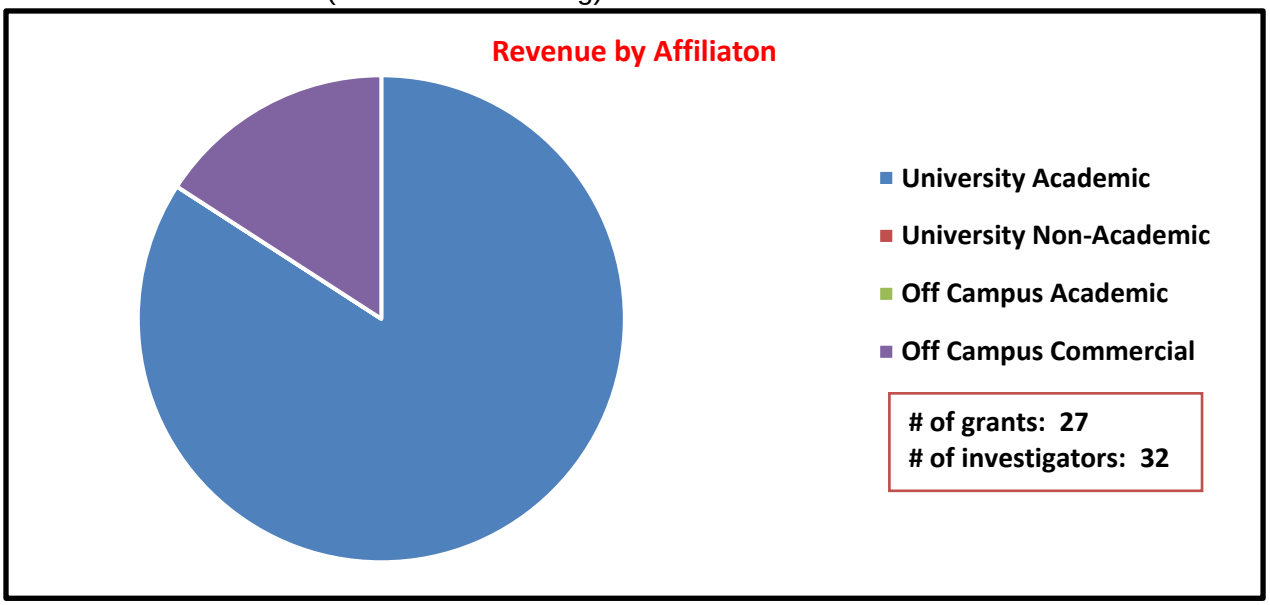
Last updates: June/July 2017

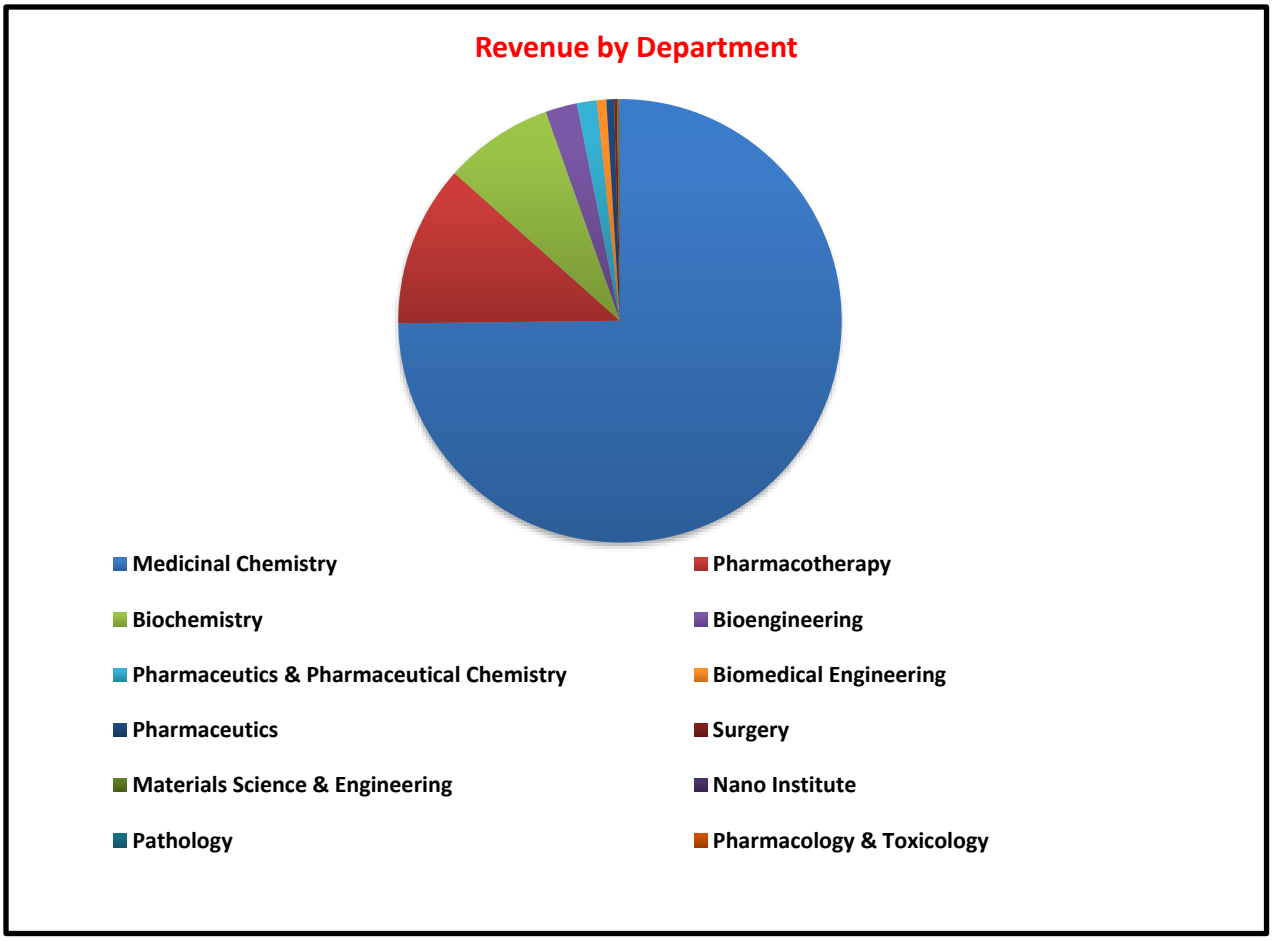
- Darrell Davis, Eric Schmidt and Jaclyn Winter, Department of Medicinal Chemistry
- Wesley Sundquist, Department of Biochemistry
- Jessica Kramer, Department of Bioengineering

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Haygood, Margo	NIH
2	Schmidt, Eric	NIH,Department
3	Franzini, Raphael	Department, USTAR
4	Winter, Jaclyn	Department
5	Chou, Hung-Chieh	NIH, Army Medical Research, JDRF, USTAR
6	Vaporsens, Inc	Commercial
7	Echelon Biosciences	Commercial
8	Davis, Darrell	Department
9	ESI VioGen Biosciences	Commercial
10	Kramer, Jessica	Department, NSF

Publications

1. Lacerna, N. M., 2nd, Miller, B. W., Lim, A. L., Tun, J. O., Robes, J. M. D., Cleofas, M. J. B., Concepcion, G. P. (2019). Mindapyrroles A-C, Pyoluteorin Analogues from a Shipworm-Associated Bacterium. *J Nat Prod, 82*(4), 1024-1028. doi:10.1021/acs.jnatprod.8b00979
2. Lin, Z., Phadke, S., Lu, Z., Beyhan, S., Abdel Aziz, M. H., Reilly, C., & Schmidt, E. W. (2018). Onydecalins, Fungal Polyketides with Anti- Histoplasma and Anti-TRP Activity. *J Nat Prod, 81*(12), 2605-2611. doi:10.1021/acs.jnatprod.7b01067

3. Shipway, J. R., Altamia, M. A., Rosenberg, G., Concepcion, G. P., Haygood, M. G., & Distel, D. L. (2019). Tamilokus mabinia, a new, anatomically divergent genus and species of wood-boring bivalve from the Philippines. *PeerJ, 7*, e6256. doi:10.7717/peerj.6256
4. Tu, J., Svatunek, D., Parvez, S., Liu, A. C., Levandowski, B. J., Eckvahl, H. J., Franzini, R. M. (2019). Stable, Reactive, and Orthogonal Tetrazines: Dispersion Forces Promote the Cycloaddition with Isonitriles. *Angew Chem Int Ed Engl, 58*(27), 9043-9048. doi:10.1002/anie.201903877
5. Tu, J., Xu, M., & Franzini, R. M. (2019). Dissociative Bioorthogonal Reactions. *Chembiochem*. doi:10.1002/cbic.201800810
6. Tu, J., Xu, M., Parvez, S., Peterson, R. T., & Franzini, R. M. (2018). Bioorthogonal Removal of 3-Isocyanopropyl Groups Enables the Controlled Release of Fluorophores and Drugs in Vivo. *J Am Chem Soc, 140*(27), 8410-8414. doi:10.1021/jacs.8b05093
7. Wozniak, C. E., Lin, Z., Schmidt, E. W., Hughes, K. T., & Liou, T. G. (2018). Thailandamide, a Fatty Acid Synthesis Antibiotic That Is Coexpressed with a Resistant Target Gene. *Antimicrob Agents Chemother, 62*(9). doi:10.1128/AAC.00463-18

Preclinical Imaging Facility

Overview

The Preclinical (formerly Small Animal) Imaging Facility extends the benefits of modern diagnostic medical imaging technologies to the studies of anatomy and physiology in small animals. The facility operates one of each MRI, PET/SPECT/CT and fluorescence tomography scanners. The instruments are equipped with supporting and monitoring hardware that allows a wide variety of imaging experiments, including longitudinal studies, to be performed on live animals and specimens. Imaging scientists, full-time imaging personnel, and animal support technicians are available for technical consultation and experimental assistance.

Services

The Preclinical Imaging Facility has a variety of modalities to choose from such as MRI, PET/SPECT/CT, and near-infrared fluorescence imaging. Examples of scanning capabilities include the following:

7 Tesla small animal MRI systems

- Diffusion-weighted and diffusion tensor imaging
- Relaxometry (T1, T2, T2*) mapping
- Perfusion MRI
- Functional and awake-state functional MRI
- MR angiography
- Cardiac MRI
- NMR spectroscopy (localized and non-localized)
- Chemical shift imaging
- Parallel imaging techniques

CT/PET/SPECT Scanners

- Automatic transition between modes and seamless coordination of CT, SPECT, and PET data
- System can be configured as an ultra-high resolution preclinical CT scanner; a high-resolution, high-sensitivity preclinical SPECT scanner; or as a dual modality preclinical SPECT/CT scanner
- The Inveon 2-Head SPECT Module is designed to efficiently detect gamma rays ranging in energy from 30 keV to 250 keV, the SPECT system is ideal for use with most single photon-emitting radionuclides
- Includes two Inveon Research Workplace workstations for multimodality image review, fusion, and analysis which CT, PET, SPECT, and MR data in DICOM and Siemens Inveon CT, PET, and SPECT formats, as well as raw data import

FMT Mouse System

- 4 channel excitation with near-infrared laser diodes at 635, 670, 745, and 785 nm, maximizing tissue penetration depth and permitting multiplexed analysis of biological pathways
- System can be configured as an ultra-high resolution preclinical CT scanner; a high-resolution, high-sensitivity preclinical SPECT scanner; or as a dual modality preclinical SPECT/CT scanner

- The Small Animal Imaging Facility also includes an Instrument Development Lab which primarily provides infrastructure for the construction of custom RF coils. These are often necessary to optimize the data quality for a given MRI application.
- The facility also houses basic machining tools (including a Milling machine) for making experimental apparatus's such as scanning platforms and stereo taxes.

Equipment

- 7 Tesla Bruker BioSpec MRI Scanner
- Siemens Inveon CT/PET/SPECT System
- VISEN (now Perkin Elmer) FMT 2500™ Fluorescence Molecular Tomography

Personnel

- Edward Hsu, Ph.D., Director
- Samer Merchant, M.S., Manager
- Tyler Thompson, Research Assistant
- Samuel Colby, Research Assistant

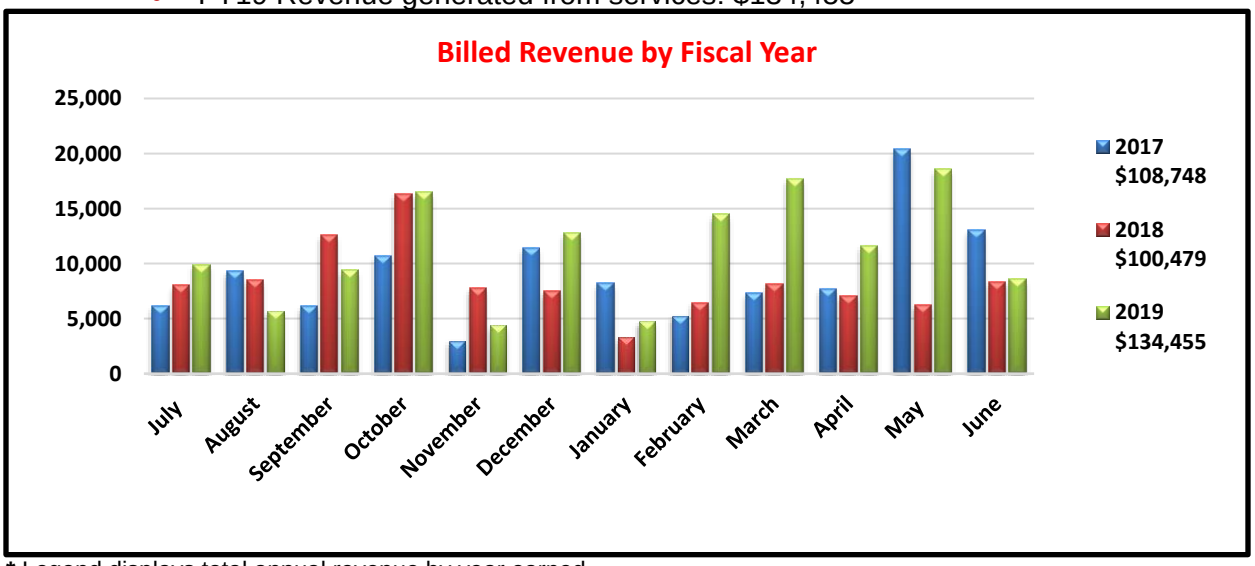
2019 Annual Update

Revenue/Expenses

FY19 Expenses: Total $281,631

FY19 Revenue: Total $284,455

- VP of Health Sciences Support: $50,000
- VP of Research Support: $100,000
- FY19 Revenue generated from services: $134,455



***** Legend displays total annual revenue by year earned.

Advisory Board Committee

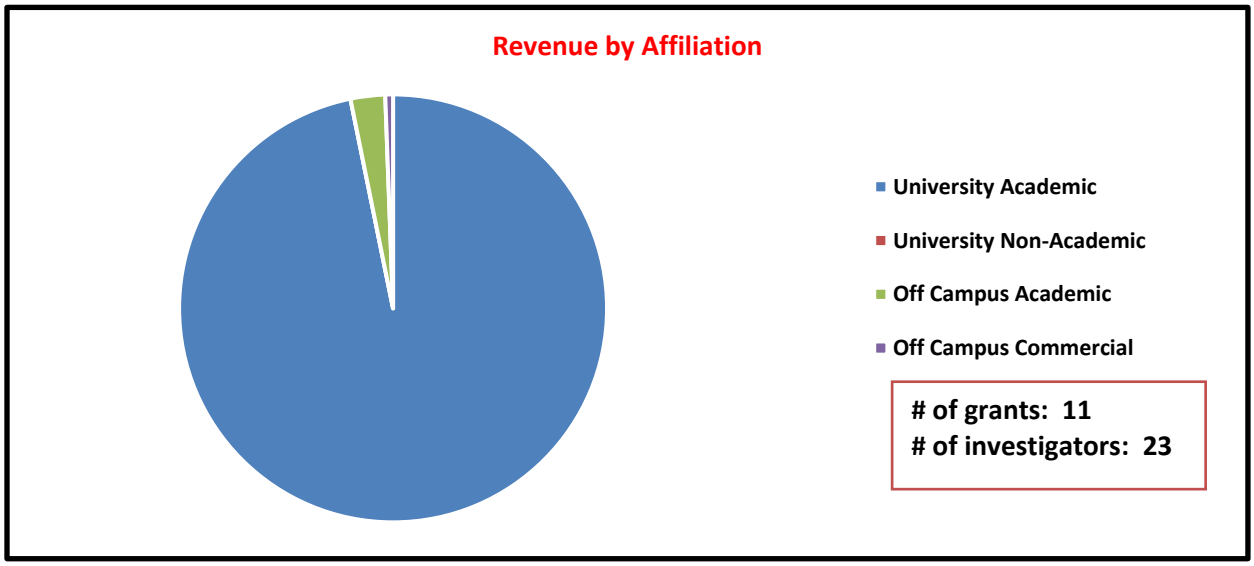
Last meeting date: April 1, 2018

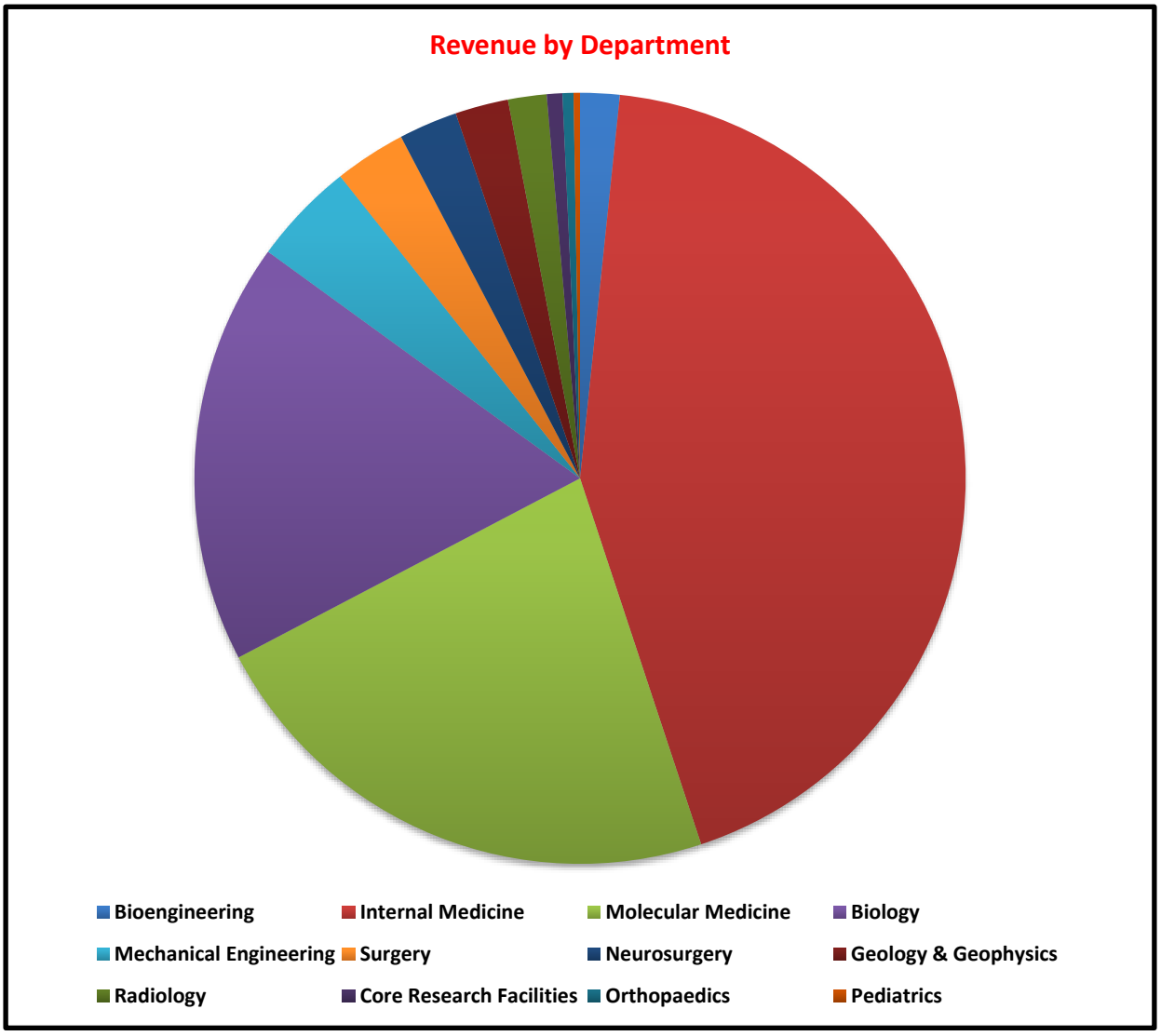
- Rob MacLeod, Professor, Bioengineering/SCI/CVRTI
- John Phillips, Research Associate Professor, Hematology
- Roger Van Andel, Director, Office of Comparative Medicine
- Edward DiBella, Professor, Radiology
- Donna Cross, Associate Professor, Radiology

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Donato, Anthony	NIH
2	Whitehead, Kevin	Department
3	Shapiro, Michael	NIH
4	Ranjan, Ravi	NIH, Utah State University
5	MacLeod, Rob	Nora Eccles Treadwell Foundation
6	Czabaj, Michael	Nora Eccles Treadwell Foundation
7	University of Texas-Austin	Off Campus Academic
8	Dudek, Ed	Department
9	Langell, John	NIH
10	Irmis, Randy	Department

Publications

1. Avazmohammadi, R., Mendiola, E. A., Soares, J. S., Li, D. S., Chen, Z., Merchant, S., Sacks, M. S. (2019). A Computational Cardiac Model for the Adaptation to Pulmonary Arterial Hypertension in the Rat. *Ann Biomed Eng, 47*(1), 138-153. doi:10.1007/s10439-018-02130-y
2. Blanton, C. (2018). Bone Response to Dietary Co-Enrichment with Powdered Whole Grape and Probiotics. *Nutrients, 10*(2). doi:10.3390/nu10020146
3. Burton, B. M., Aras, K. K., Good, W. W., Tate, J. D., Zenger, B., & MacLeod, R. S. (2018). A Framework for Image-Based Modeling of Acute Myocardial Ischemia Using Intramurally Recorded Extracellular Potentials. *Ann Biomed Eng, 46*(9), 1325-1336. doi:10.1007/s10439-018-2048-0
4. Kholmovski, E. G., Silvernagel, J., Angel, N., Vijayakumar, S., Thomas, S., Dosdall, D., Ranjan, R. (2018). Acute noncontrast T1-weighted magnetic resonance imaging predicts chronic radiofrequency ablation lesions. *J Cardiovasc Electrophysiol, 29*(11), 1556-1562. doi:10.1111/jce.13709
5. Melstrom, K. M. (2017). The relationship between diet and tooth complexity in living dentigerous saurians. *J Morphol, 278*(4), 500-522. doi:10.1002/jmor.20645
6. Prakosa, A., Arevalo, H. J., Deng, D., Boyle, P. M., Nikolov, P. P., Ashikaga, H., Trayanova, N. A. (2018). Personalized virtual-heart technology for guiding the ablation of infarct-related ventricular tachycardia. *Nat Biomed Eng, 2*(10), 732-740. doi:10.1038/s41551-018-0282-2
7. Schachner, E. R., Sedlmayr, J. C., Schott, R., Lyson, T. R., Sanders, R. K., & Lambertz, M. (2017). Pulmonary anatomy and a case of unilateral aplasia in a common snapping turtle (Chelydra serpentina): developmental perspectives on cryptodiran lungs. *J Anat, 231*(6), 835-848. doi:10.1111/joa.12722
8. Thomas, S., Silvernagel, J., Angel, N., Kholmovski, E., Ghafoori, E., Hu, N., Ranjan, R. (2018). Higher contact force during radiofrequency ablation leads to a much larger increase in edema as compared to chronic lesion size. *J Cardiovasc Electrophysiol, 29*(8), 1143-1149. doi:10.1111/jce.13636
9. Unnikrishnan, G., Mao, H., Sundaramurthy, A., Bell, E. D., Yeoh, S., Monson, K., & Reifman, J. (2019). A 3-D Rat Brain Model for Blast-Wave Exposure: Effects of Brain Vasculature and Material Properties. *Ann Biomed Eng*. doi:10.1007/s10439-019-02277-2

Small Animal Ultrasound Facility

Overview

The Small Animal Ultrasound Facility has two state-of-the-art VisualSonics 2100 ultrasound machines capable of imaging mice, rats, and other animal models with excellent spatial and temporal resolution. The facility has probes that cover the spectrum from 9-70 MHz (standard human clinical ultrasound covers the spectrum from 2.5-12 MHz). These machines are capable of real-time 2D imaging as well as a full spectrum of Doppler techniques (pulsed-wave, color, tissue, power). One of the two machines is also capable of 3D imaging and contrast imaging (both targeted and non-targeted). Software is available for advanced image analysis of cardiac mechanics with speckle tracking that allows analysis of strain and strain rate. These tools allow near histologic resolution imaging of live animals, and are well suited to challenging applications such as the resolving the rapid heart rates of mice, or the microscopic size and function of early and mid-gestation embryos, and everything in between. The facility has long been an extremely important tool in the practice of clinical medicine because it offers real-time imaging providing understanding of anatomy and physiology, is non-invasive, and can be repeated serially.

Services

The facility has the capability for anesthesia and monitoring of mice and rats, and will support training laboratory personnel in the design of protocols and the use of the equipment for acquiring images. An off-line image analysis station is also available for later review and analysis of studies.

- Ultrasound imaging access
- Training in use of equipment
- Experiment design and assistance with protocol optimization
- Off-line image review and analysis

Equipment

- Two VisualSonics 2100 ultrasound machines
- Off-line image analysis station and network storage for backing-up data files

Personnel

- Kevin Whitehead, M.D., Director
- Kandis Carter, Laboratory Technician
- Tiehua Chen, Laboratory Technician

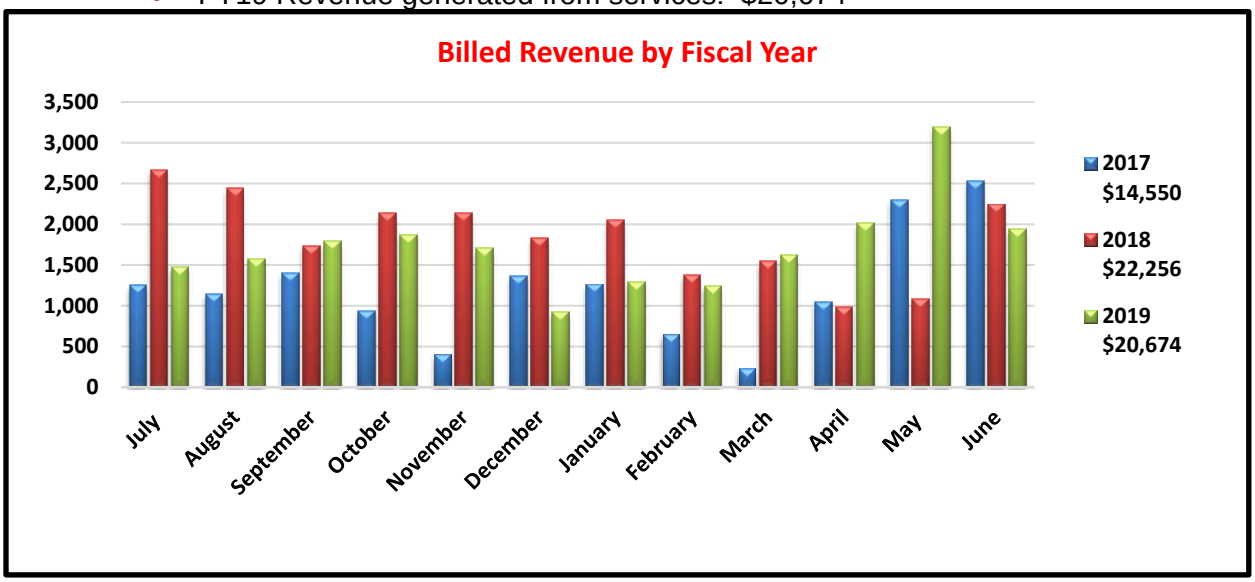
2019 Annual Update

Revenue/Expenses

FY19 Expenses: Total $41,139

FY19 Revenue: Total $30,674

- VP of Health Sciences Support: $10,000
- FY19 Revenue generated from services: $20,674



***** Legend displays total annual revenue by year earned.

Advisory Board Committee

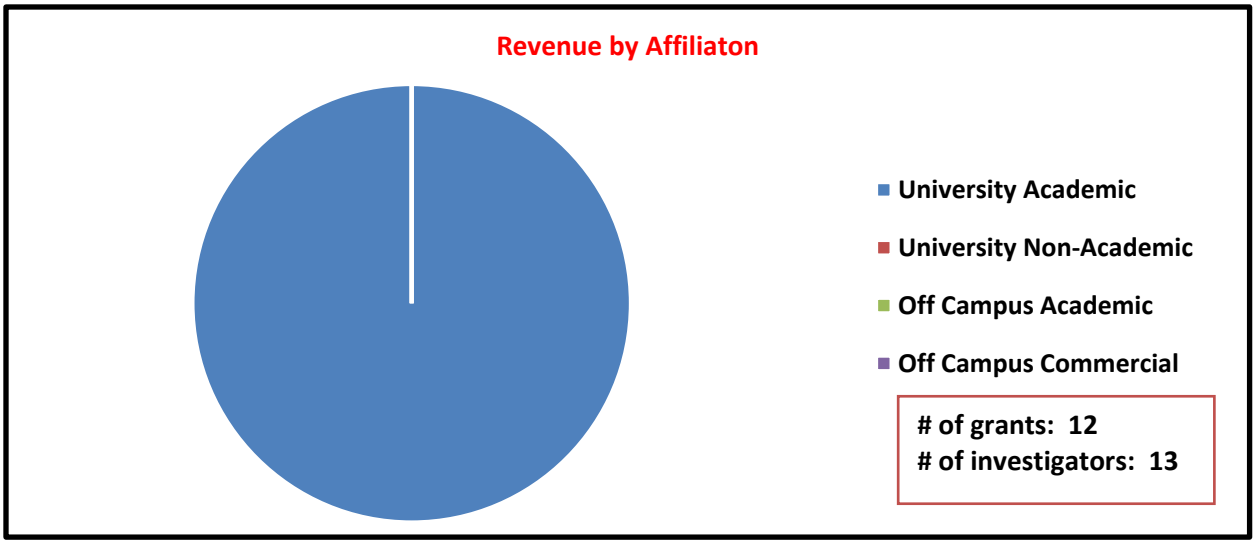
Last meeting date: April 15, 2013

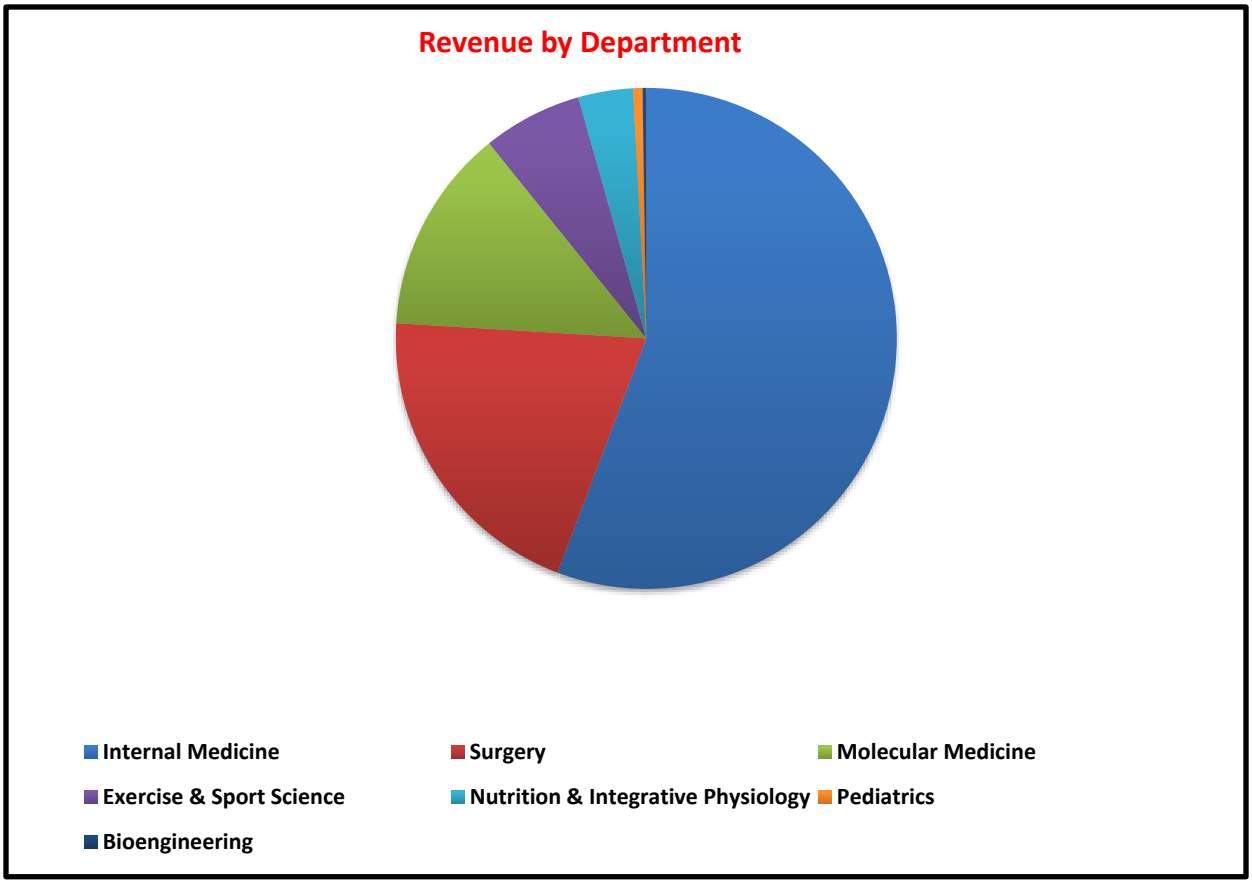
- Andy Weyrich, Associate Dean for Basic and Translational Sciences
- Craig Selzman, Associate Professor, Cardiothoracic Surgery
- Brent Wilson, Assistant Professor, Cardiology

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Drakos, Stavros	Doris Duke FTD, NIH, Eccles Treadwell FTD
2	Selzman, Craig	Department
3	Franklin, Sarah	NIH
4	Symons, John	NIH
5	Boudina, Sihem	Department
6	Pon Velayutham, Anandh	Department
7	Leibold, Elizabeth	NIH
8	Lai, Kent	Department
9	Summers, Scott	NIH
10	Phillips, John	NIH

Publications

1. Balakrishnan, B., Verheijen, J., Lupo, A., Raymond, K., Turgeon, C., Yang, Y., Lai, K. (2019). A novel phosphoglucomutase-deficient mouse model reveals aberrant glycosylation and early embryonic lethality. *J Inherit Metab Dis*. doi:10.1002/jimd.12110

Service Recharge Centers

Overview

The HSC Administration Office also manages Service/Recharge Centers. These Centers are not cores but follow most of the same guidelines as the HSC Cores. The Administration Office processes the billing, collections and ordering of supplies for these Centers. Each Center receives monthly reports showing revenue and expenses and has access to the internal tracking system which shows in real time what their account balances are. The Administration Office charges a fee of 5% on revenue collected from billed services. These Centers are listed on the HSC Cores website under Service/Recharge Centers. If it is determined at a later time that a Center would benefit from becoming a Core, then all guidelines must be followed.

Service/Recharge Centers are primarily created to provide services to the University Community but can also provide services to external customers. The administration of these facilities is performed by the home department. Only recharge activity for these groups is managed by the Administrative Office, this is partly due to the efficient billing system that has been developed in collaboration with our IT support group managed by Mr. Rick Haycock.

Genetic Science Learning Center

Overview

The GSLC specializes in translating complex science and health concepts for those who are not experts in a particular field. They produce award-winning educational materials and programs that make science and health easy for everyone to understand.

Uniqueness

The GSLC uniquely brings together in one team synergistic expertise in design and production of educational materials and programs as well as research and evaluation on the efficacy of both. It's team is unique among groups at US academic institutions that produce science and health education materials, in that it includes expertise in science and health writing, science research, instructional and educational material design, multimedia animation and interactivity, graphic design, video production, video game and app development, original music composition and audio engineering, course and workshop design, and research and evaluation of educational materials and programs; other groups outsource some of these functions.

The GSLC produces the most highly-used online life science education resource in the world. Each year its Learn.Genetics and Teach.Genetics websites are visited by over 16 million individuals who view over 60 million pages and come from every country. These sites, thus, provide an unparalleled, international dissemination mechanism for educational materials developed through collaborative projects with faculty. The GSLC has received numerous awards for the educational materials it produces. Among others, these include the first award of the *Science* Prize for Online Resources in Education from *Science Magazine* and AAAS.

The GSLC has over 20 years of experience in producing educational materials and programs for patients, the lay public, students at the K-12 and higher education levels, and K-12 teachers. They successfully collaborate with faculty and others in producing materials and programs and conducting evaluations for both large and small projects.

Services

The GSLC offers the following services:

Design and Production of Educational Materials

- Design and production of educational materials for:
  - Research studies
  - Clinical trials recruitment
  - Patients and families
  - K-12 students and teachers
  - Higher education students
  - Diverse audiences, including tailoring for cultural and language differences
- Science and health writing
- Instructional design
- Multimedia animation and interactivity
- 2D and 3D animation
- Graphic design for online and print-based materials
- Video production, including script writing, production and scheduling, videography, editing, and post-production

- Original music composition/scoring and audio engineering for video and multimedia materials
- Video game development
- App design and development
- Website design and development

Designing and Holding Educational Programs

- Online courses in Canvas for University credit
- In-person courses and workshops, with or without University credit
- Classroom programs for K-12 students
- Programs for the lay public
- Facilitating connections with K-12 teachers, schools and districts

Conducting Research and Evaluation Studies

- Evaluation of educational materials and programs
- Quantitative, qualitative and mixed-methods designs
- Small and medium-scale randomized controlled trials
- Development of valid knowledge assessment (test) items
- Focus groups and key informant or participant interviews
- Survey design

Cross-Cutting Services

- Dissemination of educational materials via conference presentations and manuscripts
- Writing education sections of grant proposals
- Consultation and planning of Broader Impacts for NSF grant proposals

An initial consultation is provided in order to define a project's scope and budget. For grant proposals, text describing the GSLC and its contributions to the project, a budget and justification are provided. Once a project is agreed to and/or funded, a project lead is assigned, who serves as the primary GSLC contact for the project.

Personnel

- Louisa A. Stark, PhD, Director
- Kevin Pompei, MEd, Administrative Director
- Peter Anderson, BFA, Creative Director
- Kagan Breitenbach, BMu, Specialty Media Coordinator
- Jonathan Conger, BS, Associate Software Engineer
- Dina Drits-Esser, PhD, Senior Research Associate
- Kristin Fenker, PhD, Post-doctoral Fellow
- Elliot Francis, BS, Senior Software Engineer
- Sheila Homburger, MS, Science Content Manager
- John Maxwell Kelly, BFA, Multimedia Manager
- Molly Malone, BS, Senior Education Specialist
- Ryan Perkins, BFA, Art Director
- Julia Peterson, Graphic Artist
- Steve Reest, BS, MLS, Program Assistant
- Harmony Starr, BS, Media Production Manager

FY19 Annual Update

New Services

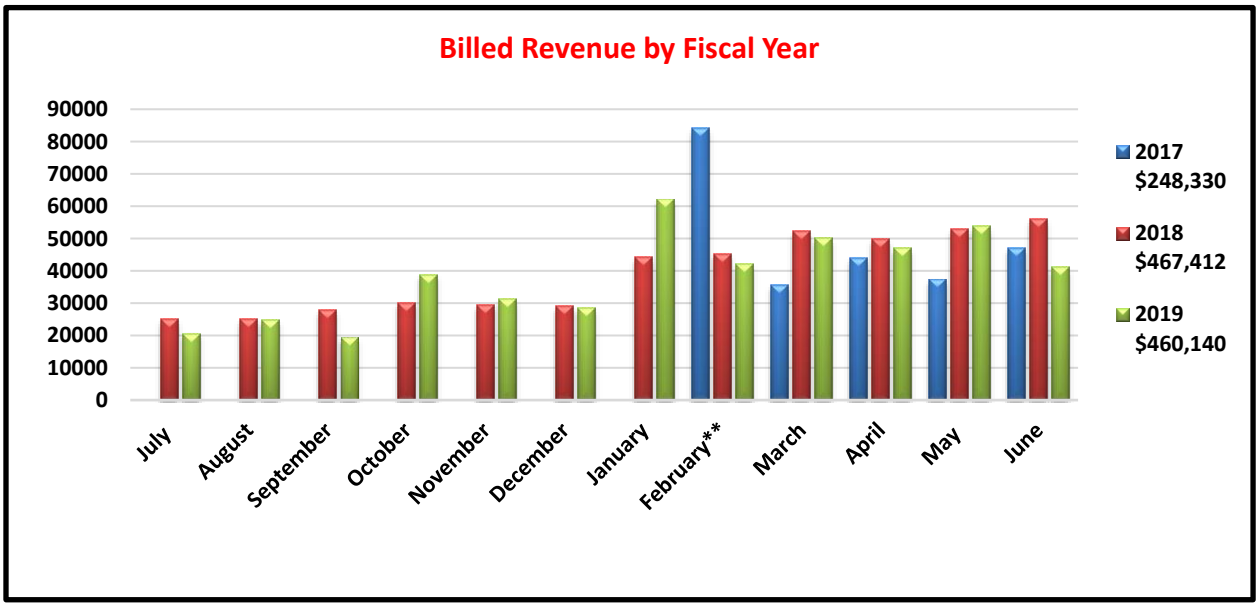
No new services for FY19

Revenue/Expenses

FY19 Expenses: $675,885

FY19 Revenue: $777,205

- Other Revenue Sources: $317,065
- FY19 Revenue generated from services: $460,140



* Legend displays total annual revenue by year earned.
** Management by Core Administration.

Management Meeting

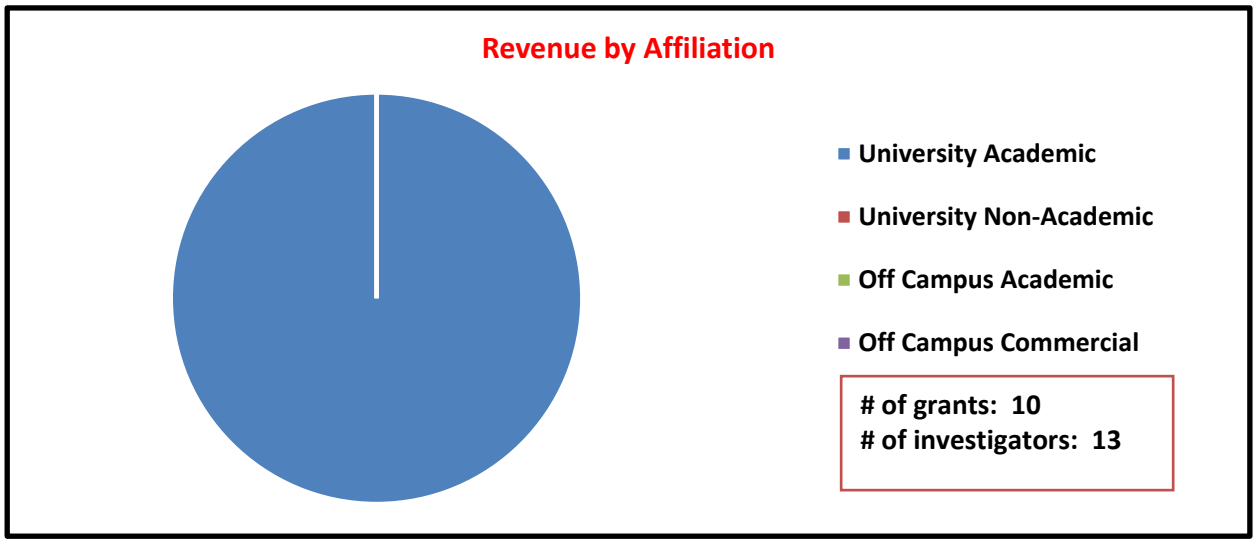
Last meeting date: April 10, 2019

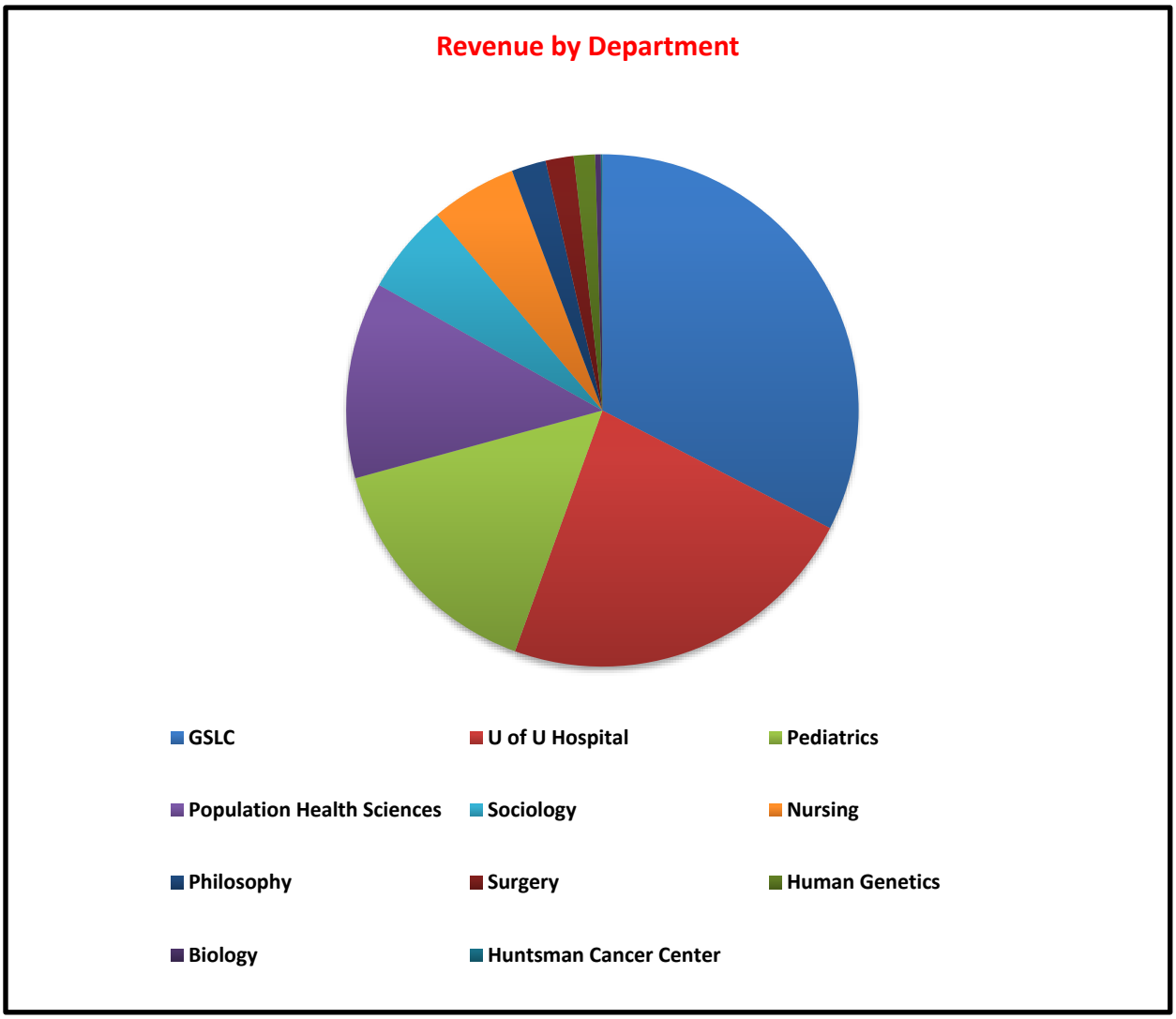
- Louisa Stark, PhD, GSLC Director
- Kevin Pompei, MEd, Administrative Director
- John Phillips, PhD, HSC Core Research Facility, Director
- Brenda Smith, Director, Accounting and Finance, HSC Core Research Facility Operations
- Amy Tanner, Director, Research & Science, SVPHS Research Unit
- Natalie Johnson, Manager, Administration, Department of Human Genetics

FY19 Scientific Impact

Research Support

Revenue Generated (see charts):





Top Users

1	Utah State Board of Education	Off Campus Academic
2	Patterson , Brittany	U of U Hospital
3	Keenan, Heather	NIH
4	Fagerlin, Angie	American Heart Association
5	Utz, Rebecca	NIH
6	Rothwell, Erin	NIH
7	Haber, Matt	NSF
8	Park, Albert	Amendment 2 LLC
9	Stark, Louisa	Health Insight
10	Botkin, Jeffrey	NIH

Goals for FY2020

The GSLC will continue to produce high-quality, award-winning educational materials, programs and evaluations. We will work to inform researchers and units across the University of Utah campus and elsewhere about our capabilities and our availability to collaborate on projects. In this way, we will seek to increase our visibility and expand our users.

Publications

1. Drits-Esser, D., Coulter, H., Mannello, M. C., Sunada, G., Alder, S. C., Davis, P. F. A., … Stark, L. A. (2019). The Community Faces Model: Community, University and Health Department Partners Thriving Together for Effective Health Education. *Collaborations: A Journal of Community-based Research and Practice, 2(1), 10*. doi:http://doi.org/10.33596/coll.29
2. Homburger, S. A., Drits-Esser, D., Malone, M., Pompei, K., Breitenbach, K., Perkins, R. D., . . . Stark, L. A. (2019). Development and pilot testing of a three-dimensional, phenomenon-based unit that integrates evolution and heredity. *Evolution: Education and Outreach, 12*(1), 13. doi:10.1186/s12052-019-0106-1

Educational Modules Published Online

1. Evolution: DNA and the Unity of Life https://teach.genetics.utah.edu/content/evolution/ and https://learn.genetics.utah.edu/content/evolution/
2. Insect Herbivores and Plants https://learngendev.azurewebsites.net/content/herbivores/

Iron & Heme

Overview

The Iron and Heme Core provides analysis of biologically important metals, precursor porphyrins and heme. The core also measures activity of the enzymes responsible for heme biosynthesis. Analysis and quantification of heme and its precursors can be obtained for cell pellets, tissue, whole blood, urine, feces and other complex biological materials. Analysis of enzyme activity can be provided for cell pellets, tissue and blood. An Agilent 7900-ICP mass spectrometer is used to measure iron content (as well as other metals) in biological samples.

Uniqueness

The Iron and Heme Core provides a service, not available at most universities including experienced UPLC/HPLC analysis of heme and porphyrin and tetrapyrrole precursor (ALA and PBG) content, assays for activity of enzymes involved in heme biosynthesis. We receive and process samples and provide service for academic laboratories all over the United States. We are able to assay and measure each of the 8 heme biosynthetic intermediates from tissue and cell sources.

Services

The Iron and Heme Core's primary mission is to facilitate research into the role of heme, heme precursors and transition metals in both normal and disease states. The Iron and Heme core lab has extensive experience with the separation and identification of tetrapyrroles and with running and developing heme biosynthesis pathway enzyme assays. We specialize in iron analysis by ICP-MS and also test for other metals. We are offering the following services:

- Metal analysis by ICP-MS
- UPLC Analysis of Total Heme and protoporphyrin IX
- Spectral Analysis of Heme
- UPLC analysis of porphyrins
- Assays for the following Heme Biosynthetic Enzymes (ALAS, ALAD/PBGS, PBGD, U3S, UROD, COPOX & FECH)

Equipment

Metal Analysis:

- Agilent 7900-ICP mass spectrometer
- Agilent SPS4 autosampler

Heme and Porphyrin analysis:

- Waters Acquity ultra performance liquid chromatography (UPLC) system, equipped with a reverse phase C18 column, a photodiode array detector and a fluorescence detector for reversed phase analytical work
- Agilent 8453 diode array spectrophotometer
- HPLC Waters 2795 Alliance HT separations module with a Waters 474 Scanning Fluorescence Detector and a Waters 2996 PDA Detector (photodiode array)

Personnel

- Hector Bergonia, Lab Specialist Tetrapyrrole Biochemistry
- Laurie Jackson, Core Director

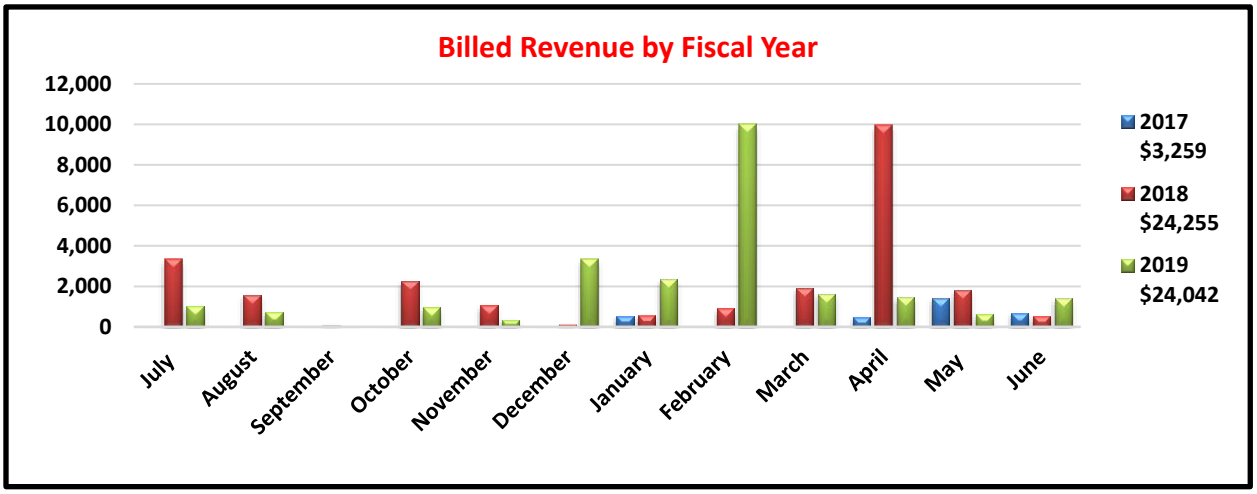
2019 Annual Update

Revenue/Expenses

FY19 Total Expenses: $23,144

FY19 Total Revenue: $24,255

- VP of Research Support: $0
- FY19 Revenue generated from services: $24,042



* Legend displays total annual revenue by year earned.

Advisory Board Committee (CIHD Operations Committee)

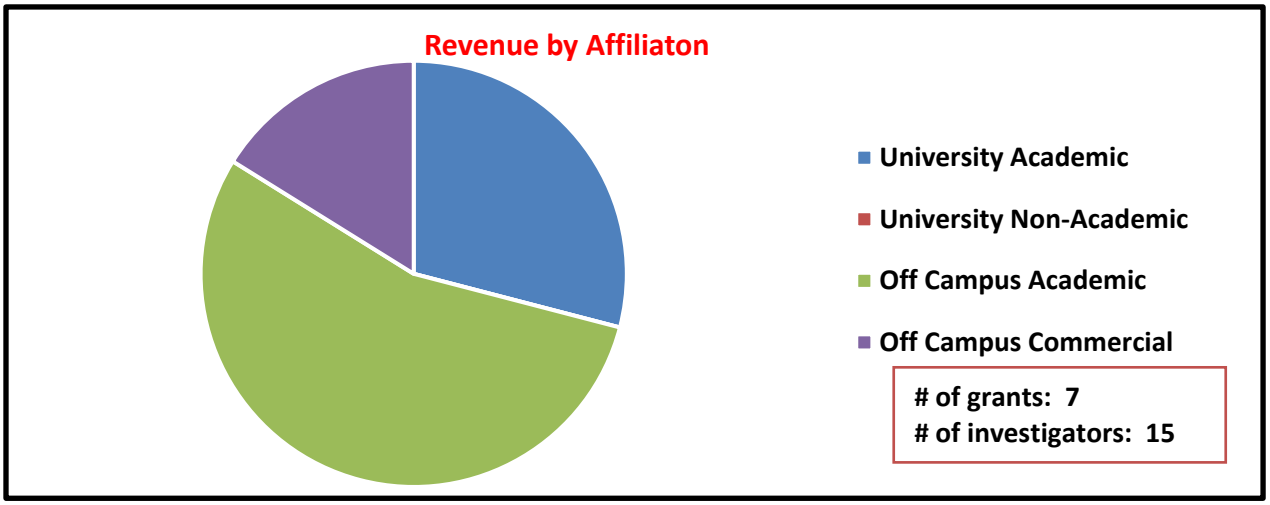
Last meeting date: October 4, 2017

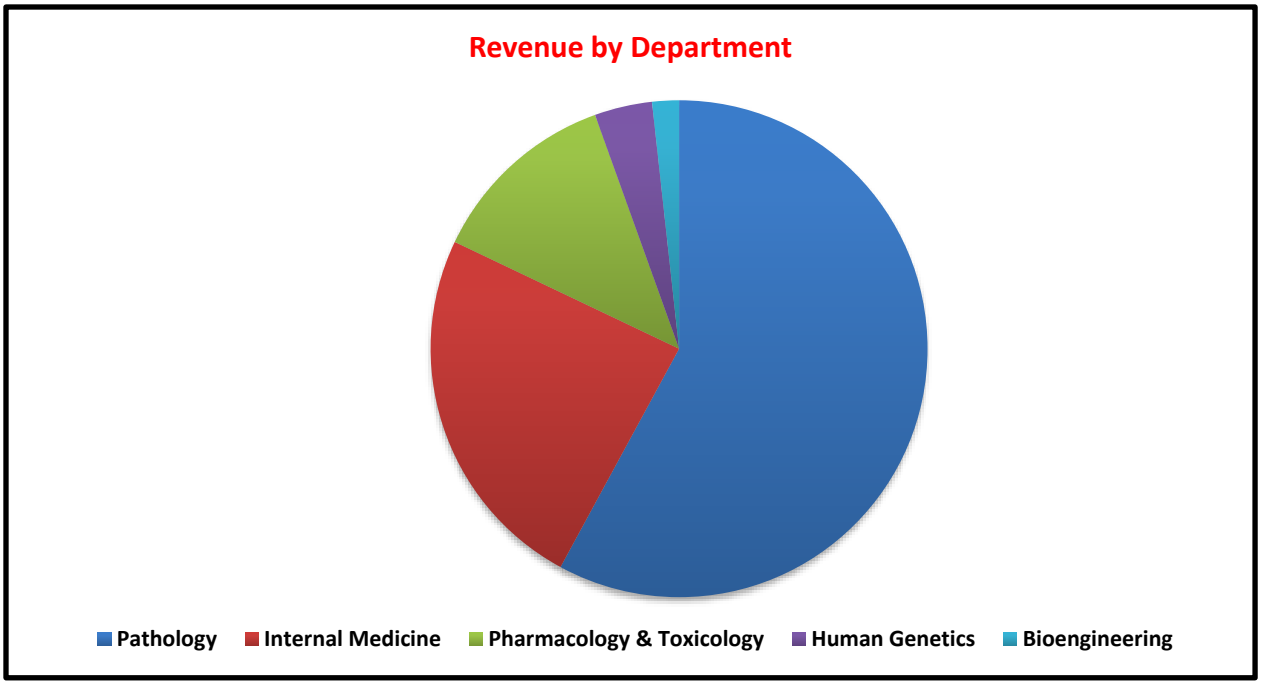
- John D. Phillips
- James Cox
- Diane M Ward
- Dennis Winge

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	University of Delaware	Off Campus Academic
2	Ward, Diane	NIH
3	Massachusetts General Hospital	Off Campus Academic
4	Koh, Mei	Kuda Therapeutics LLC, USTAR, NIH,NCI
5	University of California SDO	Off Campus Academic
6	University of Wisconsin Madison	Off Campus Academic
7	Cho, Monique	Department
8	IUSM-Glick Eye Institute	Commercial
9	Leibold, Elizabeth	NIH
10	Icahn School of Medicine Mt. Sinai	Off Campus Academic

Goals for FY2020

- Establish new procedure (forms) for logging metal analysis requests
- Increase awareness of our services

Publications

1. J. Chung et al. Erythropoietin signaling regulates heme biosynthesis (2017 May 29) eLIFE 6:e24767.
2. Seguin et al. Reductions in the mitochondrial ABC transporter Abcb10 affect the transcriptional profile of heme biosynthesis genes (2017 August 14) J. Biol. Chem. 292(39):16284.
3. Y. Y. Yien et al, Mutation in human *CLPX* elevates levels of delta-aminolevulinate synthase and protoporphyrin IX to promote erythropoietic protoporphyria (2017, September 5) PNAS E8045-E8052.
4. Y. Y. Yien et al, FAM210B is an erythropoietin target and regulates erythroid heme synthesis by controlling mitochondrial iron import and ferrochelatase activity. (2018) J. Biol. Chem. 293:19797-19811.

5. Rocha, ER, Bergonia, HA, Gerdes, S, Jeffrey Smith, C. *Bacteroides fragilis* requires the ferrous-iron transporter FeoAB and the CobN-like proteins BtuS1 and BtuS2 for assimilation of iron released from heme. *MicrobiologyOpen*. 2019; 8:e669.
6. Rocha, Timothy M. Bahr, Robert D. Christensen, Diane M. Ward, Fanjing Meng, Laurie K. Jackson, Kelly Doyle, Daniel R. Christensen, Anne G. Harvey, Hassan M. Yaish, Ferritin in serum and urine: A pilot study, Blood Cells, Molecules, and Diseases, Volume 76, 2019, Pages 59-62.

Materials Characterization Lab

Overview

The Materials Characterization Lab (MCL) is a user research facility managed by the Materials Science and Engineering (MSE) Department at the University of Utah. The lab offers clients access to a wide range of analytical instrumentation and services for a variety of biochemical, organic, inorganic, and environmental samples.

The MCL provides researchers with training on the care and operation of equipment used in materials characterization. In addition to providing training for new users, our staff is available to help users in the design of experiments and the interpretation of results.

The MCL maintains a ~1300 sq. ft. lab facility, including optical and metallographic microscopes, two scanning electron microscopes (SEM), an energy dispersive X-ray spectrometer (EDS), a Fourier transform infrared (FTIR) spectrometer, an ultraviolet-visible-near-infrared (UV-Vis-NIR) spectrophotometer, two X-ray diffractometers (XRD), a differential scanning calorimeter (DSC), a combination thermogravimetric analyzer and differential scanning calorimeter (DSC-TGA), a dilatometer, an Instron mechanical testing system, a BET surface area and pore size analyzer, a particle size analyzer (PSA) carbon and gold sputter coaters, a compression mounting press, and a grinding and polishing system.

Uniqueness

The MCL has an extensive history of successful collaborations with academia, government, and industry clients ranging from startups to multinational corporations in the aerospace, automotive, coatings, geochemical, medical, semiconductor, and other markets.

MSE faculty and staff serve as resources in the following areas of specialization: biofuel cells, ceramics, composites, computational electronic materials and polymers, electronic materials and assemblies, explosive sensing, nanomaterials, nanotechnology, and more.

The MCL has expertise in:

- Biomedical materials and devices
- Ceramics
- Composites
- Electronic materials
- Metals and metal oxides
- Polymers

The MCL provides the following:

- Cross-sectional analysis
- Materials analysis, comparison, and identification
- Microphotography suitable for advertising and training purposes
- Routine analysis for quality assurance and control

Services & Equipment

The MCL serves as a facility for Materials Science and Engineering undergraduate and graduate level courses that involve materials characterization.

The MCL staff also provide consultations and experiment design suggestions based on the needs of the user. The services offered by the MCL include materials characterization with the following techniques:

Optical Microscopy

- Olympus BH2 Series System Microscope
- Olympus Tokyo PME Inverted Stage / Metallographic Microscope
- Olympus VANOX Universal Research Microscope

Scanning Electron Microscopy

- Hitachi S-3000N Scanning Electron Microscope (SEM) with variable pressure modes and Secondary Electron (SE) and Backscatter Electron (BSE)
- Hitachi TM3030Plus Tabletop Microscope (SEM) with SE, BSE detectors, and Thermo Scientific Pathfinder SDD energy dispersive x-ray spectrometer (EDS).

Spectroscopy

- Varian 3100 Excalibur Series Fourier Transform Infrared Spectrometer (FTIR) with Attenuated Total Reflectance (ATR) and Transmission Accessories
- Perkin-Elmer LAMBDA 950 UV-Vis-NIR Spectrophotometer with 150 mm Integrating Sphere, 2D Detector Module, and Universal Reflectance (URA) Accessories

X-Ray Diffraction

- Philips PANalytical X'Pert X-Ray Diffractometer (XRD) with powder diffraction and thin film detectors.
- Bruker D2 Phaser X-Ray Diffractometer (XRD) with Phi axis rotation abilities.

Macroscopic & Physical Testing

- NETZSCH DSC 3500 Sirius Differential Scanning Calorimeter (DSC)
- TA Instruments SDT 650 thermogravimetric analyzer and differential scanning calorimeter (DSC-TGA) with autosampler
- Anter Corporation Work Horse IB Dilatometer
- Instron 5969 Dual Column Tabletop Testing System
- Micromeritics Gemini V BET Surface Area and Pore Size Analyzer
- Beckman Coulter LS230 particle size analyzer (PSA) with polarized light detectors
- Micromeritics FlowPrep 060 Sample Degas System
- METTLER AE100 Analytical Balance

Sample Preparation

- Cressington 108carbon/A Carbon Coater for Conductive Carbon Coatings
- Cressington 108auto Sputter Coater for Conductive Gold and other precious metal Coatings

Cross-Sectioning / Microsectioning

- Buehler SimpliMet II Mounting Press
- LECO Spectrum System 1000 with Oscillating Polishing Head and Six Sample Holder

Personnel

- Taylor Sparks, Ph.D., Director, Assistant Professor, Faculty Advisor
- Angela Nelson, Administrative Officer
- Kimberly Watts, Lab Manager

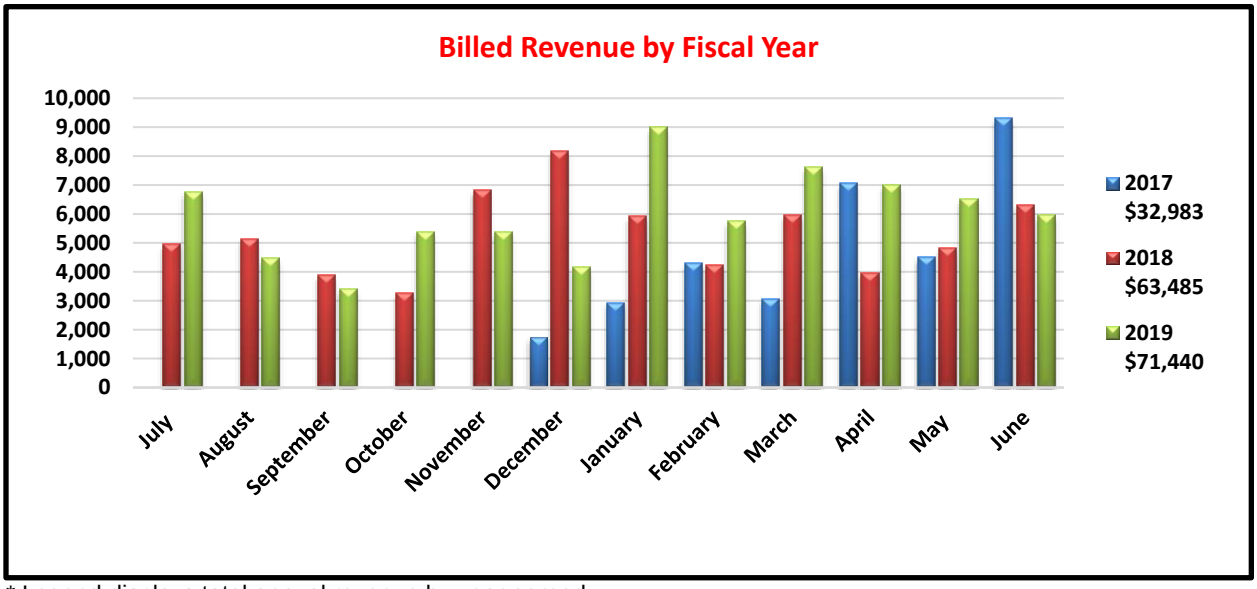
2019 Annual Update

Revenue/Expenses

FY19 Expenses: Total $59,792

FY19 Revenue: Total $71,440

- VP of Research Support: $ 0
- FY19 Revenue generated from services: $71,440



* Legend displays total annual revenue by year earned.

Advisory Board Committee

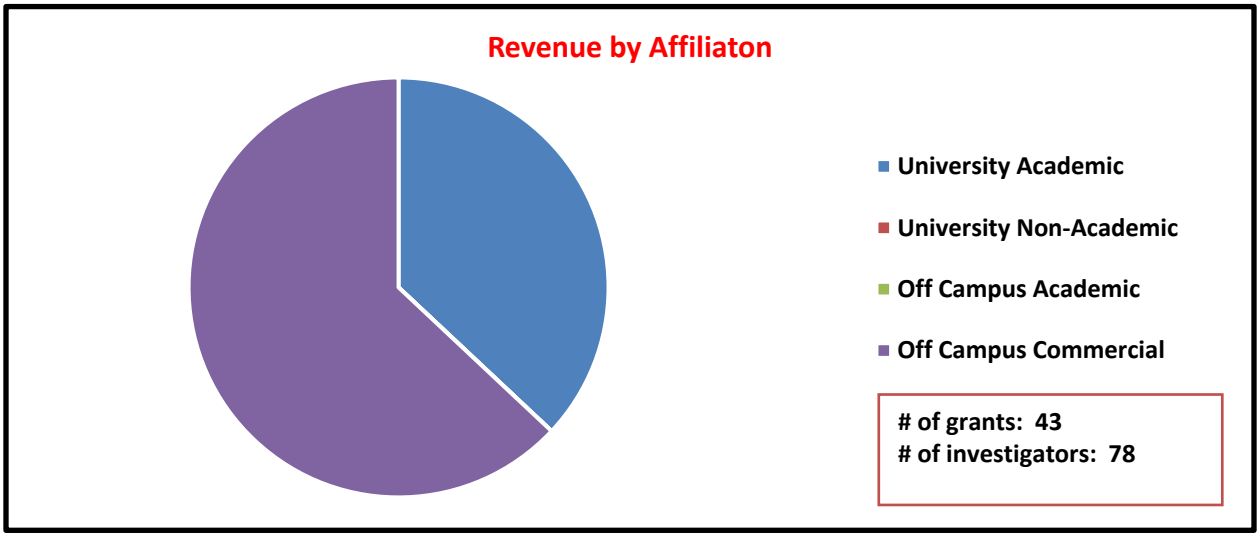
Last meeting date: July 30, 2018

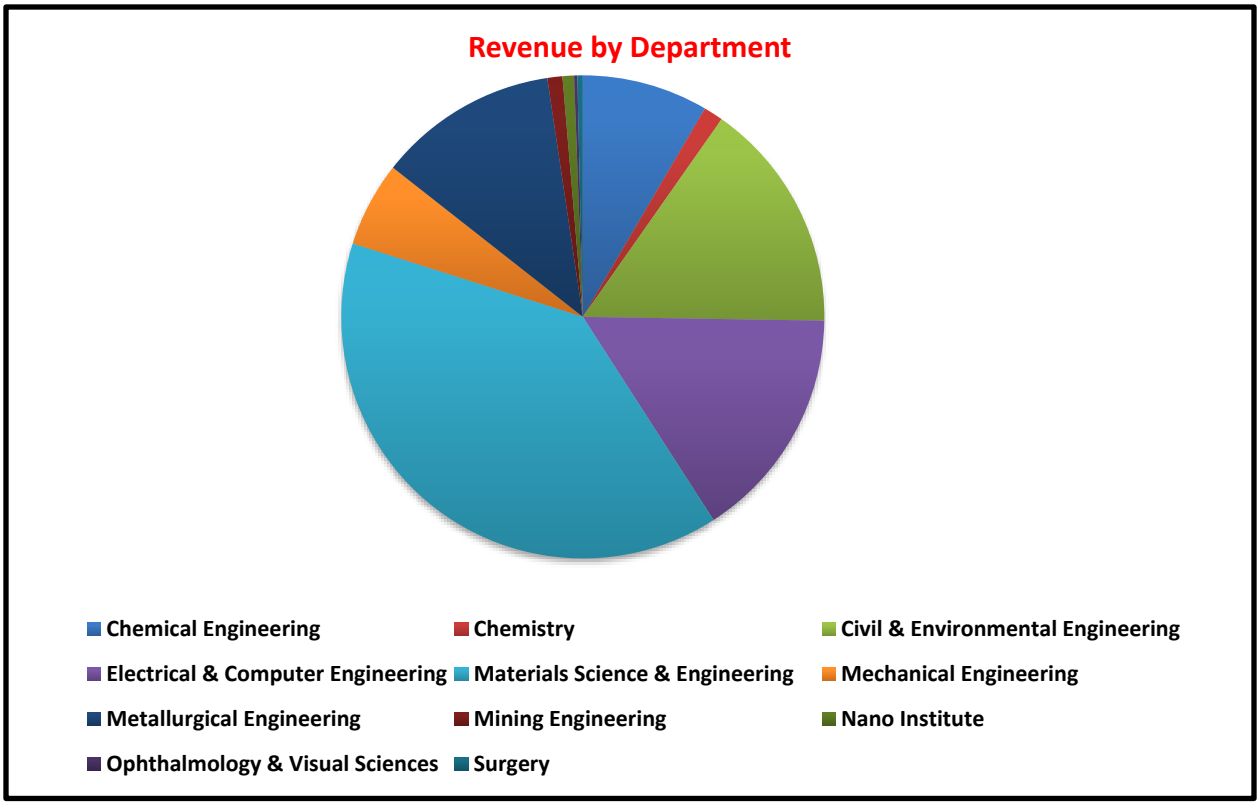
- Taylor Sparks, Ph.D., Assistant Professor
- Mike Scarpulla, Ph.D., Associate Professor
- Dmitry Bedrov, Ph.D., Associate Professor

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Sparks, Taylor	NSF, Department
2	OxEon Energy	Commercial
3	American Oxygen, LLC	Commercial
4	HiFunda, LLC	Commercial
5	Novus Research Group	Commercial
6	Allucent Biomedical	Commercial
7	Simpson, Michael	DOE, Department
8	Stryker	Commercial
9	Utah Materials Research	Commercial
10	Redmond Minerals, Inc.	Commercial

Goals for FY2020

- Increase lab usage and revenue
- Create standard training videos and materials for interns and users alike
- Formulate and enact lab organization practices that will decrease turnaround time for lab results

Publications

No known publications acknowledged this facility in FY19.

National Center for Veterans Studies

Overview

The mission of the National Center for Veterans Studies (NCVS) at The University of Utah is to engage in research, education, outreach, and advocacy for improving the lives of military personnel, veterans, and their families. The NCVS conducts research primarily focused on suicide prevention and PTSD among service members and veterans, and provides evidence-based treatments to this community at no cost. NCVS staff also conduct training workshops and educational presentations for healthcare providers and the public.

Services

NCVS offers a range of services including consulting, training, and psychological treatments.

Main services that have been developed and used during FY2019 include:

- **Suicide prevention training workshops.** The NCVS provides a range of training workshops to licensed mental healthcare providers, certified peer specialists, and other members of the community. These workshops focus on translating the results of NCVS research into a range of settings in order to better prepare healthcare providers and communities to assist in prevention and intervention for high-risk individuals.

- **Psychological treatments for service members, veterans, and first responders.** The NCVS offers evidence-based treatments for the military, veteran, and first responder communities at no-cost. The NCVS has pioneered innovative treatment delivery methods shown to yield more rapid recovery from posttraumatic stress disorder (PTSD) and suicidal thinking. The primary treatments offered by the NCVS include cognitive processing therapy for PTSD and brief cognitive behavioral therapy for suicide prevention. Service members, veterans, and first responders interested in receiving these therapies can contact the NCVS to schedule an initial consultation at ncvs@utah.edu or 801-587-7978.

Personnel

- Craig Bryan, PsyD, ABPP, Executive Director
- AnnaBelle Bryan, MS, Director of Operations
- Feea Leifker, PhD, Director of Clinical Services
- David Rozek, PhD, Director of Training

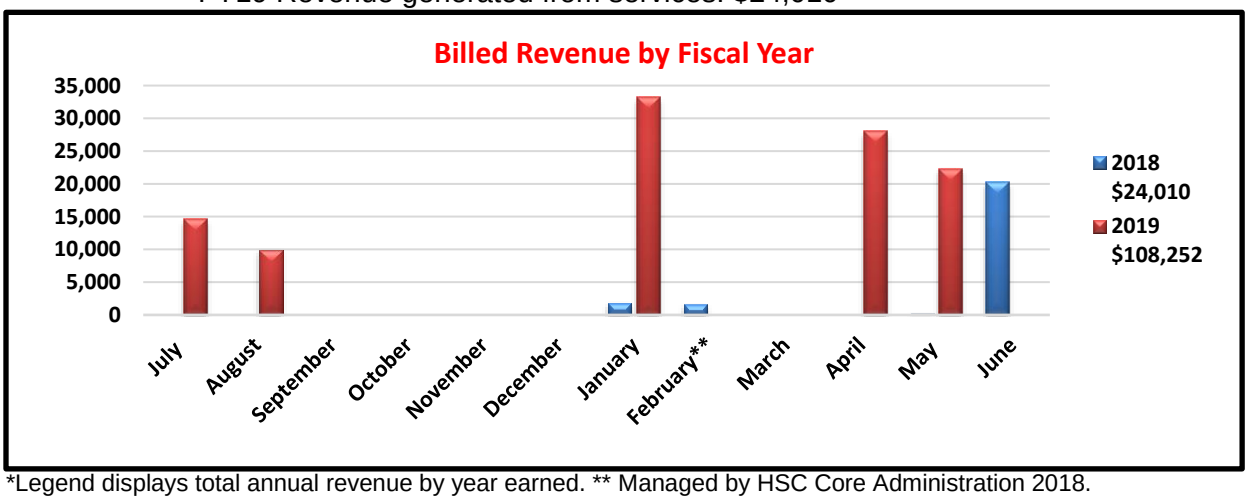
2019 Annual Update

Revenue/Expenses

FY19 Expenses: Total $45,323

FY19 Revenue: Total $108,252

- VP of Research Support: $ 0
- FY19 Revenue generated from services: $24,010



*Legend displays total annual revenue by year earned. ** Managed by HSC Core Administration 2018.

Grant Support – The NCVS has been awarded the following research grants this year:

- Department of Defense – Peer to Peer Programs for Military Suicide Prevention
- The Boeing Company – Suicide & Trauma Reduction Initiative for Veterans (STRIVE)
- Bob Woodruff Foundation – R&R Program
- Department of Defense – Brief Cognitive Behavioral Therapy Replication Trial
- Department of Defense – Project Safe Guard (Prime: University of Southern Mississippi)

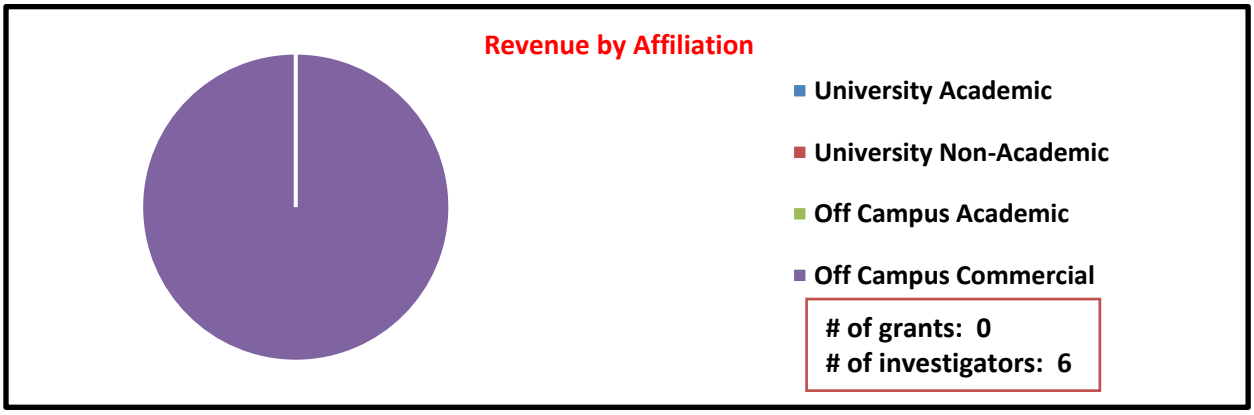
Advisory Board Committee

- N/A

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):



Top Users

1	Warfighter & Family Services	Commercial
2	Avera	Commercial
3	Landspitali Mental Health Services	Commercial
4	AF Reserve	Commercial
5	New Roads	Commercial
6	Whiteman AFB	Commercial

Publications

1. Albanese, B. J., Macatee, R. J., Boffa, J. W., Bryan, C. J., Zvolensky, M. J., & Schmidt, N. B. (2018). Interactive effects of traumatic brain injury and anxiety sensitivity on PTSD symptoms: A replication and extension in two clinical samples. *Cognit Ther Res, 42*(4), 510-523. doi:10.1007/s10608-017-9883-4
2. Applegarth, D. M., Wood, D. S., Bryan, A. O., & Bryan, C. J. (2019). Examining Help-Seeking Among National Guard Service Members. *Military Behavioral Health, 7*(2), 198-205. doi:10.1080/21635781.2018.1526143
3. Ben Barnes, J., Presseau, C., Jordan, A. H., Kline, N. K., Young-McCaughan, S., Keane, T. M., and the Consortium to Alleviate, P. (2019). Common Data Elements in the Assessment of Military-Related PTSD Research Applied in the Consortium to Alleviate PTSD. *Mil Med, 184*(5-6), e218-e226. doi:10.1093/milmed/usy226
4. Brown, L. A., McLean, C. P., Zang, Y., Zandberg, L., Mintz, J., Yarvis, J. S., consortium, S. S. (2019). Does prolonged exposure increase suicide risk? Results from an active duty military sample. *Behav Res Ther, 118*, 87-93. doi:10.1016/j.brat.2019.04.003
5. Brown, L. A., Zang, Y., Benhamou, K., Taylor, D. J., Bryan, C. J., Yarvis, J. S., Consortium, S. S. (2019). Mediation of suicide ideation in prolonged exposure therapy for posttraumatic stress disorder. *Behav Res Ther, 119*, 103409. doi:10.1016/j.brat.2019.103409
6. Bryan, C., & Harris, J. (2018). The Structure of Suicidal Beliefs: A Bifactor Analysis of the Suicide Cognitions Scale. *Cognitive Therapy and Research*. doi:10.1007/s10608-018-9961-2
7. Bryan, C. J. (2018). The need for secondary prevention of suicides in the U.S. military and its practical implications. *Psychological Services*.
8. Bryan, C. J. (2019). Cognitive behavioral therapy for suicide prevention (CBT-SP): Implications for meeting standard of care expectations with suicidal patients. *Behav Sci Law, 37*(3), 247-258. doi:10.1002/bsl.2411
9. Bryan, C. J. (2019). A Preliminary Validation Study of Two Ultra-Brief Measures of Suicide Risk: The Suicide and Perceived Burdensomeness Visual Analog Scales. *Suicide Life Threat Behav, 49*(2), 343-352. doi:10.1111/sltb.12447
10. Bryan, C. J., Bryan, A., Rugo, K., Hinkson, K., & Leifker, F. (2019). Happiness, Meaning in Life, and PTSD Symptoms Among National Guard Personnel: A Multilevel Analysis. *Journal of Happiness*, 1-14. doi:https://doi.org/10.1007/s10902-019-00129-3
11. Bryan, C. J., & Bryan, A. O. (2019). Financial Strain, Suicidal Thoughts, and Suicidal Behavior Among US Military Personnel in the National Guard. *Crisis*, 1-9. doi:10.1027/0227-5910/a000592
12. Bryan, C. J., Bryan, A. O., Anestis, M. D., Khazem, L. R., Harris, J. A., May, A. M., & Thomsen, C. Firearm availability and storage practices among military personnel who have thought about suicide: a cross-sectional study. *JAMA Network Open*.
13. Bryan, C. J., Leifker, F. R., Rozek, D. C., Bryan, A. O., Reynolds, M. L., Oakey, D. N., & Roberge, E. (2018). Examining the effectiveness of an intensive, 2-week treatment program for military personnel and veterans with PTSD: Results of a pilot, open-label, prospective cohort trial. *J Clin Psychol, 74*(12), 2070-2081. doi:10.1002/jclp.22651
14. Bryan, C. J., May, A. M., & Harris, J. (2019). Examining emotion relief motives as a facilitator of the transition from suicidal thought to first suicide attempt among active duty soldiers. *Psychol Serv, 16*(2), 293-301. doi:10.1037/ser0000234
15. Bryan, C. J., May, A. M., Rozek, D. C., Williams, S. R., Clemans, T. A., Mintz, J., Burch, T. S. (2018). Use of crisis management interventions among suicidal patients: Results of a randomized controlled trial. *Depress Anxiety, 35*(7), 619-628. doi:10.1002/da.22753
16. Bryan, C. J., Oakey, D. N., Harris, J. A., & Res, C. T. (2018). Reasons for Living Among U.S. Army Personnel Thinking About Suicide. *Cognitive Therapy and Research, 42*(6), 758-768. doi:https://doi.org/10.1007/s10608-018-9932-7
17. Bryan, C. J., Peterson, A. L., & Rudd, M. D. (2018). Differential Effects of Brief CBT Versus Treatment as Usual on Posttreatment Suicide Attempts Among Groups of Suicidal Patients. *Psychiatr Serv, 69*(6), 703-709. doi:10.1176/appi.ps.201700452

18. Bryan, C. J., Rozek, D. C., Burch, T. S., Leeson, B., & Clemans, T. A. (2019). Therapeutic Alliance and Intervention Approach Among Acutely Suicidal Patients. *Psychiatry, 82*(1), 80-82. doi:10.1080/00332747.2018.1485371
19. Bryan, C. J., Rozek, D. C., Butner, J., & Rudd, M. D. (2019). Patterns of change in suicide ideation signal the recurrence of suicide attempts among high-risk psychiatric outpatients. *Behav Res Ther*. doi:10.1016/j.brat.2019.04.001
20. Bryan, C. J., Vujanovic, A. A., & Nock, M. K. (2019). Innovations in the science of suicide. *Behaviour Research and Therapy*, 103451. doi:https://doi.org/10.1016/j.brat.2019.103451
21. Bryan, C. J., Wood, D., Applegarth, M., & Bryan, A. O. Subtypes of Mental Health Stigma and Barriers to Care Among National Guard Personnel: Results of a Latent Class Analysis. *Armed Forces & Society, 0*(0), 0095327X19842220. doi:10.1177/0095327x19842220
22. Deka, R., Bryan, C. J., LaFleur, J., Oderda, G., Atherton, A., & Stevens, V. (2018). Benzodiazepines, Health Care Utilization, and Suicidal Behavior in Veterans With Posttraumatic Stress Disorder. *J Clin Psychiatry, 79*(6). doi:10.4088/JCP.17m12038
23. Fang, Q., McNaughton-Cassill, M., Bryan, C., Pirani, S., & Osman, A. (2019). Further evidence for score reliability and validity of the Anxiety Depression Distress Inventory-27 scale. *Military Psychology, 31*(2), 160-168. doi:10.1080/08995605.2019.1578151
24. Griffin, B. J., Purcell, N., Burkman, K., Litz, B. T., Bryan, C. J., Schmitz, M., Maguen, S. (2019). Moral Injury: An Integrative Review. *J Trauma Stress, 32*(3), 350-362. doi:10.1002/jts.22362
25. Kanzler, K. E., Pugh, J. A., McGeary, D. D., Hale, W. J., Mathias, C. W., Kilpela, L. S., McCracken, L. M. (2018). Mitigating the Effect of Pain Severity on Activity and Disability in Patients with Chronic Pain: The Crucial Context of Acceptance. *Pain Med*. doi:10.1093/pm/pny197
26. Kopacz, M. S., Adams, M. S., Searle, R., Koenig, H. G., & Bryan, C. J. (2019). A Preliminary Study Examining the Prevalence and Perceived Intensity of Morally Injurious Events in a Veterans Affairs Chaplaincy Spiritual Injury Support Group. *J Health Care Chaplain, 25*(2), 76-88. doi:10.1080/08854726.2018.1538655
27. Kopacz, M. S., Bryan, C. J., Bishop, T. M., & Ashrafioun, L. (2018). Alcohol and Suicide Risk: Examining the Role of Meaning-Making. *J Dual Diagn, 14*(4), 220-227. doi:10.1080/15504263.2018.1513618
28. Kopacz, M. S., Lockman, J., Lusk, J., Bryan, C. J., Park, C. L., Sheu, S. C., & Gibson, W. C. (2019). How meaningful is meaning-making? *New Ideas in Psychology, 54*, 76-81. doi:https://doi.org/10.1016/j.newideapsych.2019.02.001
29. Martin, R. L., Assavedo, B. L., Bryan, A. O., Green, B. A., Capron, D. W., Rudd, M. D., Anestis, M. D. (2018). The Relationship between Post-Battle Experiences and Thwarted Belongingness and Perceived Burdensomeness in Three United States Military Samples. *Arch Suicide Res*, 1-18. doi:10.1080/13811118.2018.1527266
30. May, A. M., Crenshaw, A. O., Leifker, F., Bryan, C. J., & Baucom, B. R. W. (2019). Knowledge of suicide history, current depressive symptoms, and future suicide risk within couples. *Behav Res Ther*. doi:10.1016/j.brat.2019.03.015
31. May, A. M., Lawson, W. C., Bryan, A., & Bryan, C. J. (2018). Nonsuicidal self-injury, suicide ideation and suicide attempts in the National Guard. *Compr Psychiatry, 86*, 115-118. doi:10.1016/j.comppsych.2018.08.003
32. Moreno, J. L., Nabity, P. S., Kanzler, K. E., Bryan, C. J., McGeary, C. A., & McGeary, D. D. (2019). Negative Life Events (NLEs) Contributing to Psychological Distress, Pain, and Disability in a U.S. Military Sample. *Mil Med, 184*(1-2), e148-e155. doi:10.1093/milmed/usy259
33. Roberge, E. M., Bryan, C. J., Peterson, A., & Rudd, M. D. (2019). Variables associated with reductions in insomnia severity among acutely suicidal patients receiving brief cognitive behavioral therapy for suicide prevention. *J Affect Disord, 252*, 230-236. doi:10.1016/j.jad.2019.04.045
34. Roberge, E. M., Haddock, L. A., Oakey-Frost, N., Hinkson, K. D., Bryan, A. O., & Bryan, C. J. Retraumatization: a specific risk factor for PTSD, depression, and suicide outcomes in National Guard personnel. *Theory, Research, Practice, and Policy*.
35. Rozek, D. C., Keane, C., Sippel, L. M., Stein, J. Y., Rollo-Carlson, C., & Bryan, C. J. (2019). Short-term effects of crisis response planning on optimism in a U.S. Army sample. *Early Interv Psychiatry, 13*(3), 682-685. doi:10.1111/eip.12699
36. White, K. L., Harris, J. A., Bryan, A. O., Reynolds, M., Fuessel-Herrmann, D., & Bryan, C. J. (2018). Military sexual trauma and suicidal behavior among National Guard personnel. *Compr Psychiatry, 87*, 1-6. doi:10.1016/j.comppsych.2018.08.008

Nuclear Engineering

Overview

UNEP provides state-of-the-art laboratories and devices for alpha, beta, gamma and neutron radiation detection, irradiation of material samples to study various effects of all types of radiation, and neutron activation analysis techniques (nondestructive technique to find a sample elemental composition). UNEP maintains a 7,500 sq ft nuclear engineering and radiochemistry facility, including a fully operable 100 kW TRIGA Mark-1 nuclear reactor, 3 High Purity Germanium (HPGe) gamma detectors, liquid scintillation counting, and alpha spectrometry.

Uniqueness

The Utah Nuclear Engineering Facility is the only nuclear research reactor in the State of Utah, and one of the few in the Intermountain West area. We offer a number of unique, non-destructive testing techniques for analyzing isotopic and chemical composition of a wide variety of samples. UNEP has been at the forefront of establishing a safety culture and practices, already implemented at large scale commercial power plants, in a research reactor environment. UNEP also allows students from the University of Utah, as well as other local universities, to train for and obtain a Reactor Operator (RO) license from the Nuclear Regulatory Commission (NRC).

Services

The types of services offered by UNEP include material characterization by elemental and isotopic composition analysis, sample irradiation services, and radiation hardness testing of samples placed in high radiation environments. Example services are as follows:

- Neutron Activation Analysis (NAA)
- Sample Irradiation
- Electronics Hardness Testing
- Radioisotope Generation
- Passive Gamma Spectroscopy
- Alpha Spectroscopy
- Liquid Scintillation Counting
- Fission Track Analysis

Because of the uniqueness and lack of familiarity that often encompasses a research reactor an important aspect of our work is consulting with researchers and PIs at the early stages of their research in order to establish an efficient and cost effective plan with utilizing our TRIGA reactor and a wide variety of radiation detectors.

Equipment

Radiation Detectors:

- Canberra Alpha Analyst
- Canberra HPGe detectors
  - BEGe 3830
  - REGe 4020
  - GC 4020
- Beckman Liquid Scintillation Counter
- NaI and LaBr detectors
- TRIGA Research Reactor

Personnel

- Matthew Lund, Reactor Supervisor
- Amanda Foley, Reactor Operator
- Lucas Albright, Reactor Operator
- Steven Pappas, Operator in Training
- Alexander Reifsnyder, Operator in Training
- Donavan Feist, Lab Analyst

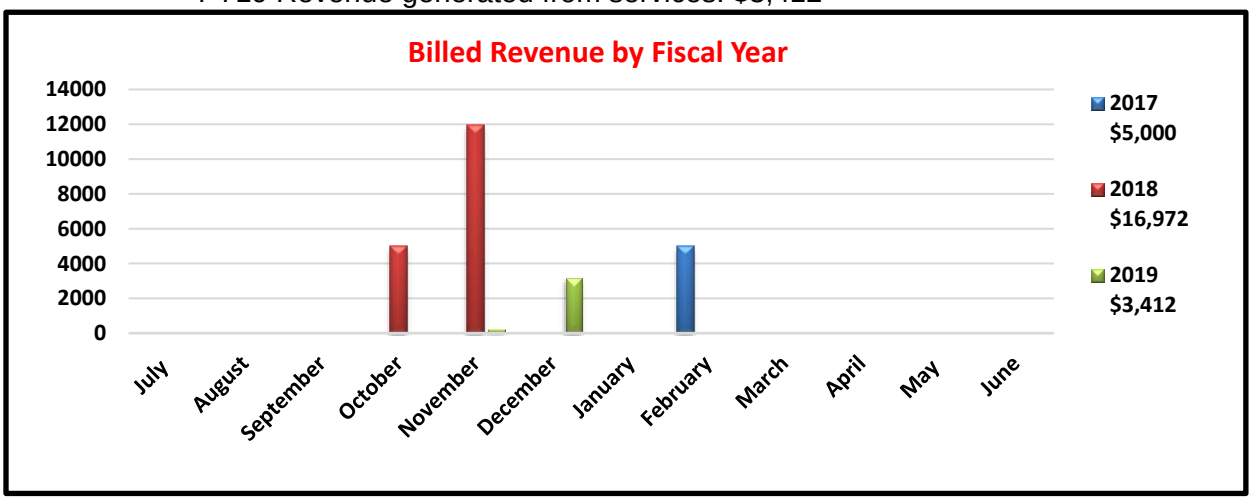
2019 Annual Update

Revenue/Expenses

FY19 Expenses: $3,460

FY19 Revenue: $3,412

- FY19 Revenue generated from services: $3,412



* Legend displays total annual revenue by year earned.

Advisory Board Committee

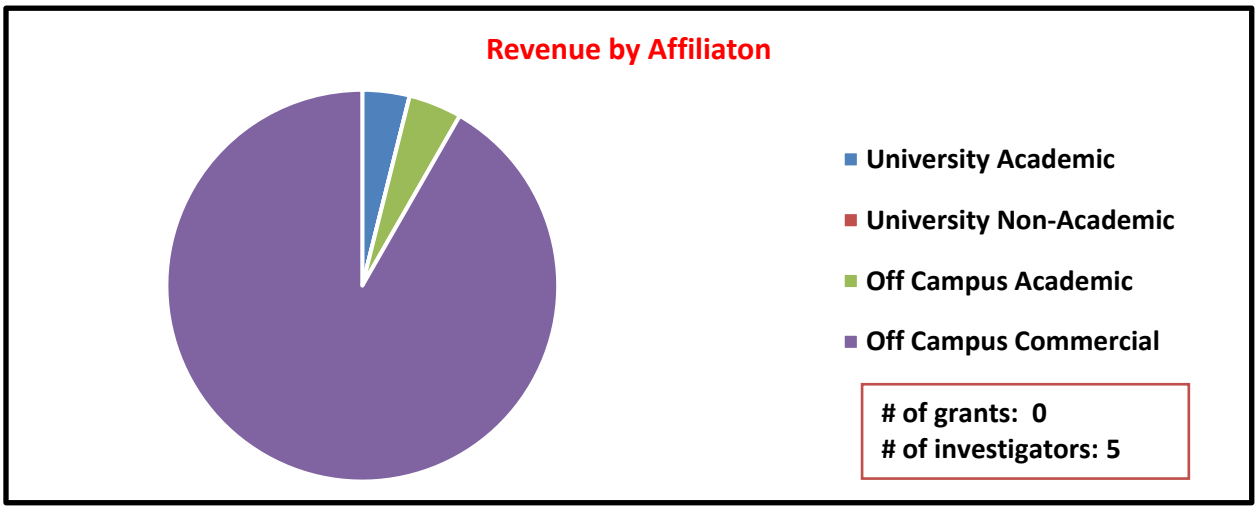
Last meeting date: March 27, 2017

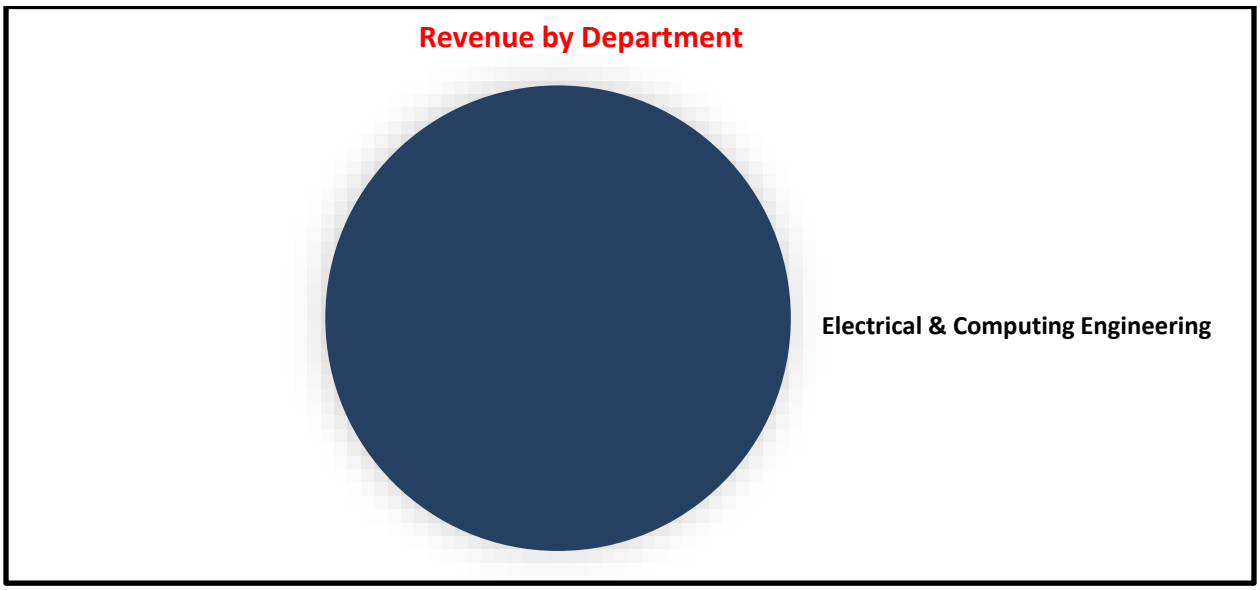
- Jim Byrne, Reactor Safety Committee Chair
- Terry Ring, Professor, Chemical Engineering
- Greg Moffitt, Former Reactor Supervisor

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Phoenix, LLC	Commercial
2	University of Washington	Off Campus Academic
3	Wheeler Machinery	Commercial
4	Life-E	Commercial
5	Krishnamoorthy, Sriram	Department

Goals for FY2020

- Characterize and begin utilizing pneumatic irradiator
- Alpha spectrometry
- More consistent user base
- International 2 Week Training course with Okayama University

- Possible labs/classes with outside entities

Scalable Analytics & Informatics

Overview

The University of Utah Center for Scalable Analytics and Informatics (USAI) provides support to research and operations groups inside and outside the University of Utah. These services include Annotation and Chart Review, Natural Language Processing, EMR-driven Clinical Trial Recruitment, Analytics and Data Services, and Enterprise Architecture and Application Development.

Uniqueness

Utah Scalable Analytics and Informatics provides multiple services for researchers utilizing electronic medical records. EMR-driven Clinical Trial Recruitment provides the ability to identify patients during an encounter with a healthcare provider that potentially could participate in a clinical trial and could drastically reduce cost and increase recruitment. Annotation products help machines and humans mark-up data for classification. Natural Language Processing (NLP) processes test data to extract structured data to infer concepts that can be understood by machines and humans for further analysis. USAI's annotation product line focuses on easing the burden and increasing consistency of manual chart review and annotation tasks. While annotation and chart review are time consuming and expensive, they are vital to many part of the research process: data exploration, feasibility, defining study variables, identifying information in text notes, classifying information within a document, at the document level, at the encounter or patient level, and validating study results. USAI provides Enterprise Architecture and Application Development and has developed annotation tools to support Natural Language Processing, which improves outcomes in health services research and reduces the costs to the researcher. Education is also important to USAI and therefore USAI has recruited and trained computer science students.

Services

The following services are offered by USAI:

- Annotation and Chart Review
- Natural Language Processing
- EMR-driven Clinical Trial Recruitment
- Analytics and Data Services
- Data Science and Machine Learning
- Enterprise Architecture and Application Development

Consultation is provided in order to define a projects scope and budget in the early stages of development to make optimal and efficient use of USAI's services. The staff will also handle regulatory requirements and project management if needed.

Specialized Software

Chart Review

- eHOST
- ChartReview

Natural Language Processing

- Leo
- Chex

Clinical Trial Management

- ProjectFlow

Data Exploration and Visualization

- OHDSI Atlas

Personnel

- Scott L DuVall, PhD, Director
- Chris Ledding, Financial Analyst
- Jeffrey Ferraro, Data Science Lead
- Chris Wilson, Data Scientist
- Udara Abeysekara, Data Scientist
- Qingzhu Liu, Software Designer and Programmer
- Shaoyu Su, Software Designer and Programmer
- Hamid Saoudian, Enterprise Architect
- Ramana Seerapu, IT Project Manager
- Olga Patterson, Applied NLP Lead
- Hannah Eyre, Clinical Data Manager
- Patrick Alba, Clinical Data Manager
- Lacey Lewis, Clinical Research Annotation Manager
- Lacy Castleton, Clinical Annotator
- Holly Andreason, Clinical Annotator
- Camille Bateman, Clinical Annotator
- Kristi Gregory, Clinical Annotator
- David Kotter, Clinical Annotator
- Tiffany Quilter, Clinical Annotator
- Cara Shimizu, Clinical Annotator
- Lindsay Tanzer, Clinical Annotator
- Sally MacDonald, Clinical Annotator
- Denise Stone, Clinical Annotator

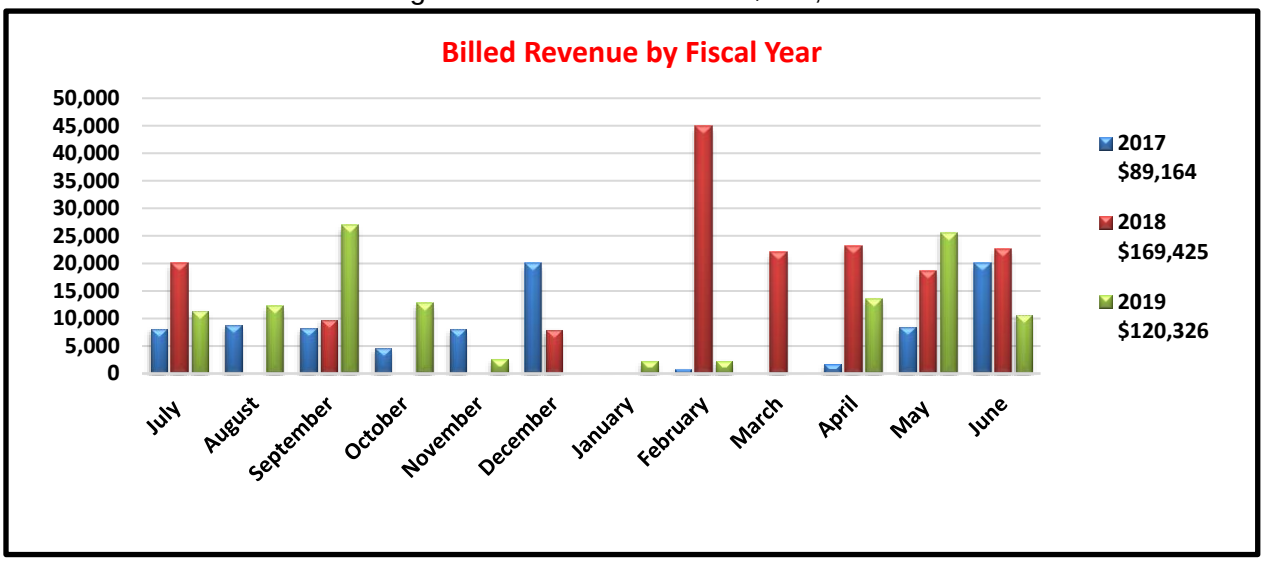
FY19 Annual Update

Revenue/Expenses

FY19 Expenses: $136,496

FY19 Revenue: $120,326

- VP of Research Support: $0
- FY 19 Revenue generated from services: $120,326



* Legend displays total annual revenue by year earned.

Management Meeting

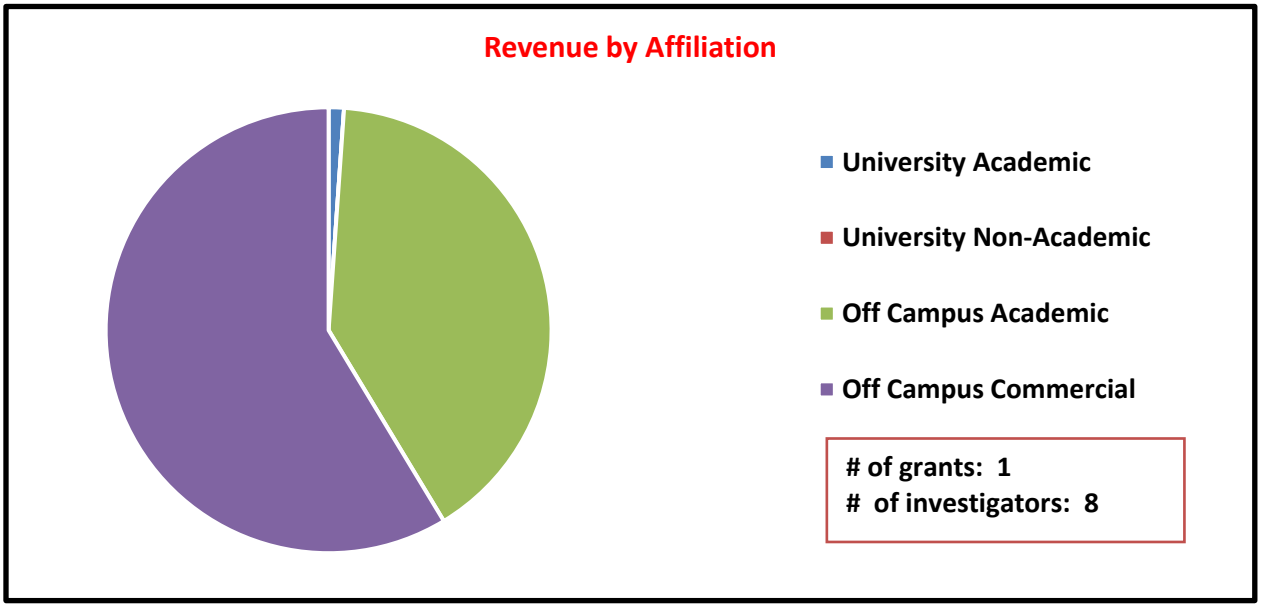
Last meeting date: August 10, 2017

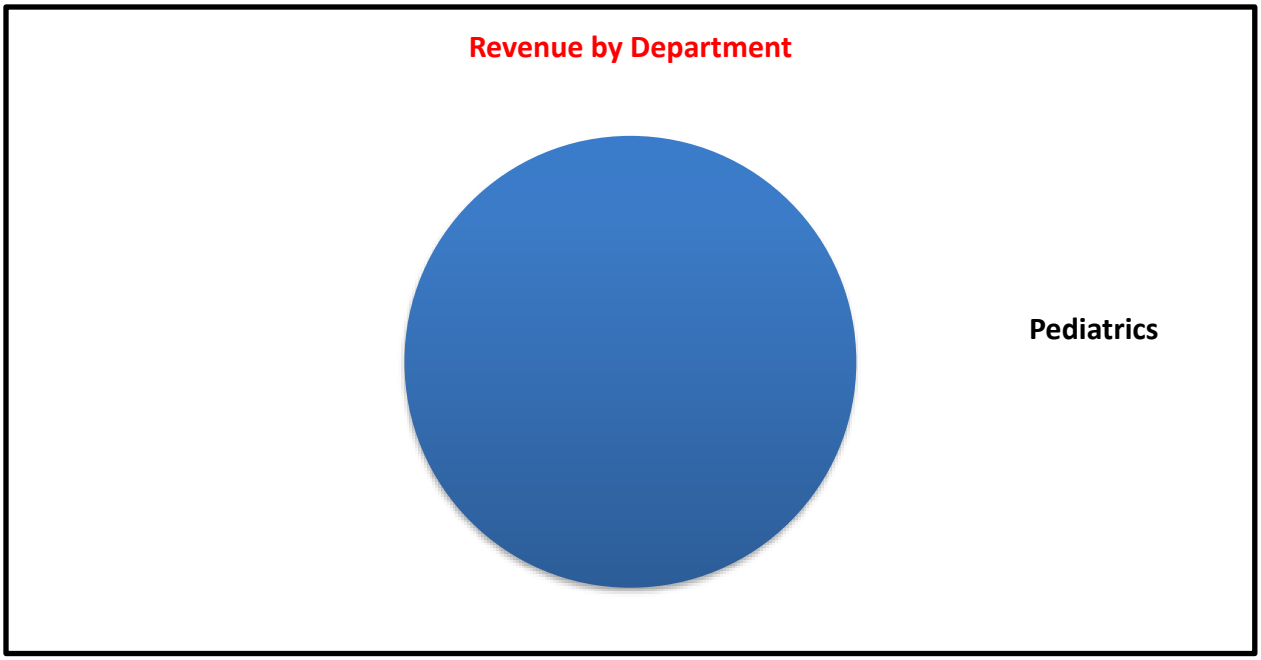
- Scott L DuVall, PhD, Director
- Christopher Ledding, MBA, Financial Analyst

FY19 Scientific Impact

Research Support

Revenue Generated (see charts):





Top Users

1	Western Inst. Biomedical Research	Off Campus Academic
2	Vanderbilt University Medical Ctr.	Off Campus Academic
3	Paraexel	Commercial
4	Sepulveda Research Corporation	Commercial
5	University of Michigan	Off Campus Academic
6	Darmouth College	Off Campus Academic
7	Bucher, Brian	Department
8	Southern Calif. Permanente Medical Group	Commercial

Goals for FY2020

USAI will continue to offer and expand its services to University and Industry members in health sciences research by providing EMR-driven patient trial recruitment, annotation and chart review, natural language processing, enterprise architecture and application development and data analysis. As a new service that will be offered in FY20, data science and machine learning services will be provided. To this end, we hired a data science lead and two data scientists. To meet increasing demand of USAI's services and to replace staff that have left, the team has additionally brought on board several new staff members to include computer programmers, data managers, and clinical annotators.

Publications

1. Bustamante, R., Earles, A., Murphy, J. D., Bryant, A. K., Patterson, O. V., Gawron, A. J., Liu, L. (2019). Ascertainment of Aspirin Exposure Using Structured and Unstructured Large-scale Electronic Health Record Data. *Med Care*. doi:10.1097/MLR.0000000000001065
2. Chanfreau-Coffinier, C., Hull, L. E., Lynch, J. A., DuVall, S. L., Damrauer, S. M., Cunningham, F. E., Tuteja, S. (2019). Projected Prevalence of Actionable Pharmacogenetic Variants and Level A Drugs Prescribed Among US Veterans Health Administration Pharmacy Users. *JAMA Netw Open, 2*(6), e195345. doi:10.1001/jamanetworkopen.2019.5345
3. Chapman, A. B., Peterson, K. S., Alba, P. R., DuVall, S. L., & Patterson, O. V. (2019). Detecting Adverse Drug Events with Rapidly Trained Classification Models. *Drug Saf, 42*(1), 147-156. doi:10.1007/s40264-018-0763-y
4. Conway, M., Mowery, D. L., South, B. R., Stoddard, G. J., Chapman, W. W., Patterson, O. V., & Zhu, S. H. (2019). Documentation of ENDS Use in the Veterans Affairs Electronic Health Record (2008-2014). *Am J Prev Med, 56*(3), 474-475. doi:10.1016/j.amepre.2018.10.019
5. Giri, A., Hellwege, J. N., Keaton, J. M., Park, J., Qiu, C., Warren, H. R., Edwards, T. L. (2019). Trans-ethnic association study of blood pressure determinants in over 750,000 individuals. *Nat Genet, 51*(1), 51-62. doi:10.1038/s41588-018-0303-9
6. Klarin, D., Damrauer, S. M., Cho, K., Sun, Y. V., Teslovich, T. M., Honerlaw, J., Assimes, T. L. (2018). Genetics of blood lipids among ~300,000 multi-ethnic participants of the Million Veteran Program. *Nat Genet, 50*(11), 1514-1523. doi:10.1038/s41588-018-0222-9
7. Lynch, K. E., Chang, J. w., Matheny, M. E., Goldfarb, A., Efimova, O., Coronado, G., & DuVall, S. L. (2018). Comparison of automated and retrospectively calculated estimated glomerular filtration rate in electronic health record data. *BMC Nephrology, 19*(1), 380. doi:10.1186/s12882-018-1179-8
8. Maguen, S., Li, Y., Madden, E., Seal, K. H., Neylan, T. C., Patterson, O. V., Shiner, B. (2019). Factors associated with completing evidence-based psychotherapy for PTSD among veterans in a national healthcare system. *Psychiatry Res, 274*, 112-128. doi:10.1016/j.psychres.2019.02.027
9. Maguen, S., Madden, E., Patterson, O. V., DuVall, S. L., Goldstein, L. A., Burkman, K., & Shiner, B. (2018). Measuring Use of Evidence Based Psychotherapy for Posttraumatic Stress Disorder in a Large National Healthcare System. *Adm Policy Ment Health, 45*(4), 519-529. doi:10.1007/s10488-018-0850-5
10. Stevens, V. W., Stenehjem, D. D., Patterson, O. V., Kamauu, A. W. C., Yim, Y. M., Morlock, R. J., & DuVall, S. L. (2018). Characterization and survival of patients with metastatic basal cell carcinoma in the Department of Veterans Affairs: a retrospective electronic health record review. *Arch Dermatol Res, 310*(6), 505-513. doi:10.1007/s00403-018-1834-8
11. Sun, Y. V., Damrauer, S. M., Hui, Q., Assimes, T. L., Ho, Y. L., Natarajan, P., Wilson, P. W. F. (2018). Effects of Genetic Variants Associated with Familial Hypercholesterolemia on Low-Density Lipoprotein-Cholesterol Levels and Cardiovascular Outcomes in the Million Veteran Program. *Circ Genom Precis Med, 11*(12). doi:10.1161/CIRCGEN.118.002192
12. Velarde, K. E., Romesser, J. M., Johnson, M. R., Clegg, D. O., Efimova, O., Oostema, S. J., Huang, G. D. (2018). An initiative using informatics to facilitate clinical research planning and recruitment in the VA health care system. *Contemp Clin Trials Commun, 11*, 107-112. doi:10.1016/j.conctc.2018.07.001
13. Wilcox, M. A., Coppola, D., Bailey, N., Wilson, A., Kamauu, A. W. C., Alba, P. R., DuVall, S. L. (2019). Risperdal((R)) CONSTA((R)) Needle Detachment. Incidence Rates Before and After Kit Redesign: A Retrospective Study using Electronic Health Records and Natural Language Processing in the Department of Veterans Affairs. *Neurol Ther, 8*(1), 95-108. doi:10.1007/s40120-019-0130-7

Transgenic & Gene Targeting

Overview

The goal of the Transgenic & Gene Targeting Core (TGTC) is to provide state of the art service and assistance in the field of mouse transgenesis and gene targeting. Our goal is to provide these services to the scientific community in a timely and cost efficient manner. The core develops technology, maintains equipment, provides consultation on project design and assists in the execution of research to maintain a position as a leader in the field of mouse genetic modification.

Our main service is to provide transgenic and gene targeted mice to researchers. CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) technology has allowed researchers, even those not adept at molecular biology, to obtain specific gene targeted mice for their research in a more dirct manner than traditional methods. TGTC uses CRISPR technology to generate knockout, knockin, and conditionally targeted alleles in mice. This method allows for faster, more efficient and less expensive generation of mice with specific genetic mutations.

Other services include conventional gene targeting of ES (embryonic stem) cells followed by injection of targeted cells to produce germline chimeras, and production of traditional transgenic mice where the transgene is randomly inserted into the genome. In addition, TGTC has expertise in mouse-related procedures including embryo and sperm cryopreservation, in vitro fertilization (IVF), intracytoplasmic sperm injection (ICSI), karyotyping of ES cells, rederivation of mice from frozen embryos, and derivation of primary ES cells. Our facility consists of two cell culture hoods and incubators, two microinjection stations for both pronuclear and blastocyst injections, three surgery areas, and a mouse room for housing and breeding the necessary animals. The TGTC staff have a vast array of experience in the gene targeting and transgenic mouse field. Our lab works closely with University of Utah regulatory groups and is in compliance with strict IACUC and USDA guidelines.

Services

- Mouse generation of targeted mutations using CRISPR/Cas technology to create specific genetic mutations including knockout, knockin, and conditional knockout
  - CRISPR mouse generation via microinjection of reagents
  - CRISPR mouse generation via ZEN (zygote electroporation of nucleases)
  - CRISPR mouse generation via GONAD (genome editing via oviductal nucleic acids delivery)
- In vivo Validation of CRISPR reagents
- Blastocyst injection of targeted ES embryonic stem cells
- Pronuclear injection of DNA to produce transgenic mice
- Gene targeting of ES embryonic stem cells
- Primary ES cell generation
- Sperm cryopreservation
- Embryo cryopreservation
- IVF, in vitro fertilization
- Rederivation of mouse lines via embryo transfer
- Ovary transfer
- Import/export sperm and/or embryos
- Karyotyping of ES embryonic stem cells

- Sperm and embryo long-term storage

Equipment

- Nikon Eclipse Ti2 microinjection station, with fluorescence, CO2, heating/cooling stage
- Leica Dmi8 microinjection stations (2)
- Eppendorf Transferman NK2 micromanipulators
- Eppendorf Femtojet microinjectors
- Eppendorf Peizo drills
- Leica S9i stereomicroscopes (2)
- Olympus SZX16 dissection microscopes (2), one with fluorescence option
- Nikon Eclipse TS100 inverted microscopes
- Zeiss Stemi508 stereomicroscope
- Sutter P-97 pipette puller
- Narashige MF-900 microforges
- TMC vibration isolation tables (3)
- ESCO, Forma, New Brunswick CO2 incubators
- MINC IVF incubator
- Brinkman benchtop autoclave
- ESCO cell culture hood
- Forma cell culture hood
- BioRad Gene Pulser Xcell electroporator
- Nepa21 GONAD electroporator, with glass slide electrode
- Thermo Cryomed controlled rate embryo freezer
- Thermo TSX Series -80 freezer
- Thermo -135 freezer
- Centrifuges, microfuges

Personnel

- Susan Tamowski, Director
- Wenhua Li, Senior Lab Specialist
- Kyle O'Connor, Senior Lab Specialist
- He Lan, Senior Lab Specialist
- Nick Black, Lab Specialist

2019 Annual Update

New Equipment

- NepaGene21 Electroporator system, with concave electrodes for in vivo GONAD, and with glass slide electrode for ZEN.

New Services

- 2-step CRISPR/Cas microinjections and ZEN to improve efficiency of obtaining floxed alleles

Goals for FY2020

Our Core strives to keep abreast of and to optimize new techniques to obtain requested mice in the most efficient manner bearing in mind the 3R's of animal research.

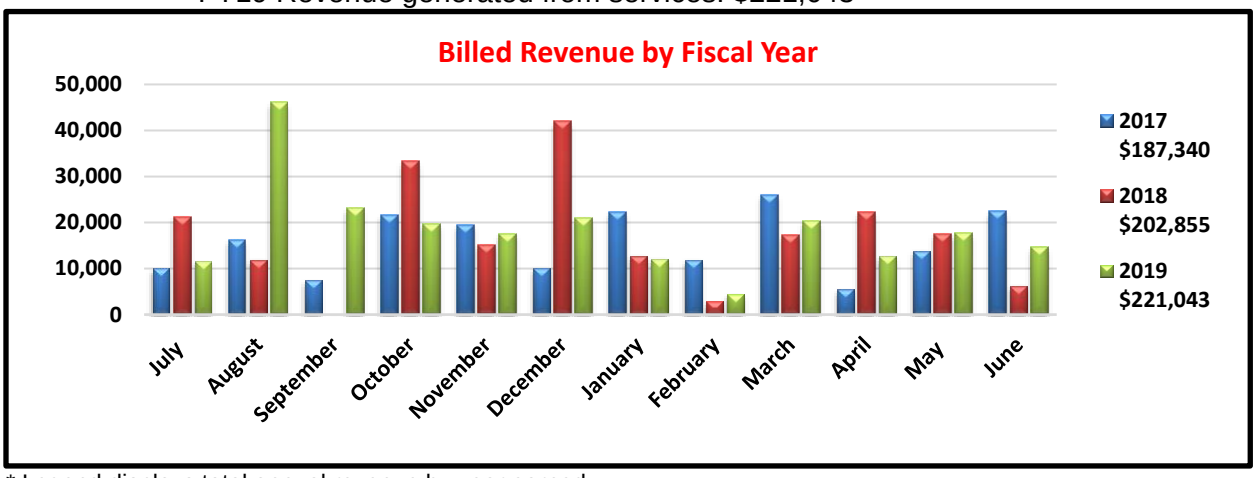
FY19 Annual Update

Revenue/Expenses

FY19 Expenses: Total $602,804

FY19 Revenue: Total $656,161

- VP of Health Sciences Support: $435,118
- FY19 Revenue generated from services: $221,043



* Legend displays total annual revenue by year earned.

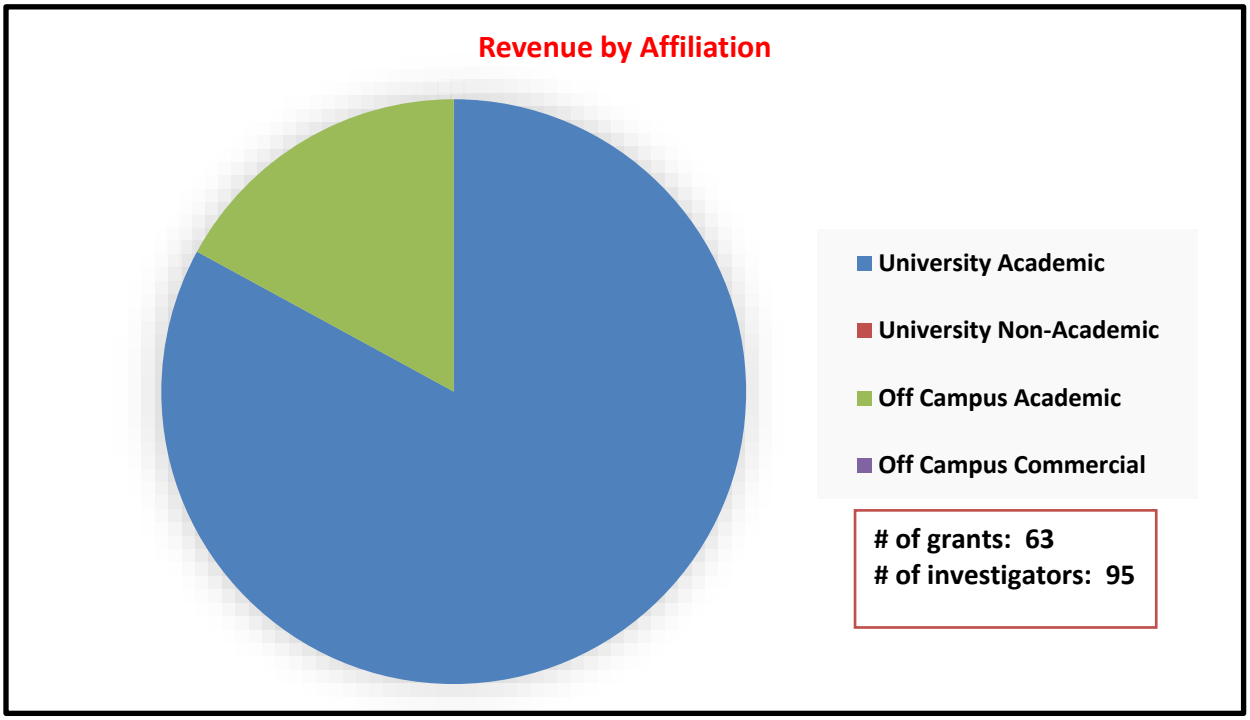
Advisory Board Committee

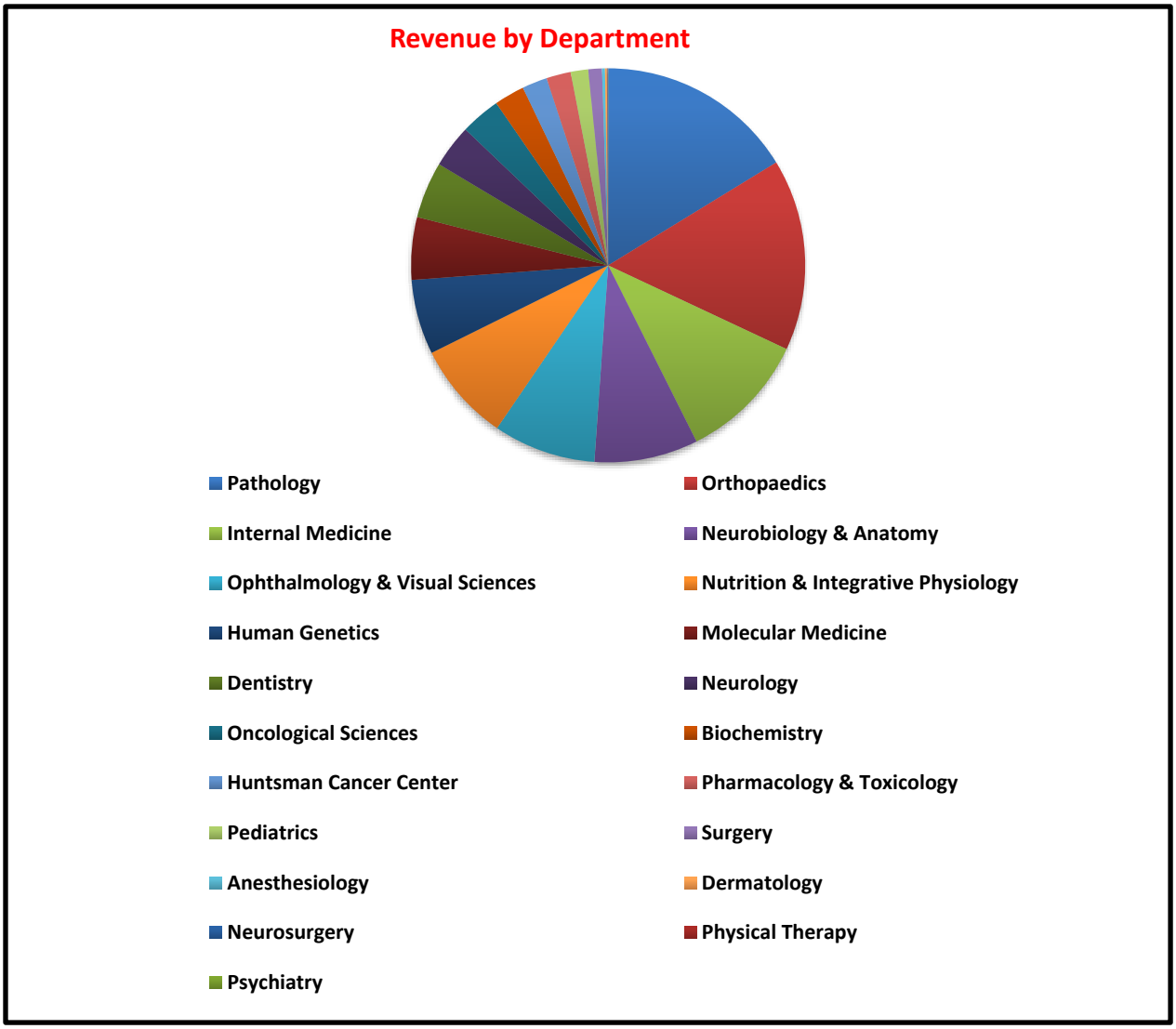
- Charlie Murtaugh, Co-Director, Professor, Human Genetics
- Suzi Mansour, Professor, Human Genetics
- Dean Tantin, Associate Professor, Pathology
- Kevin B. Jones, MD, Associate Professor, Huntsman Cancer Institute

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Jones, Kevin	NIH
2	Summers, Scott	NIH
3	Baehr, Wolfgang	NIH
4	University of Flordia	Off Campus Academic
5	Oldelberg, Shannon	NIH
6	University of South Flordia	Off Campus Academic
7	D'Souza, Rena	NIH
8	Evavold, Brian	NIH
9	Kardon, Gabrielle	Department
10	Penovich, Wanda	Department

Letter of Support for grants:

1. Elizabeth Leibold's application for an NIH grant proposal titled "*Cell-cycle regulation of Irp2 phosphorylation during hematopoiesis*" to require generation of Irp2 S157A knock-in mice using CRISPR/Cas9-nuclease technology.
2. Dr. Yijie Geng's K99 training grant to include creating a conditional topoisomerase II depletion model in mice. One line is available as frozen sperm; one is available as a targeted ES cell clone.
3. Dr. Mark Warren's grant proposal application to generate a Nav1.5 haploinsufficient Scn+/- mouse using CRISPR technology.
4. Dr. Sihem Boudina's College of Health Seed Grant application for generating Mito-Rosella transgenic mice using TARGATT site-specific transgenic technology.
5. Dr. Claudio Villaneuva's RO1 application titled "Role of Bhlhb9 in the early commitment of preadipocytes and the impact on glucose metabolism" to generate an inducible, conditional overexpression model.
6. Dr. Janis Weis' grant application titled "Molecular Genetics of Lyme arthritis" for development of a Myostatin deficient mouse.
7. Dr. Anthony Donato's grad student Zachary Clayton's NRSA application to create mice with whole-body overexpression of the human manganese superoxide dismutase (SOD2) gene.
8. Dr. Bruce Edgar's RO1 application titled "Mechanisms of intestinal epithelial regeneration" to generate a CreER mouse driven by a promoter specific to damage-sensing cells in the intestine.

UTAH Center for Genetic Discovery

Overview

The UCGD service recharge center helps investigate the genetic basis for human disease by providing whole exome and genome sequence analyses for research and clinical projects. We specialize in variant calling and disease-gene discovery utilizing tools developed by the UCGD research group, including VAAST, pVAAST, PHEVOR, Lumpy, WHAM, IOBIO, RUFUS, and others. Services offered include alignment and variant calling (SNVs, INDELs, and structural variants) for NGS datasets, joint genotyping, disease gene discovery in cohorts and families, and ad hoc research analyses as dictated by the needs of the project. In total, the UCGD has available 2340 CPU cores and 3.25 PB of disc storage, plus access to additional shared resources. Total capacity for variant calling is approximately ~100,000 genomes per year via a combination of in-house and cloud-based processing. The UCGD is able to provide high-bandwidth transfers of data via parallelized transfer methods such as Globus, Aspera, and others.

Services

- Alignment and variant calling for NGS datasets, including whole genome, exome, and panel sequences using a Sentieon (GATK-based) variant calling pipeline
- Structural variant calling, annotation, and prioritization using the Base2 Genomics platform
- Reference-free variant calling and investigation of *de novo* variants using RUFUS
- Joint genotyping of separate data sets with ancestry-matched controls
- Disease gene discovery in cohorts and families using VAAST, pVAAST, PHEVOR, GEMINI, IOBIO, and other tools as needed

Personnel

- Mary Anne Karren, Director
- Barry Moore, Project Director
- Shawn Rynearson, Software Developer
- Carson Holt, Software Developer
- Bushra Gorsi, Research Analyst
- Steven Boyden, Director of Research and Science
- Chris Fahim, Software Developer
- Ad hoc analysts from Yandell, Quinlan, and Marth laboratories including Javier Hernandez, Matt Velinder, Tom Nicholas, Andrew Farrell

2019 Annual Update

Grant Support – UCGD service recharge center provided service quotes and/or letters of support for the following grant submissions in FY19:

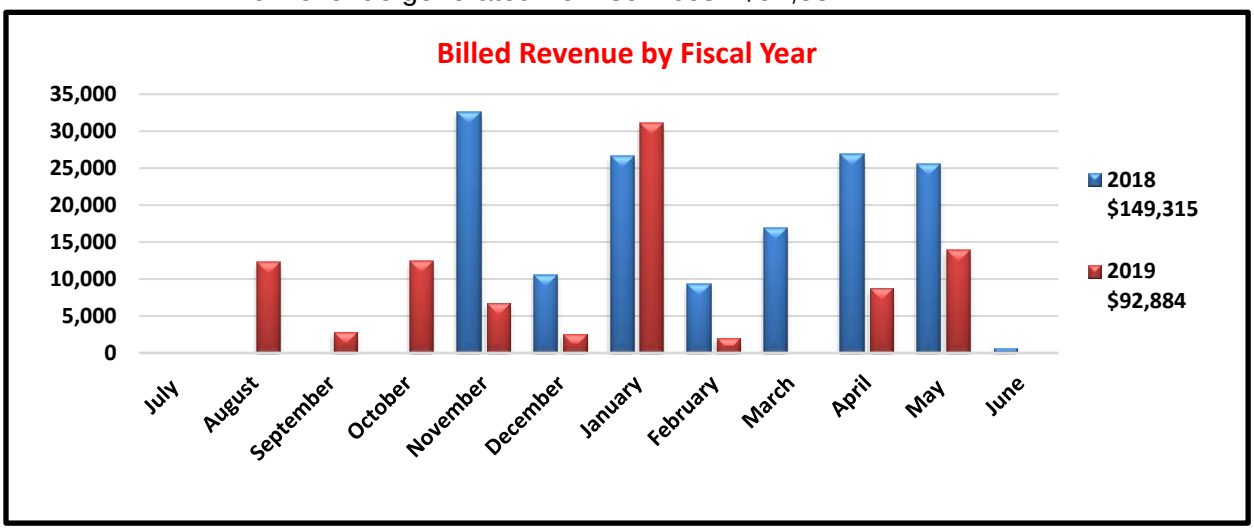
- Utah Diabetes Research Center
- Intermountain West Clinical Site for the Undiagnosed Disease Network (U01 Renewal) Guthery
- Bridging the Gap Between Genomics and Clinical Outcomes in CHD (U01 Renewal) Tristani-Firouzi
- All of Us Research Program Genome Centers (OT2) Levy/Yandell

FY19 Annual Update
Revenue/Expenses

FY19 Expenses: Total $388,767

FY19 Revenue: Total $179,984

- VP of Health Sciences Support: $ 0
- Gift Account: $ 87,100
- FY19 Revenue generated from services: $92,884



* Legend displays total annual revenue by year earned.

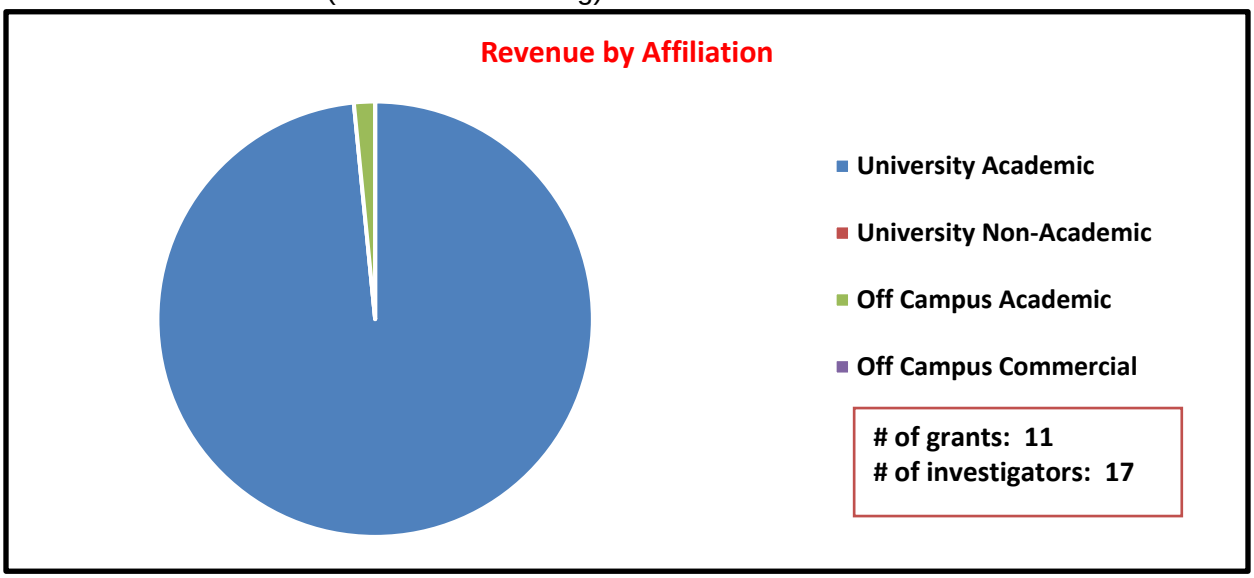
Advisory Board Committee

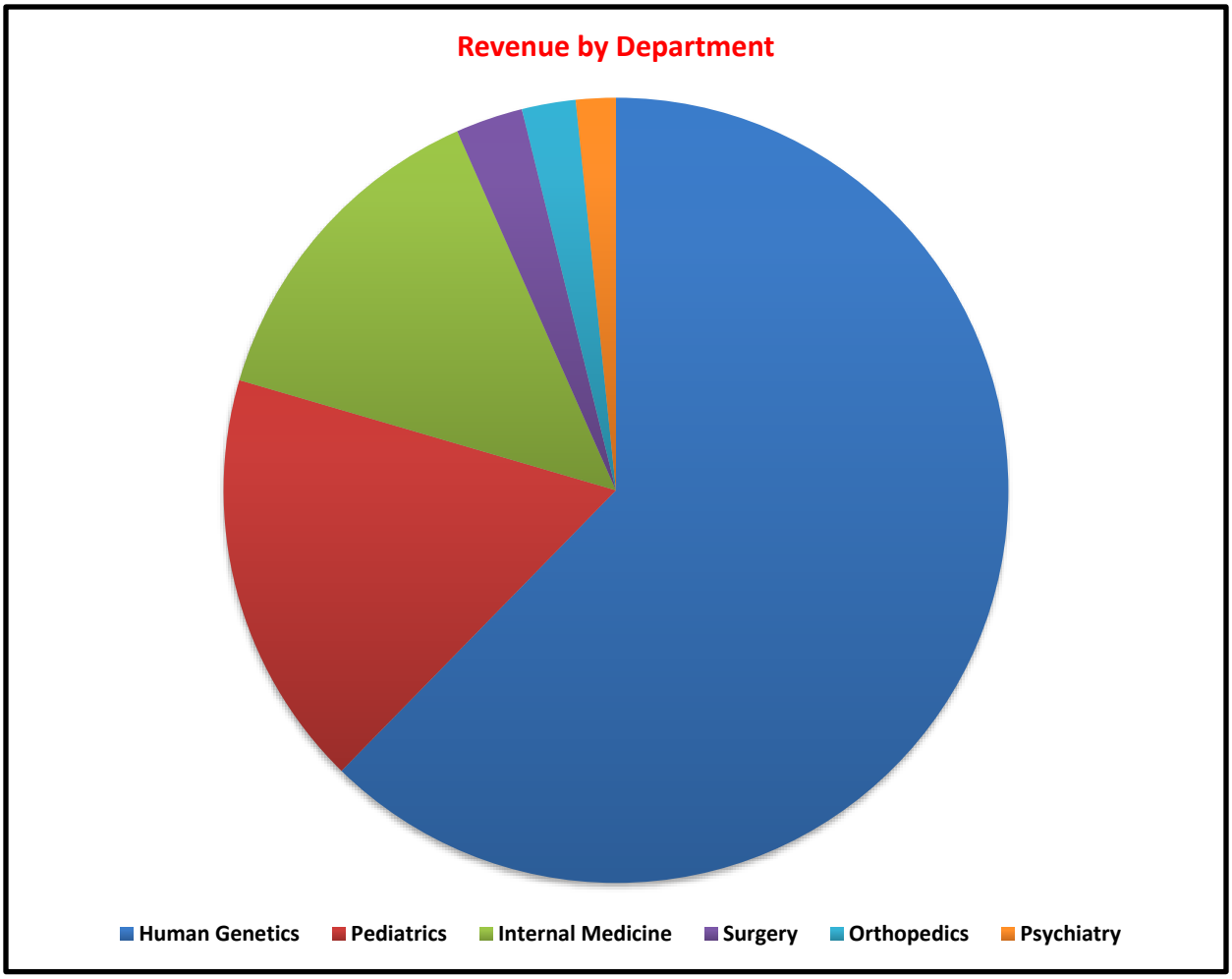
- Mark Yandell, PhD, Professor of Human Genetics
- Gabor Marth, DSc, Professor of Human Genetics
- Aaron Quinlan, PhD, Associate Professor of Human Genetics

FY19 Scientific Impact

Research Support

Revenue Generated (see charts following):





Top Users

1	Yandell, Mark	NIH, Janssen Research & Development
2	Guthery, Stephen	NIH
3	Welt, Corrine	NIH
4	Quinlan, Aaron	Department
5	Tristani, Martin	NIH
6	Marth, Gabor	NIH, Department
7	Karren, MaryAnne	Department
8	Curtin, Karen	Utah Genome Project
9	Carrell, Douglas	Department
10	Jorde, Lynn	Department

Publications:

1. Berauer, J. P., Mezina, A. I., Okou, D. T., Sabo, A., Muzny, D. M., Gibbs, R. A., Childhood Liver Disease Research, N. (2019). Identification of Polycystic Kidney Disease 1 Like 1 Gene Variants in Children With Biliary Atresia Splenic Malformation Syndrome. *Hepatology*. doi:10.1002/hep.30515
2. Wooderchak-Donahue, W. L., Akay, G., Whitehead, K., Briggs, E., Stevenson, D. A., O'Fallon, B., McDonald, J. (2019). Phenotype of CM-AVM2 caused by variants in EPHB4: how much overlap with hereditary hemorrhagic telangiectasia (HHT)? *Genet Med*. doi:10.1038/s41436-019-0443-z
3. Wooderchak-Donahue, W. L., McDonald, J., Farrell, A., Akay, G., Velinder, M., Johnson, P., Bayrak-Toydemir, P. (2018). Genome sequencing reveals a deep intronic splicing ACVRL1 mutation hotspot in Hereditary Haemorrhagic Telangiectasia. *J Med Genet, 55*(12), 824-830. doi:10.1136/jmedgenet-2018-105561

HEALTH
UNIVERSITY OF UTAH

NOTES