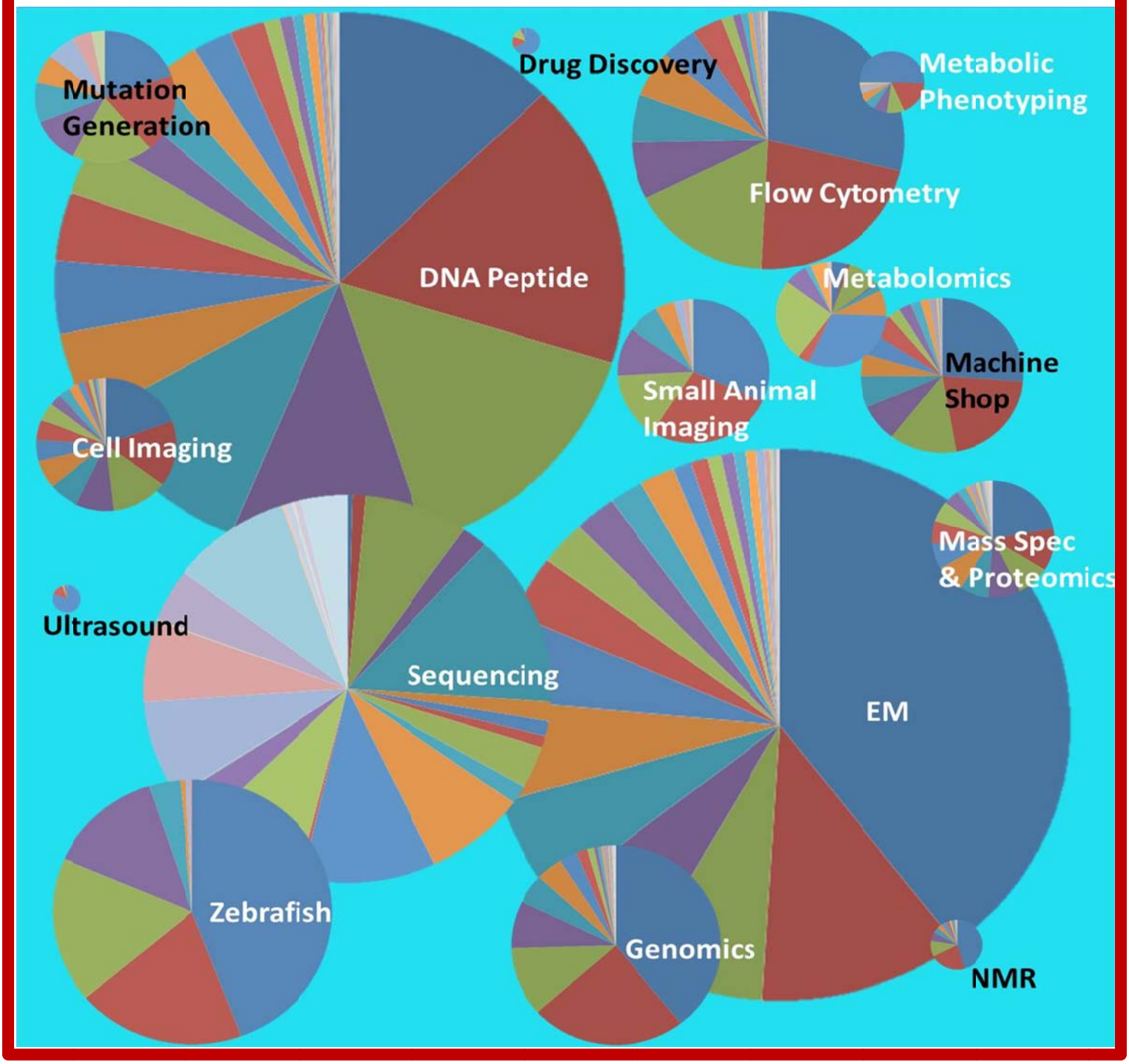
UNIVERSITY OF UTAH
HEALTH SCIENCES

2014 Annual Report
HSC Cores



UNIVERSITY OF UTAH HEALTH SCIENCES

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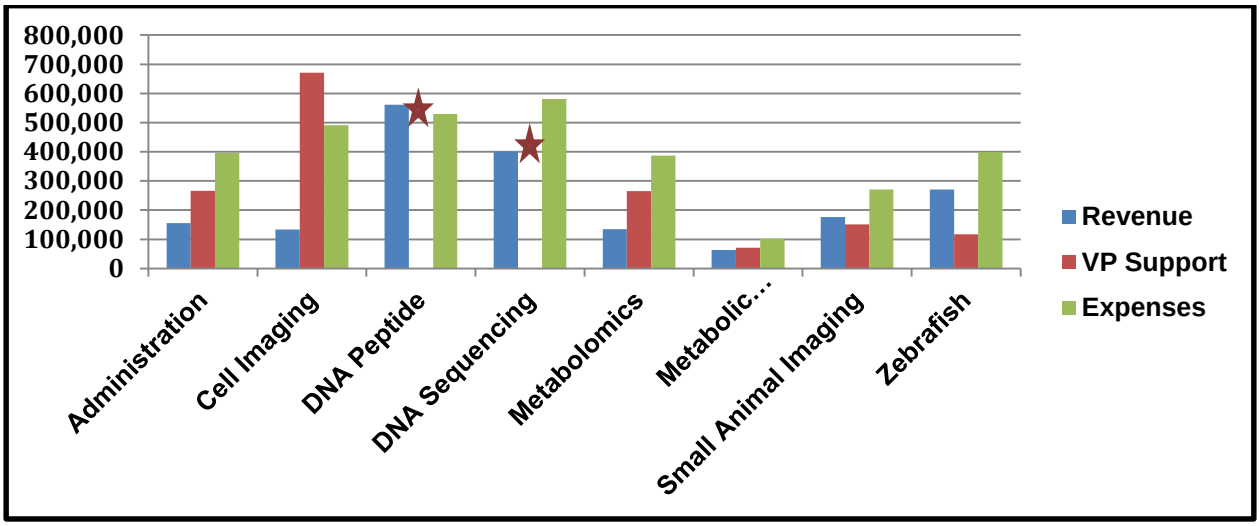
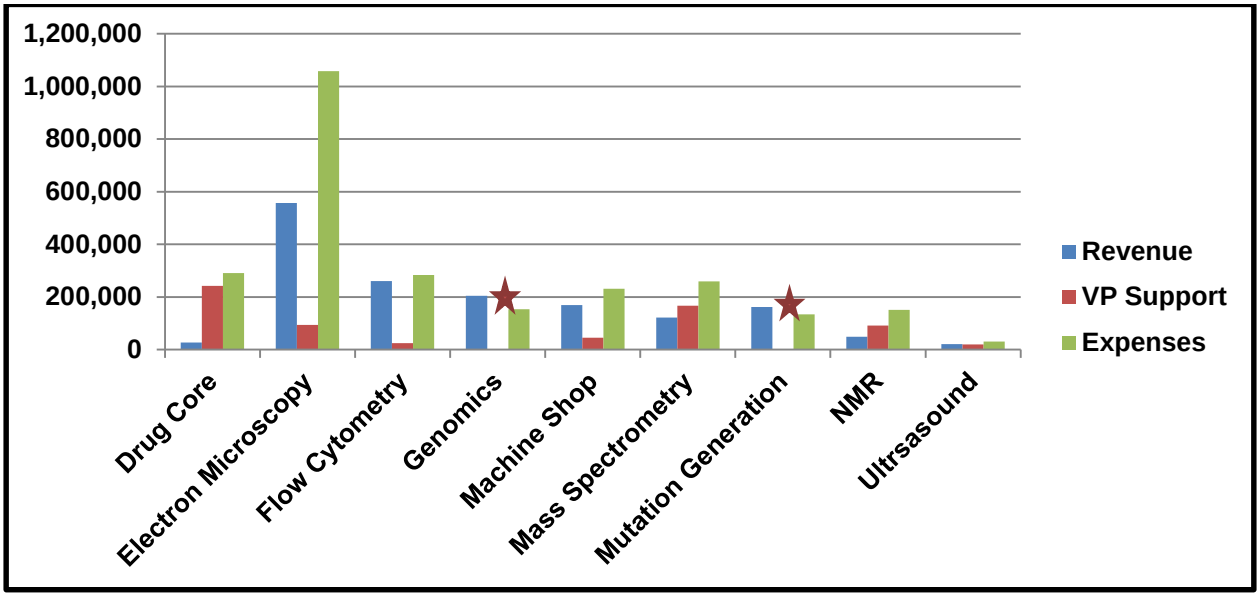
UNIVERSITY OF UTAH
HEALTH SCIENCES

Core Facilities Overall Financial Summary

Revenue & Expenses

- The Core Facilities budget for FY14 was $5 million with an expense total of $5.8 million. Approximately $3 million in expenses went to salaries and benefits while $2.8 million was spent on equipment and operating supplies.
- In FY14, $3.2 million in services were billed.
- Budget:





Cell Imaging and Electron Microscopy received capital equipment in FY13 which was partially paid for in FY14.

★ These facilities received no operating support from the VP.

Cores Administration

Overview

The Health Sciences Center (HSC) Core Facilities operate under central administration headed by Drs. Andrew Weyrich and John Phillips. They are assisted by Ms. Brenda Smith, Ms. Esther Kim, and Mr. Jeff Ware. The Cores Administration office is responsible for the personnel management and financial affairs of the Core Facilities, as well providing community services for the School of Medicine (SOM), for example the X-ray film developer and Irradiator are managed through the office. All facilities operate on a charge-back basis, although the percent recovery of operating expenses for each facility varies greatly, the goal of the HSC Core Facilities is to make necessary technology and the expertise to operate available to all faculty and students at the University of Utah.

Personnel

- Andrew Weyrich, Ph.D., Associate Dean for Basic and Translational Sciences, Director HSC Core Facilities
- John Phillips, Ph.D., Associate Director HSC Core Facilities
- Brenda Smith, Administrative Manager
- Esther Kim, Administrative Assistant
- Jeff Ware, Accountant

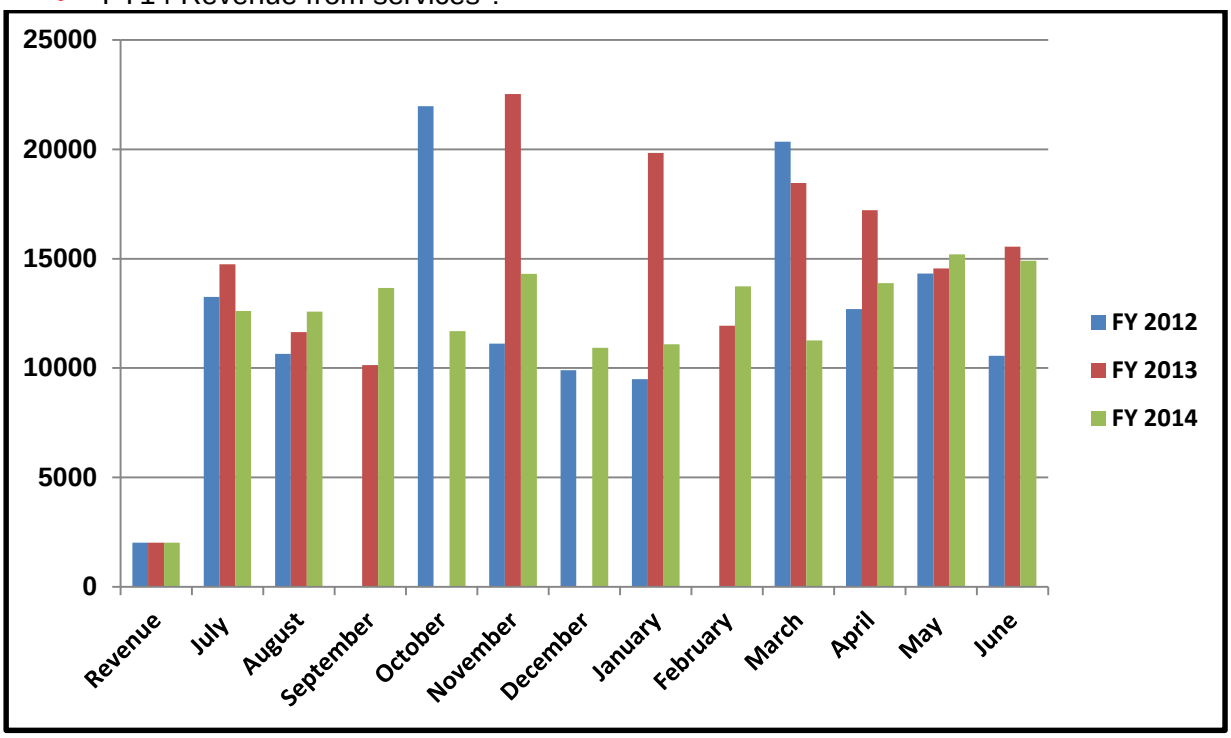
2014 Annual Update

- In FY12, the billing process took approximately 2 weeks to complete. In FY13, our team developed a LEAN project to improve the process to 4 days due to employee cross-training and the implementation of new billing standards.
- The goals for the Cores Administration office for FY14 were to improve the billing process time to 3 business days and to create an internal tracking system using File Maker Pro that will provide real time balances of each Cores budget. A shadow system will track orders sent to the business office allowing the directors to view the balance of their activity accounts. The directors will be able to access this tracking system by simply logging in and selecting either the Account Summary or the Detail Transaction Reports.
- In FY14, the Cores Administration office successfully reduced the amount of time to process billing to 2 business days. The internal tracking system was created and lists each account balance in real time. Each director can access the system by logging in and reviewing their reports. This tracking system stores different fiscal year data.
- First Annual Retreat was proposed and run. Results were better understanding of what cores did, how cores could interact, how cores could organize to provide better services and data. Worked with Admin Core to develop standards for Faculty Advisory meetings and roles.

Cores Administration Revenue & Expenses

- VP of Research Support: $266,000
- FY14 revenue: $155,856
- FY14 expenses: $396,181

- FY14 Revenue from services*:



*This represents the income from the 5% administrative fee charged to each core, based on collected revenue from billed services.

Advisory Board Committee

Last meeting date: January 10, 2014

- Andy Weyrich, Director, Core Facilities
- Joseph Yost, Professor, Neurobiology and Anatomy
- Mark Yandell, Professor, Human Genetics
- John Phillips, Associate Director, Core Facilities
- Dennis Winge, Professor, Hematology
- David Stillman, Professor, Pathology
- Wes Sundquist, Professor, Biochemistry
- Stephen Lessnick, Professor, Pediatric Hematology
- Carl Wittwer, Professor, Pathology
- Eric Schmidt, Professor, Medicinal Chemistry

Addendum

- Faculty Oversight Committee Guidelines can be found for all cores at the following link: http://cores.utah.edu/wp-content/uploads/2015/09/Faculty-Advisory-Committee-Responsibilities-2.pdf

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 two Olympus FV1000 Spectral confocals, two Nikon A1 confocals, and a Multi-photon confocal from Prairie. A Nikon Ti automated microscope for live cell imaging has both Spinning Disk Confocal and Widefield capabilities. 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) and also available for live cell imaging. Nikon Elements, Metamorph, Imaris and Volocity 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.

Equipment

- Two Olympus FV1000 Confocal Microscopes
- Nikon A1 Confocal Microscope
- Nikon A1R Confocal Microscope
- Prairie Multi-Photon Confocal Microscope
- Zeiss Axioscan Z1 automated slide scanner with 100 slide loader
- Nikon Widefield/Spinning Disk Confocal Microscope
- Olympus CCD Widefield Microscope
- EVOS FL Widefield Microscope
- Nikon Ti Automated Microscope

Personnel

- Christopher Rodesch, Ph.D., Director
- Michael J. Bridge, Ph.D., Research Associate
- Michael Redd, Ph.D., Research Associate

2014 Annual Update

New Equipment

- In July 2013, the Cell Imaging Facility added a Prairie Multi-photon confocal microscope
- In June 2014, a Zeiss Axioscan Z1 with 100 slide loader came online with funding from the Internal School of Medicine Equipment competition (Grainger)

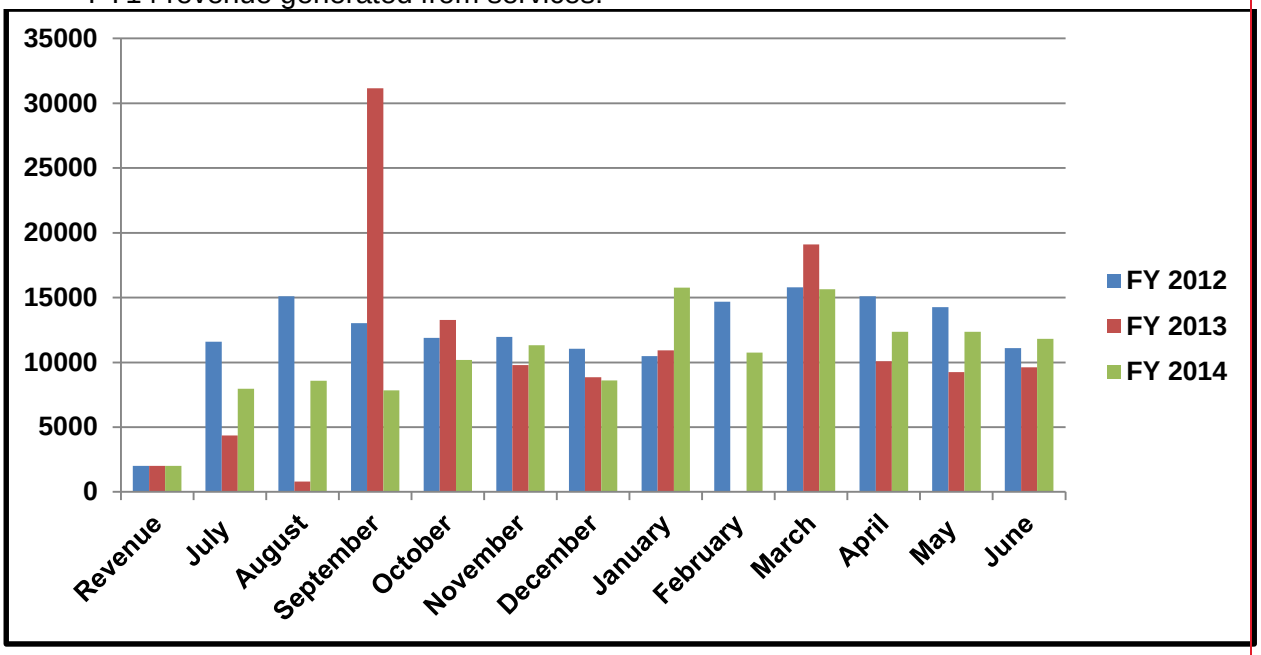
New Services

- Mike Redd can perform zebrafish based imaging experiments for an hourly rate
- Cell based quantification is available on the Imaris workstation

Revenue/Expenses

- VP of Research Support for normal operating expenses: $170,000
- VP of Research Support for Two-Photon Scope: $495,599 (note: remainder of cost was transferred in FY2013).
- FY14 revenue: $133,215

- FY14 expenses: $244,473
- FY14 revenue generated from services:



Advisory Board Committee

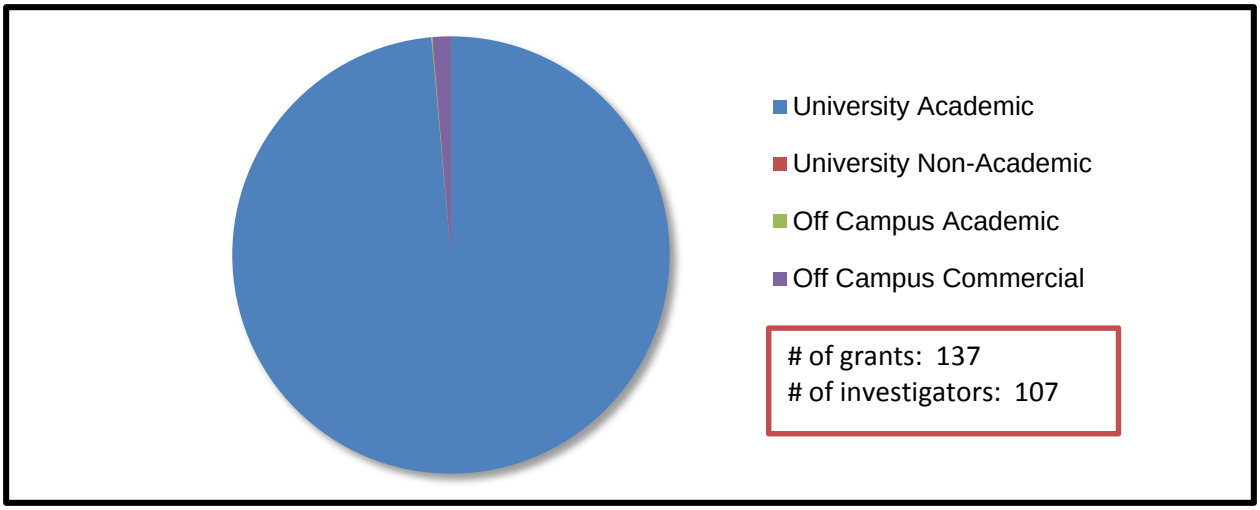
Last meeting date: February 20th, 2014

- Gabrielle Kardon, Associate Professor, Human Genetics
- Kristen Kwan, Assistant Professor, Human Genetics
- Jody Rosenblatt, Assistant Professor, Oncological Sciences
- Josh Bonkowsky, Associate Professor, Neurobiology and Anatomy
- Adam Douglass, Assistant Professor, Neurobiology and Anatomy
- Jason Shepherd, Assistant Professor, Neurobiology and Anatomy
- Matt Wachowiak, Associate Professor, Neurobiology and Anatomy

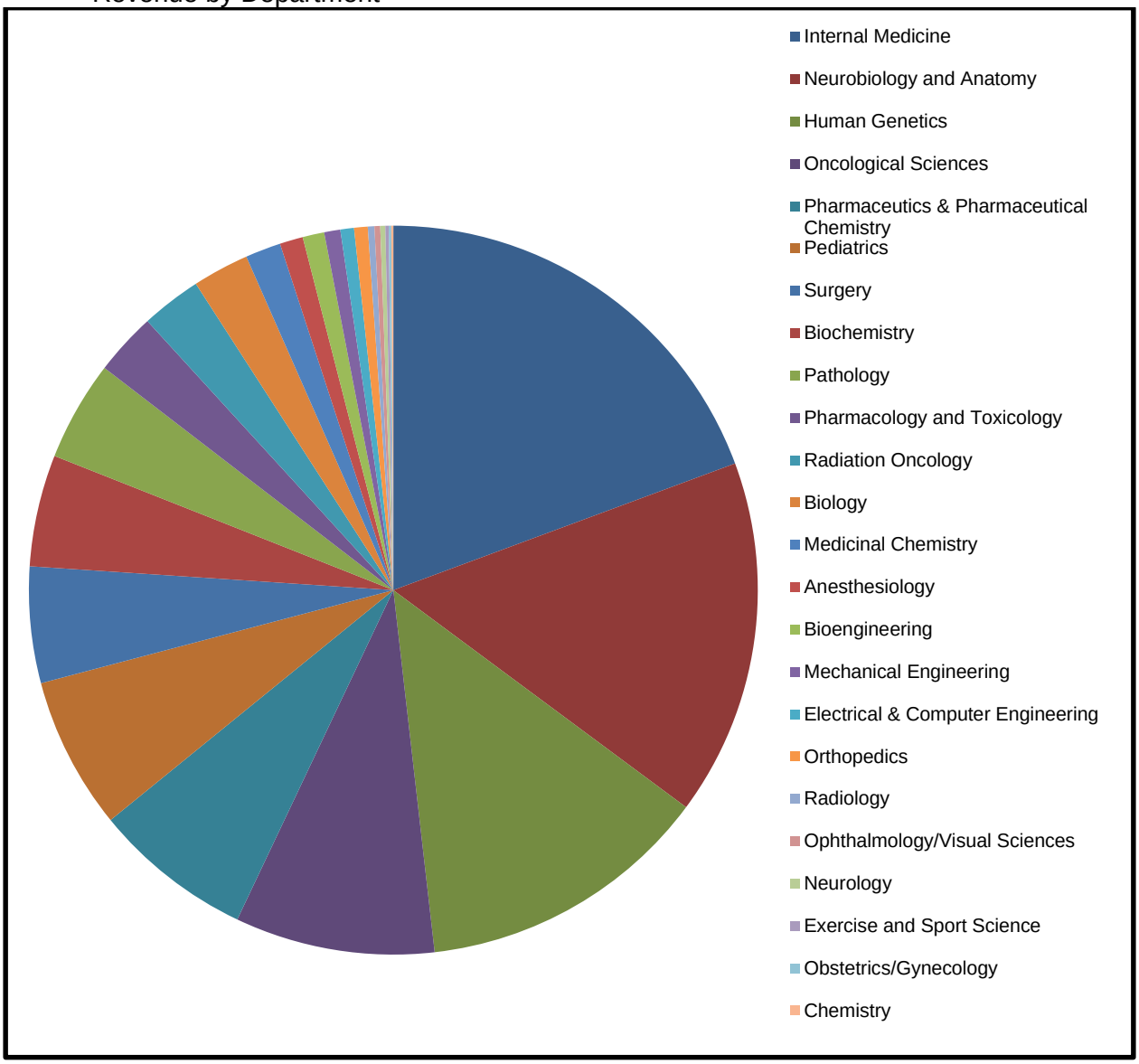
FY14 Scientific Impact

Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

Li, Dean	NIH, HUNTS
Dorsky, Richard	NIH
Kardon, Gabrielle	NIH
Bonkowsky, Josh	NIH, NIDDK
Redd, Michael	NIH, HUNTS
Capecchi, Mario	HHM
Yost, Joseph	NIH
Sundquist, Wesley	NIH, DHHS, HCI, University
Bhaskara, Srividya	Department
Williams, Megan	Edward Mallinckrodt Jr. Foundation

Publications

1. Briona, L.K. and R.I. Dorsky, *Radial glial progenitors repair the zebrafish spinal cord following transection.* Exp Neurol, 2014. **256**: p. 81-92.
2. Lours-Calet, C., et al., *Evolutionarily conserved morphogenetic movements at the vertebrate head-trunk interface coordinate the transport and assembly of hypopharyngeal structures.* Dev Biol, 2014. **390**(2): p. 231-46.
3. Mleynek, T.M., et al., *Lack of CCM1 induces hypersprouting and impairs response to flow.* Hum Mol Genet, 2014.
4. Pan, H., et al., *Efficiency of high molecular weight backbone degradable HPMA copolymer-prostaglandin E1 conjugate in promotion of bone formation in ovariectomized rats.* Biomaterials, 2013. **34**(27): p. 6528-38.
5. Ramirez, P.W., et al., *Downmodulation of CCR7 by HIV-1 Vpu results in impaired migration and chemotactic signaling within CD4(+) T cells.* Cell Rep, 2014. **7**(6): p. 2019-30.
6. Schober, M.E., et al., *Erythropoietin improved cognitive function and decreased hippocampal caspase activity in rat pups after traumatic brain injury.* J Neurotrauma, 2014. **31**(4): p. 358-69.
7. Squires, S., et al., *Effects of redox state on the efficient uptake of cell permeable Peptide in Mammalian cells.* Open Biochem J, 2013. **7**: p. 54-65.
8. Umpierre, A.D., et al., *Impaired cognitive ability and anxiety-like behavior following acute seizures in the Theiler's virus model of temporal lobe epilepsy.* Neurobiol Dis, 2014. **64**: p. 98-106.

UNIVERSITY OF UTAH
HEALTH SCIENCES

Centralized Zebrafish Animal Resource Facility

Overview

The Centralized Zebrafish Animal Resource (CZAR) Facility provides state-of-the-art systems for housing, breeding, and performing experiments with zebrafish, an emerging vertebrate model system. It comprises of 5000 fish tanks maintained on 4 independent recirculating water systems, and houses a large number of wildtype and mutant zebrafish strains. The communal laboratory 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. Currently, the facility is used by 12 large laboratories and supports an additional six to ten small-scale user groups.

Services

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

- Housing and maintaining zebrafish, monitoring their care, 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 wildtype lines and providing animals from these lines to investigators
- Providing laboratory bench space and supplies to perform experiments
- Providing shared-use equipment including 7-8 microinjection stations and 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 sperm cryopreservation and storage
- Providing quarantine facilities to house the zebrafish from outside sources to generate clean lines to import into the facility
- Instituted user feedback systems to monitor husbandry success through efficiency of mating data and nursery survival rates

Equipment

- M205 FA Leica Microscope
- Zeiss Microscope
- Olympus Microscope
- 7 microinjection stations with bright field stereomicroscopes
- Analog camera and monitor to facilitate teaching microinjection in real time

Personnel

- Maurine Hobbs, Ph.D., Director
- Sharon Johnson, Senior Laboratory Specialist (Zebrafish Husbandry and WT Line Maintenance)
- Talmage Long, Technician (Dedicated Nursery Manager)

2014 Annual Update

New Equipment

- In April 2013, the Zeiss microscope was upgraded with an LED light source
- In February 2014, Injection station 1 was fitted with an analog camera and monitor to facilitate teaching microinjection to new users
- In May 2014, temperature sensors were installed throughout the facility to help monitor the quality of temperature control, and record deviations that could affect zebrafish health

New Services

- Charges for cryopreservation and storage of fish line sperm were introduced in 2013
- In 2013 improvements to the web interface and web calendar for equipment sign up were completed
- In June 2014, Ms. Johnson began a program to maintain WT or transgenic lines for any lab for a nominal fee
- The CZAR Facility now offers a “Fish School” course for new users to learn best practices in handling and caring for their zebrafish, as well as how to tell male and female zebrafish apart

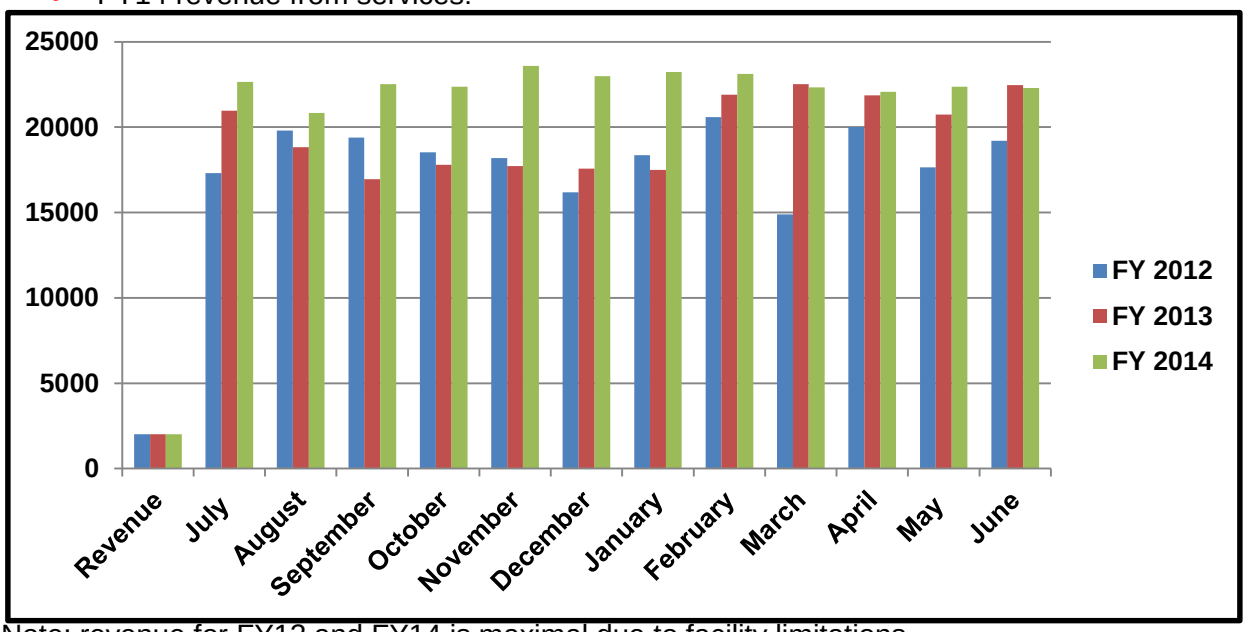
Revenue/Expenses

- VP of Research Support: $115,000
- Total FY14 revenue: $270,384
- Total FY14 expenses: $399,249

Grants

June 2014, Dr. Grunwald was awarded a $500,000 G20 grant to expand the CZAR Facility by 51% in the next year. University will match award ~600,000.

- FY14 revenue from services:



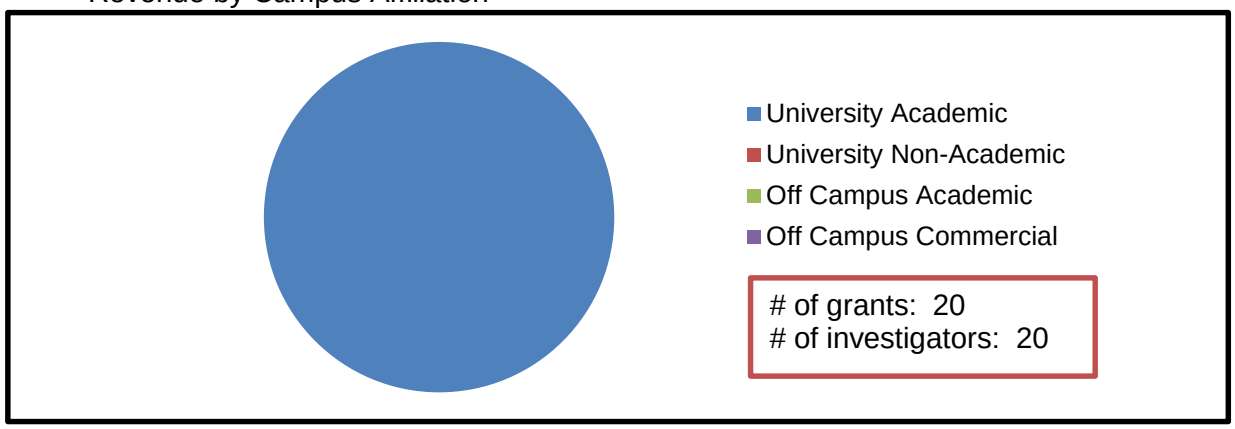
Note: revenue for FY13 and FY14 is maximal due to facility limitations.

Advisory Board Committee
Last meeting Date: June 9, 2014

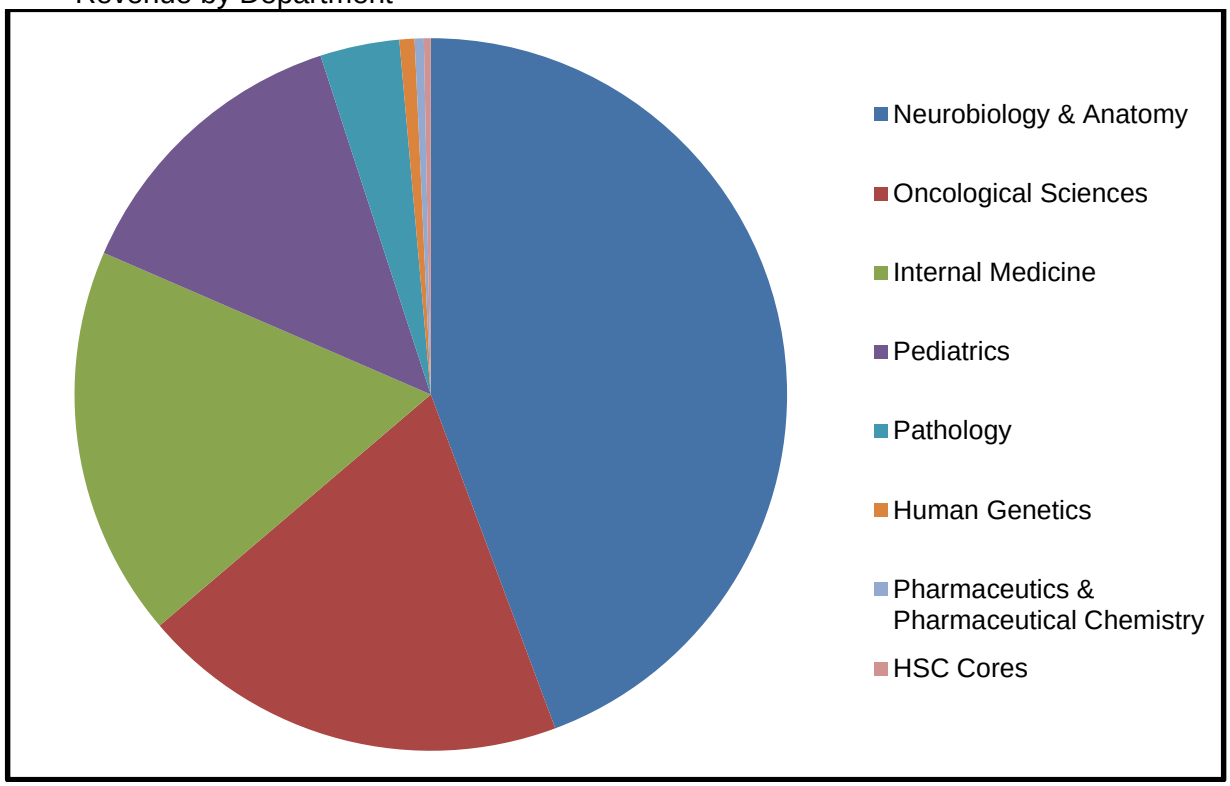
- David Grunwald, Professor, Human Genetics
- Josh Bonkowsky, Associate Professor, Neurobiology and Anatomy and Pediatrics
- Richard Dorsky, Associate Professor, Neurobiology and Anatomy
- Kristen Kwan, Assistant Professor, Human Genetics
- Amnon Schlegel, Assistant Professor, Internal Medicine
- Rodney Stewart, Assistant Professor, Oncological Sciences
- Jack Taylor, Director, Office of Comparative Medicine
- Joseph Yost, Professor, Neurobiology and Anatomy and Pediatrics

FY14 Scientific Impact
Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

1	Grunwald, David	NIH
2	Schlegel, Amnon	DHHS
3	Dorsky, Richard	NIH
4	Yost, Joseph	NIH
5	Bonkowsky, Josh	NIH
6	Cairns, Bradley	NIH, HHMI
7	Rosenblatt, Jody	NIH
8	Tavtigian, Sean	NIH
9	Vetter, Monica	NIH, Department
10	Tristani-Firouzi, Martin	American Heart Association

Publications

1. Arrington, C.B., A.G. Peterson, and H.J. Yost, *Sdc2 and Tbx16 regulate Fgf2-dependent epithelial cell morphogenesis in the ciliated organ of asymmetry.* Development, 2013. **140**(19): p. 4102-9.
2. Brimley, C.J., et al., *National variation in costs and mortality for leukodystrophy patients in US children's hospitals.* Pediatr Neurol, 2013. **49**(3): p. 156-162 e1.
3. Briona, L.K. and R.I. Dorsky, *Spinal cord transection in the larval zebrafish.* J Vis Exp, 2014(87).
4. Briona, L.K. and R.I. Dorsky, *Radial glial progenitors repair the zebrafish spinal cord following transection.* Exp Neurol, 2014. **256**: p. 81-92.
5. Iwasaki, K., et al., *Expression of arginine vasotocin receptors in the developing zebrafish CNS.* Gene Expr Patterns, 2013. **13**(8): p. 335-42.
6. Karanth, S., et al., *Polyunsaturated fatty acyl-coenzyme As are inhibitors of cholesterol biosynthesis in zebrafish and mice.* Dis Model Mech, 2013. **6**(6): p. 1365-77.
7. Neugebauer, J.M., et al., *Differential roles for 3-OSTs in the regulation of cilia length and motility.* Development, 2013. **140**(18): p. 3892-902.
8. Neugebauer, J.M. and H.J. Yost, *FGF signaling is required for brain left-right asymmetry and brain midline formation.* Dev Biol, 2014. **386**(1): p. 123-34.
9. Purnell, S.M., S.B. Bleyl, and J.L. Bonkowsky, *Clinical exome sequencing identifies a novel TUBB4A mutation in a child with static hypomyelinating leukodystrophy.* Pediatr Neurol, 2014. **50**(6): p. 608-11.
10. Samson, S.C., et al., *3-OST-7 regulates BMP-dependent cardiac contraction.* PLoS Biol, 2013. **11**(12): p. e1001727.
11. Slattum, G., et al., *Autophagy in oncogenic K-Ras promotes basal extrusion of epithelial cells by degrading S1P.* Curr Biol, 2014. **24**(1): p. 19-28.
12. Slattum, G.M. and J. Rosenblatt, *Tumour cell invasion: an emerging role for basal epithelial cell extrusion.* Nat Rev Cancer, 2014. **14**(7): p. 495-501.
13. Wehner, D., et al., *Wnt/beta-catenin signaling defines organizing centers that orchestrate growth and differentiation of the regenerating zebrafish caudal fin.* Cell Rep, 2014. **6**(3): p. 467-81.
14. Xing, L., et al., *Rapid and efficient zebrafish genotyping using PCR with high-resolution melt analysis.* J Vis Exp, 2014(84): p. e51138.

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

Equipment

- ABI 3900 DNA Synthesizer (2)
- ABI 394 DNA Synthesizer (3)
- 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
- Scott Endicott, Research Associate
- Karen Freedman, Lab Specialist
- Chandra Hayes, Lab Aide
- Sheyenne Shamsa, Lab Aide
- Francisco Samaniega, Lab Aide
- Amanda Jarvis, Lab Aide

2014 Annual Update

New Equipment

- The DNA Peptide Facility did not obtain any additional equipment in FY14

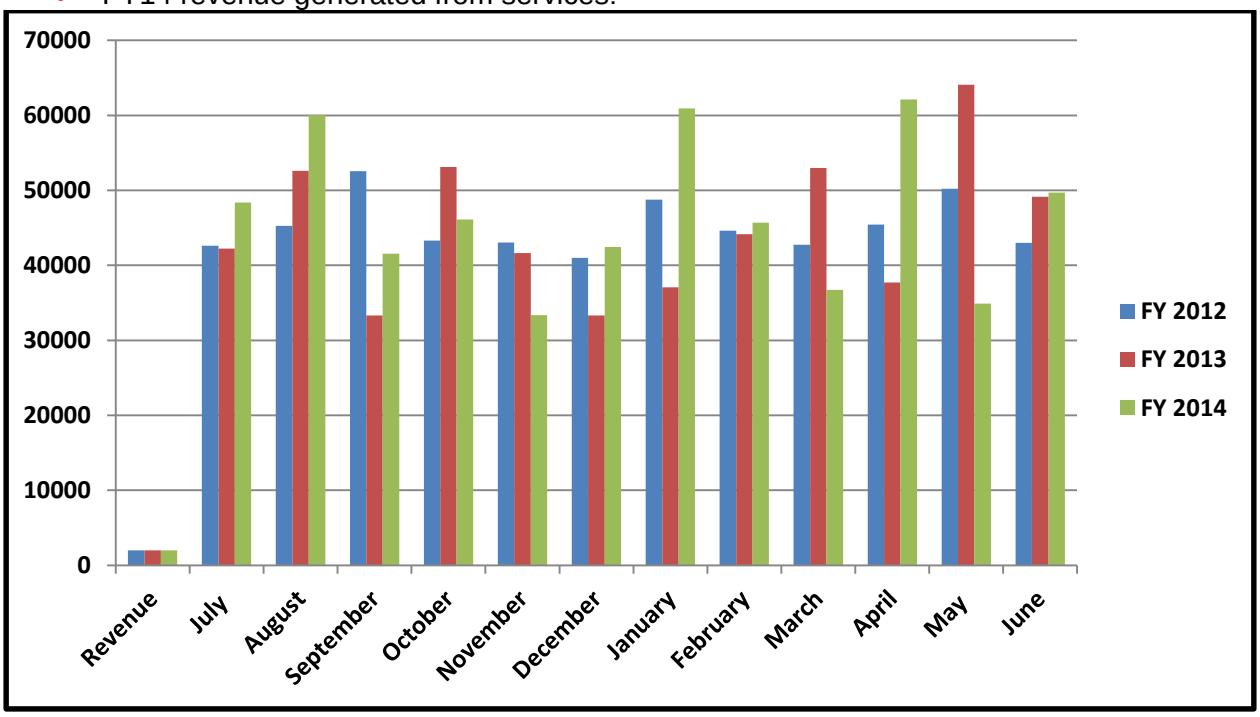
New Services

- The DNA Peptide Facility did not implement any additional services in FY14

Revenue/Expenses

- VP of Research Support: $0
- FY14 revenue: $561,896
- FY14 expenses: $529,804

- FY14 revenue generated from services:

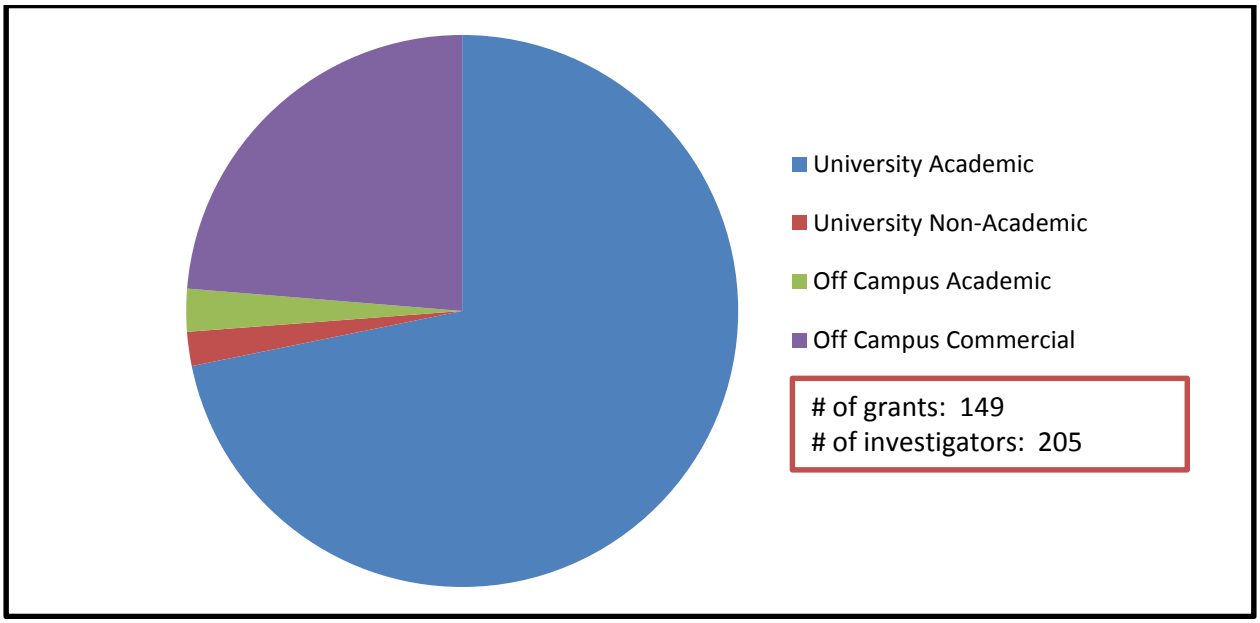


Advisory Board Committee
Last meeting date: August 2014

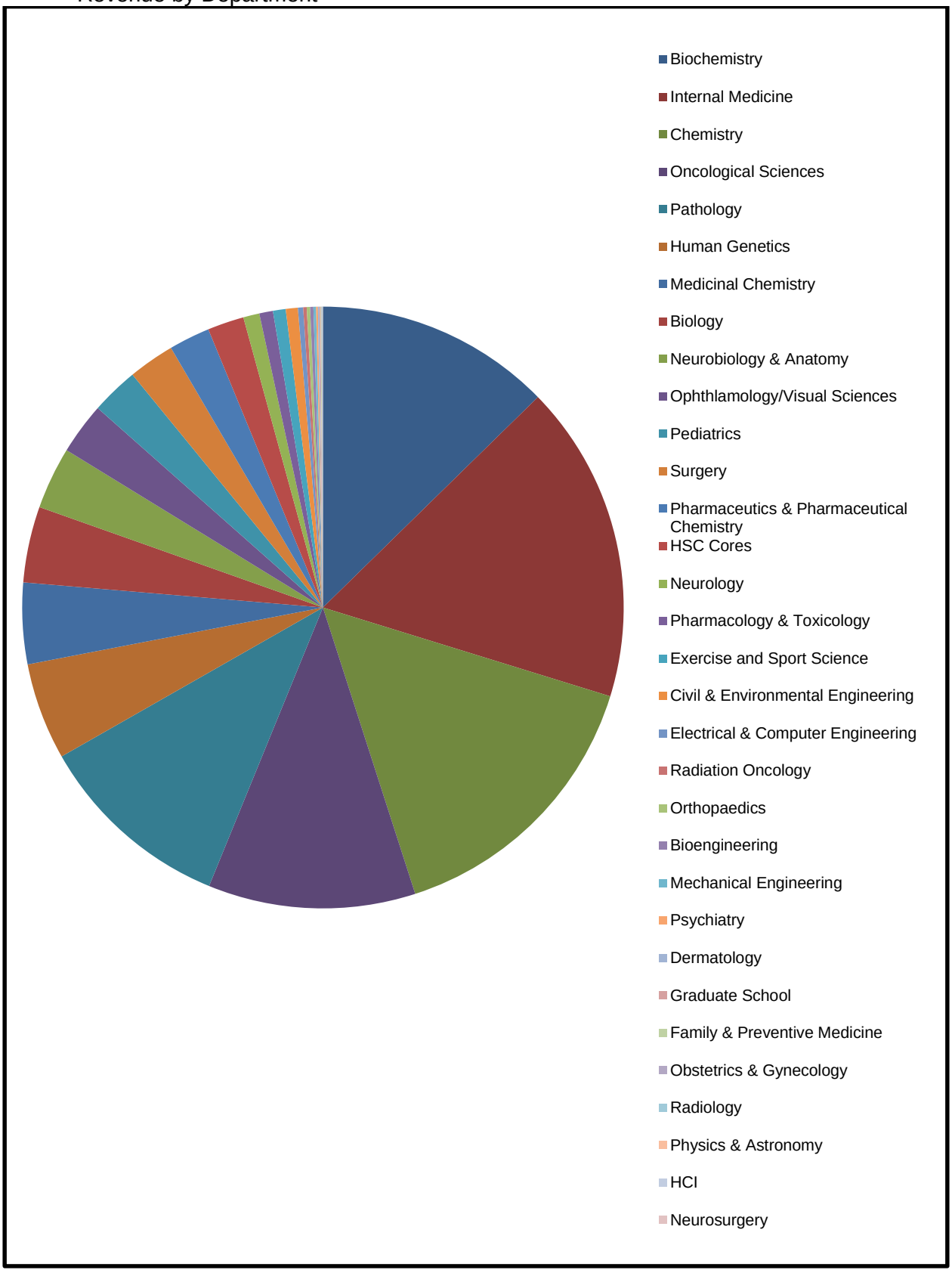
- Eric Schmidt, Professor, College of Pharmacy
- Jen Heemstra, Assistant Professor, Chemistry
- John Weis, Professor, Pathology

FY14 Scientific Impact
Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

1	BioFire Diagnostics	Off Campus
2	Burrows, Cynthia	NIH, NSF
3	Tavtigian, Sean	NIH, HCI
4	Sundquist, Wesley	NIH, DHHS
5	Li, Dean	NIH
6	Weyrich, Andy	NIH
7	Heemstra, Jan	NIH
8	Wittwer, Carl	NIH
9	Rutter, Jared	NIH, NSF
10	ARUP	Off Campus

Publications

1. Ames, P., Q. Zhou, and J.S. Parkinson, *HAMP domain structural determinants for signalling and sensory adaptation in Tsr, the Escherichia coli serine chemoreceptor.* Mol Microbiol, 2014. **91**(5): p. 875-86.
2. Beumer, K.J., et al., *Comparing zinc finger nucleases and transcription activator-like effector nucleases for gene targeting in Drosophila.* G3 (Bethesda), 2013. **3**(10): p. 1717-25.
3. Bramwell, K.K., et al., *Lysosomal beta-glucuronidase regulates Lyme and rheumatoid arthritis severity.* J Clin Invest, 2014. **124**(1): p. 311-20.
4. Briegel, A., et al., *The mobility of two kinase domains in the Escherichia coli chemoreceptor array varies with signalling state.* Mol Microbiol, 2013. **89**(5): p. 831-41.
5. Davis, C.T., et al., *ARF6 inhibition stabilizes the vasculature and enhances survival during endotoxic shock.* J Immunol, 2014. **192**(12): p. 6045-52.
6. Han, X.S. and J.S. Parkinson, *An unorthodox sensory adaptation site in the Escherichia coli serine chemoreceptor.* J Bacteriol, 2014. **196**(3): p. 641-9.
7. Jin, Q., et al., *Base-excision repair activity of uracil-DNA glycosylase monitored using the latch zone of alpha-hemolysin.* J Am Chem Soc, 2013. **135**(51): p. 19347-53.
8. Kent, A.D., N.G. Spiropulos, and J.M. Heemstra, *General approach for engineering small-molecule-binding DNA split aptamers.* Anal Chem, 2013. **85**(20): p. 9916-23.
9. Kishore, B.K., et al., *Cellular localization of adenine receptors in the rat kidney and their functional significance in the inner medullary collecting duct.* Am J Physiol Renal Physiol, 2013. **305**(9): p. F1298-305.
10. Kurokawa, S., et al., *Sepp1(UF) forms are N-terminal selenoprotein P truncations that have peroxidase activity when coupled with thioredoxin reductase-1.* Free Radic Biol Med, 2014. **69**: p. 67-76.
11. Nishiyama, S., A. Garzon, and J.S. Parkinson, *Mutational analysis of the P1 phosphorylation domain in Escherichia coli CheA, the signaling kinase for chemotaxis.* J Bacteriol, 2014. **196**(2): p. 257-64.
12. Onizuka, K., et al., *Short interfering RNA guide strand modifiers from computational screening.* J Am Chem Soc, 2013. **135**(45): p. 17069-77.
13. Oottamasathien, S., et al., *Physiological relevance of LL-37 induced bladder inflammation and mast cells.* J Urol, 2013. **190**(4 Suppl): p. 1596-602.
14. Sandrin, V. and W.I. Sundquist, *ESCRT requirements for EIAV budding.* Retrovirology, 2013. **10**: p. 104.
15. Slattum, G., et al., *Autophagy in oncogenic K-Ras promotes basal extrusion of epithelial cells by degrading S1P.* Curr Biol, 2014. **24**(1): p. 19-28.

16. Stanford, S.M., et al., *pCAP-based peptide substrates: the new tool in the box of tyrosine phosphatase assays.* Methods, 2014. **65**(2): p. 165-74.
17. Wolna, A.H., A.M. Fleming, and C.J. Burrows, *Single-molecule detection of a guanine(C8) - thymine(N3) cross-link using ion channel recording.* J Phys Org Chem, 2014. **27**(4): p. 247-251.

DNA Sequencing Facility

Overview

The DNA Sequencing Facility provides DNA sequencing services and employs the latest technologies to generate high quality data with a fast turnaround time and competitive prices. In support of DNA sequencing activities, the facility utilizes state-of-the-art DNA sequencers and lab robotics such as the Ion Torrent PGM and Proton, the Qiagen Q24 Pyrosequencer, and the Biomek FX for liquid handling needs. Data from standard DNA sequencing services are typically reported to customers within 24 hours. Sample information can be submitted online and sequencing data files are also available online for download using a simple and secure interface.

Services

DNA Sequencing Services

- Standard DNA sequencing
- Primer walking on clones
- Mutation detection and resequencing custom projects
- Ion Torrent NGS sequencing
- Pyrosequencing

Robotics

- Biomek FX with Span-8 and 96 head

Other Services

- Lab consumables for sample submission
- Life Technologies freezer program

Equipment

Sequencers

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

Liquid Handlers

- Biomek FX

Personnel

- Derek Warner, Director
- Michael Powers, Senior Laboratory Specialist
- Anna Adamson, Lab Specialist

2014 Annual Update

New Equipment

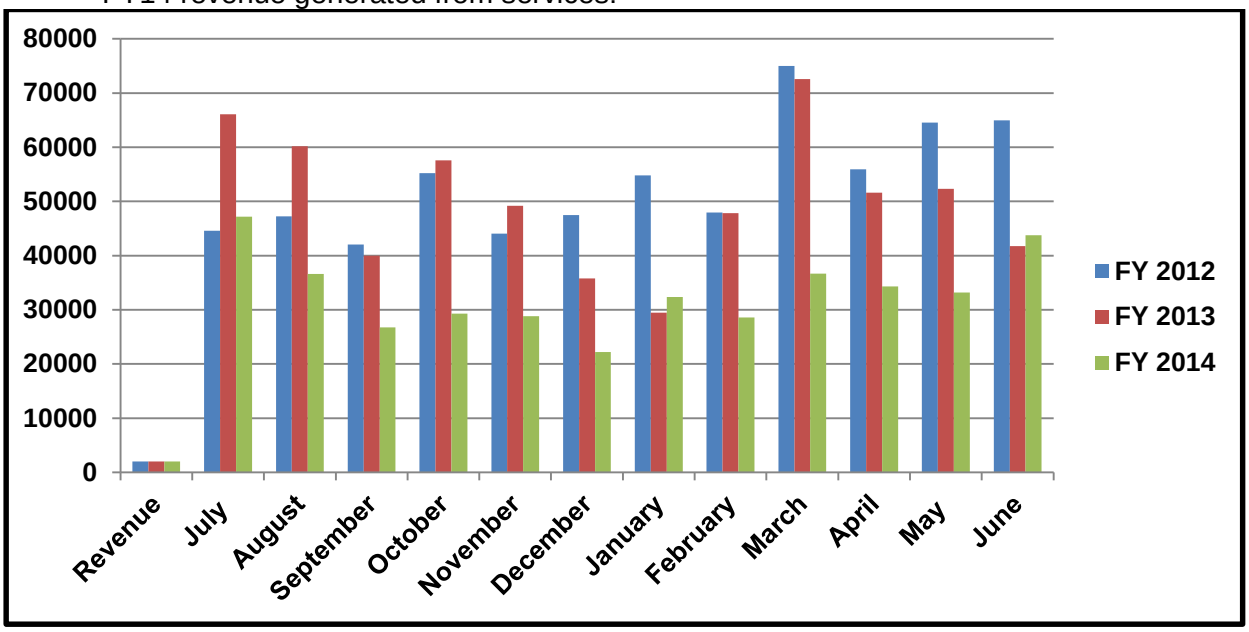
- In April 2013, the DNA Sequencing Facility purchased and installed an Advanced Analytical Fragment Analyzer for sample quantification of RNA and DNA samples prior to NGS and other downstream applications

New Services

- Support for Ion Torrent NGS is now available
- Prices have been updated for sequencing supplies
- Ion Torrent Proton is available for Exome Sequencing and RNA Seq runs and are now being brought online

Revenue/Expenses

- VP of Research Support: $0
- FY14 revenue: $399,748
- FY14 expenses: $581,460
- FY14 revenue generated from services:



Advisory Board Committee

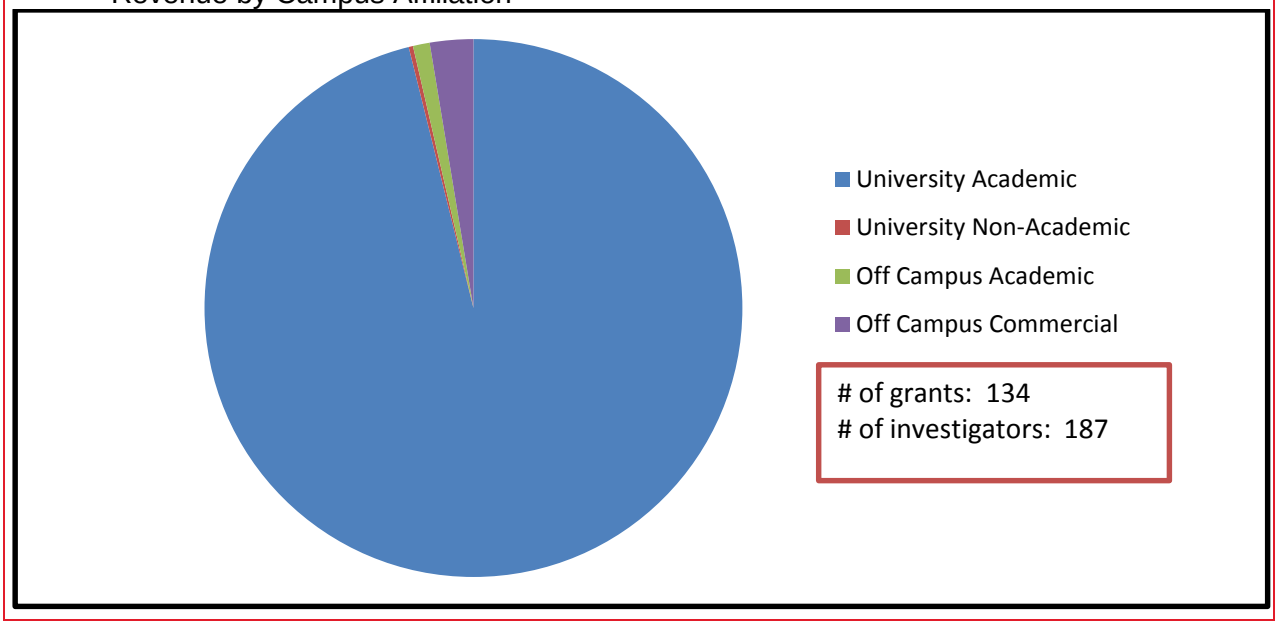
Last meeting date: June 30, 2014

- Monica Vetter, Professor, Neurobiology & Anatomy
- Colin Dale, Associate Professor, Biology
- Robert Weiss, Professor, Human Genetics

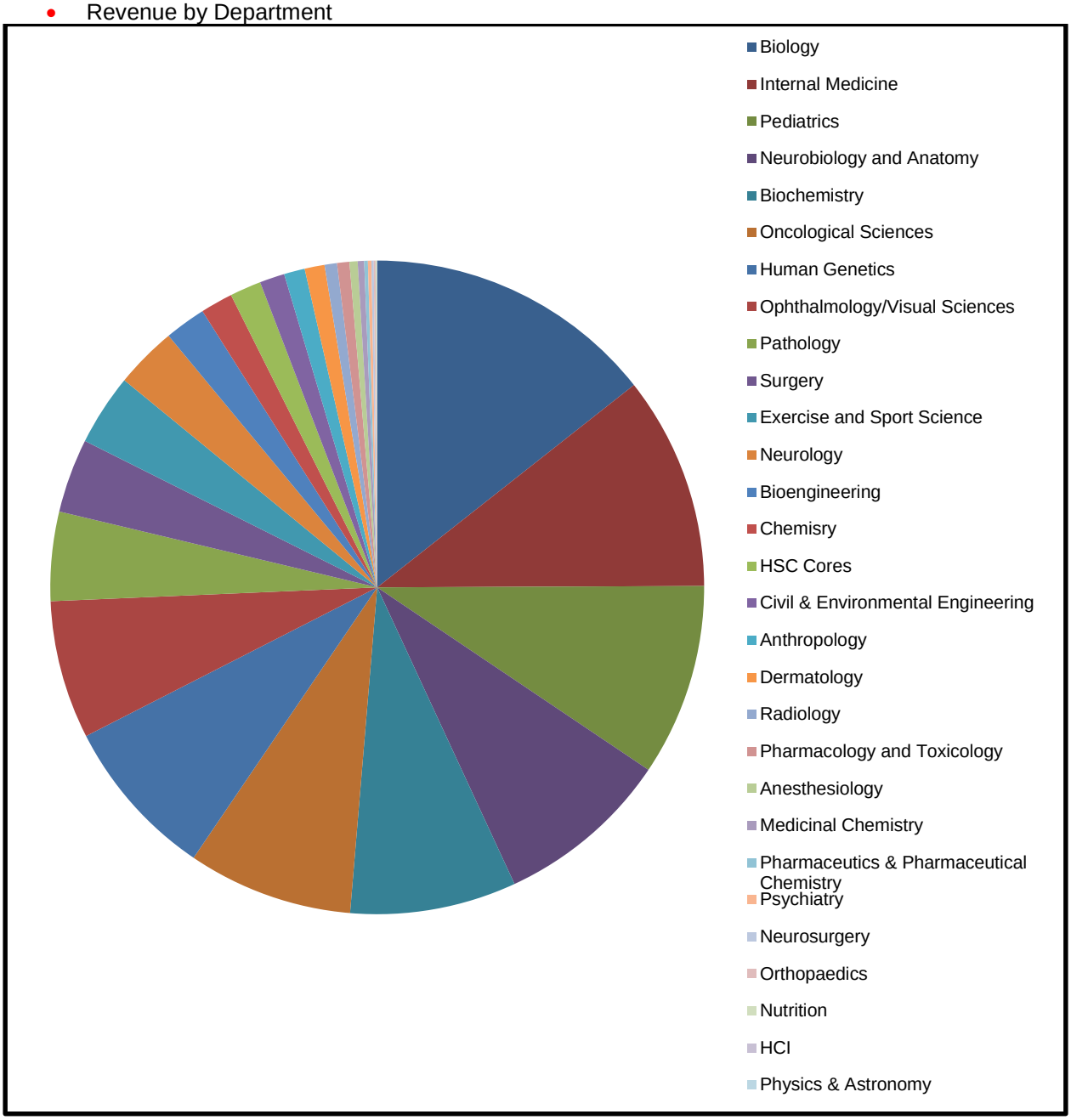
FY14 Scientific Impact

Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

1	Diana Stafforini	Department
2	Elizabeth Leibold	NIH
3	Matthew Mulvey	NIH
4	Christopher Gregg	New York Stem Cell Foundation
5	Denise Dearing	NSF
6	Douglas Grossman	Department
7	Kevin Jones	NIH
8	Markus Babst	NIH
9	Djordje Atanackovic	Department
10	Kathryn Swoboda	Department

Publications

1. Beumer, K.J., et al., *Comparing zinc finger nucleases and transcription activator-like effector nucleases for gene targeting in Drosophila.* G3 (Bethesda), 2013. **3**(10): p. 1717-25.
2. Bowles, N.E., et al., *Kawasaki disease patients homozygous for the rs12252-C variant of interferon-induced transmembrane protein-3 are significantly more likely to develop coronary artery lesions.* Mol Genet Genomic Med, 2014. **2**(4): p. 356-61.
3. Chen, K., et al., *Autoimmunity due to RAG deficiency and estimated disease incidence in RAG1/2 mutations.* J Allergy Clin Immunol, 2014. **133**(3): p. 880-2 e10.
4. Chen, Y.C., et al., *Msp1/ATAD1 maintains mitochondrial function by facilitating the degradation of mislocalized tail-anchored proteins.* EMBO J, 2014. **33**(14): p. 1548-64.
5. Chung, J., et al., *Iron regulatory protein-1 protects against mitoferrin-1-deficient porphyria.* J Biol Chem, 2014. **289**(20): p. 13707.
6. Corbin, A.S., et al., *KIT signaling governs differential sensitivity of mature and primitive CML progenitors to tyrosine kinase inhibitors.* Cancer Res, 2013. **73**(18): p. 5775-86.
7. Davis, C.T., et al., *ARF6 inhibition stabilizes the vasculature and enhances survival during endotoxic shock.* J Immunol, 2014. **192**(12): p. 6045-52.
8. Figueroa, K.P., et al., *Frequency of KCNC3 DNA variants as causes of spinocerebellar ataxia 13 (SCA13).* PLoS One, 2011. **6**(3): p. e17811.
9. Frank, D.U., et al., *Mouse TBX3 mutants suggest novel molecular mechanisms for Ulnar-mammary syndrome.* PLoS One, 2013. **8**(7): p. e67841.
10. Grossmann, A.H., et al., *The small GTPase ARF6 stimulates beta-catenin transcriptional activity during WNT5A-mediated melanoma invasion and metastasis.* Sci Signal, 2013. **6**(265): p. ra14.
11. Hansen, S.T., et al., *Changes in Purkinje cell firing and gene expression precede behavioral pathology in a mouse model of SCA2.* Hum Mol Genet, 2013. **22**(2): p. 271-83.
12. Hansen, S.T. and S.M. Pulst, *Response to ethanol induced ataxia between C57BL/6J and 129X1/SvJ mouse strains using a treadmill based assay.* Pharmacol Biochem Behav, 2013. **103**(3): p. 582-8.
13. Hu, R., et al., *Targeting human microRNA genes using engineered Tal-effector nucleases (TALENs).* PLoS One, 2013. **8**(5): p. e63074.
14. Huang, Z., et al., *Targeting the Tcf4 G13ANDE17 binding site to selectively disrupt beta-catenin/T-cell factor protein-protein interactions.* ACS Chem Biol, 2014. **9**(1): p. 193-201.
15. Imperial, J.S., et al., *A family of excitatory peptide toxins from venomous crassispirine snails: Using Constellation Pharmacology to assess bioactivity.* Toxicon, 2014. **89**: p. 45-54.
16. Khorashad, J.S., et al., *BCR-ABL1 compound mutations in tyrosine kinase inhibitor-resistant CML: frequency and clonal relationships.* Blood, 2013. **121**(3): p. 489-98.
17. Li, B., et al., *Inactivity of human beta,beta-carotene-9',10'-dioxygenase (BCO2) underlies retinal accumulation of the human macular carotenoid pigment.* Proc Natl Acad Sci U S A, 2014. **111**(28): p. 10173-8.
18. Li, L., et al., *Expression of the yeast cation diffusion facilitators Mmt1 and Mmt2 affects mitochondrial and cellular iron homeostasis: evidence for mitochondrial iron export.* J Biol Chem, 2014. **289**(24): p. 17132-41.
19. Lin, Z., et al., *Neuroactive diol and acyloin metabolites from cone snail-associated bacteria.* Bioorg Med Chem Lett, 2013. **23**(17): p. 4867-9.
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21. Matsunami, N., et al., *Identification of rare DNA sequence variants in high-risk autism families and their prevalence in a large case/control population.* Mol Autism, 2014. **5**(1): p. 5.
22. Montgomery, J.L., N. Rejali, and C.T. Wittwer, *Stopped-flow DNA polymerase assay by continuous monitoring of dNTP incorporation by fluorescence.* Anal Biochem, 2013. **441**(2): p. 133-9.
23. Montgomery, J.L., N. Rejali, and C.T. Wittwer, *The influence of nucleotide sequence and temperature on the activity of thermostable DNA polymerases.* J Mol Diagn, 2014. **16**(3): p. 305-13.
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26. Ota, S., et al., *Efficient identification of TALEN-mediated genome modifications using heteroduplex mobility assays.* Genes Cells, 2013. **18**(6): p. 450-8.
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28. Puillandre, N., et al., *Molecular phylogeny and evolution of the cone snails (Gastropoda, Conoidea).* Mol Phylogenet Evol, 2014. **78C**: p. 290-303.
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30. Semache, M., et al., *Per-Arnt-Sim kinase regulates pancreatic duodenal homeobox-1 protein stability via phosphorylation of glycogen synthase kinase 3beta in pancreatic beta-cells.* J Biol Chem, 2013. **288**(34): p. 24825-33.
31. Tilak, A., et al., *Simultaneous rather than ordered cleavage of two sites within the BMP4 prodomain leads to loss of ligand in mice.* Development, 2014. **141**(15): p. 3062-71.
32. Van Vranken, J.G., et al., *SDHAF4 Promotes Mitochondrial Succinate Dehydrogenase Activity and Prevents Neurodegeneration.* Cell Metab, 2014. **20**(2): p. 241-52.
33. Wu, X., et al., *PAS kinase drives lipogenesis through SREBP-1 maturation.* Cell Rep, 2014. **8**(1): p. 242-55.
34. Zabriskie, M.S., et al., *BCR-ABL1 Compound Mutations Combining Key Kinase Domain Positions Confer Clinical Resistance to Ponatinib in Ph Chromosome-Positive Leukemia.* Cancer Cell, 2014. **26**(3): p. 428-42.
35. Zhou, L., et al., *Symmetric snapback primers for scanning and genotyping of the cystic fibrosis transmembrane conductance regulator gene.* Clin Chem, 2013. **59**(7): p. 1052-61.

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
- Assay development
- Consultation on target identification/validation, hit to lead optimization, PK/PD/Efficacy
- Chemical support for drug discovery

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
- CyBio(Matrix) 96/384 Liquid Handler
- Matrix PlateMate Plus 384 Liquid Handler
- HP D300 Digital Dispenser
- Bio-tek Plate Washer with stacker

Automated Detection Systems:

- ImageXpress XLS Automated High-Content System
- Bio-tek Plate Synergy 4 Plate Reader with stacker

CRISPR Libraries:

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

Commercial Compound Libraries:

- Chembridge 49K Diverset

- Microsource Spectrum Collection
- NIH Clinical Collection
- Epigenetics Screening Library
- Kinase Inhibitor Library
- NCI Diversity Set IV
- Natural Products Set II

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

2014 Annual Update

New Equipment:

- ImageXpress XLS Automated High-Content System - capable of providing automated cellular imaging in fluorescent modes for fixed- or live-cell assays

New Compound Collection:

- NIH Clinical Collection - 446 compounds that have been in phase I-III clinical trials and have not been represented in other arrayed collection
- Epigenetics Screening Library - 75 small molecules that are known to modulate the activity of a variety of epigenetic ‘writers and erasers’ and ‘reader’ proteins
- NCI Diversity Set IV - 1596 compounds with diverse pharmacophores which were derived from the almost 140,000 compounds available for distribution from the Developmental Therapeutics Program (DTP) repository at NCI/NIH
- Natural Products Set II - 120 natural product compounds from Developmental Therapeutics Program (DTP) repository at NCI/NIH

New CRISPR Libraries:

- The genome-scale CRISPR-Cas9 knockout (GeCKO) v2 library consists of 122,417 unique guide sequences targeting 19,052 human genes and including 1000 control (non-targeting) sgRNAs
- Subset CRISPR libraries: a) human Lentiviral sgRNA library-kinases, and b) human Lentiviral sgRNA library-nuclear proteins

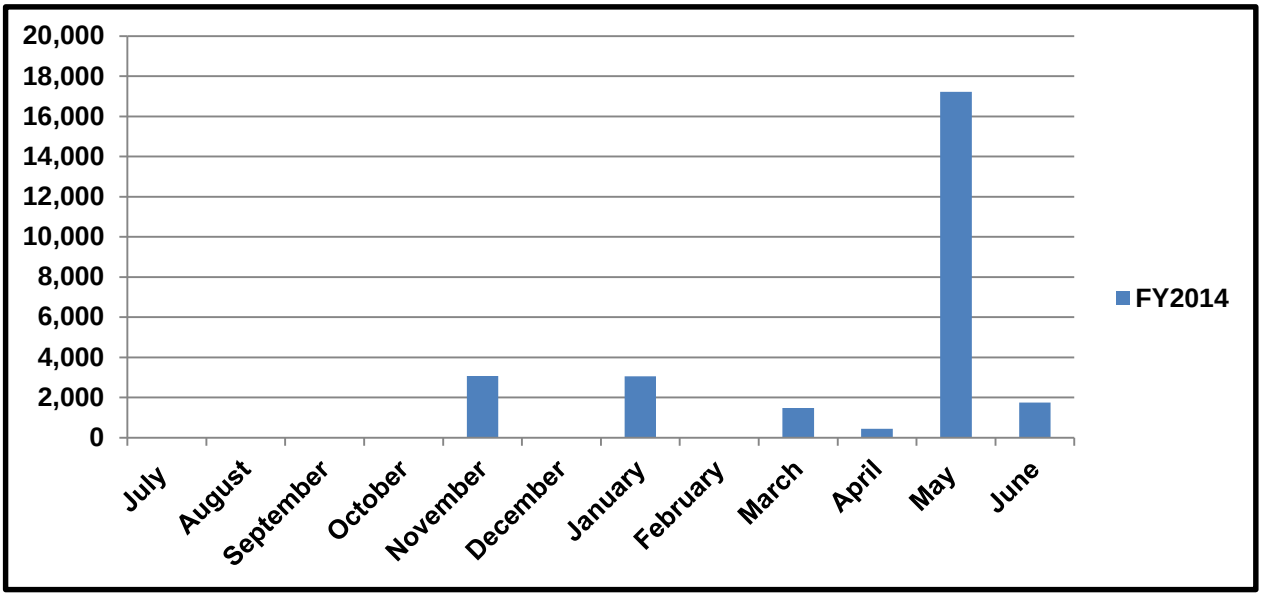
New Services:

- Web-based secured UUPCC compound management system - capable of 1) compound searching by compound ID, relevant chemical properties or structure and substructure, 2) compound ordering for complete set copies, subset plate copies, or individually cherry-picked compounds, 3) inventory tracking and maintaining accurate compound quantity/volume balances
- CRISPR screening
- Cell-base high-content screening

Revenue/Expenses

- VP of Research Support: $242,104
- FY14 Revenue: $27,028
- FY14 Expense: $290,914

- FY14 revenue generated from services:



Advisory Board Committee

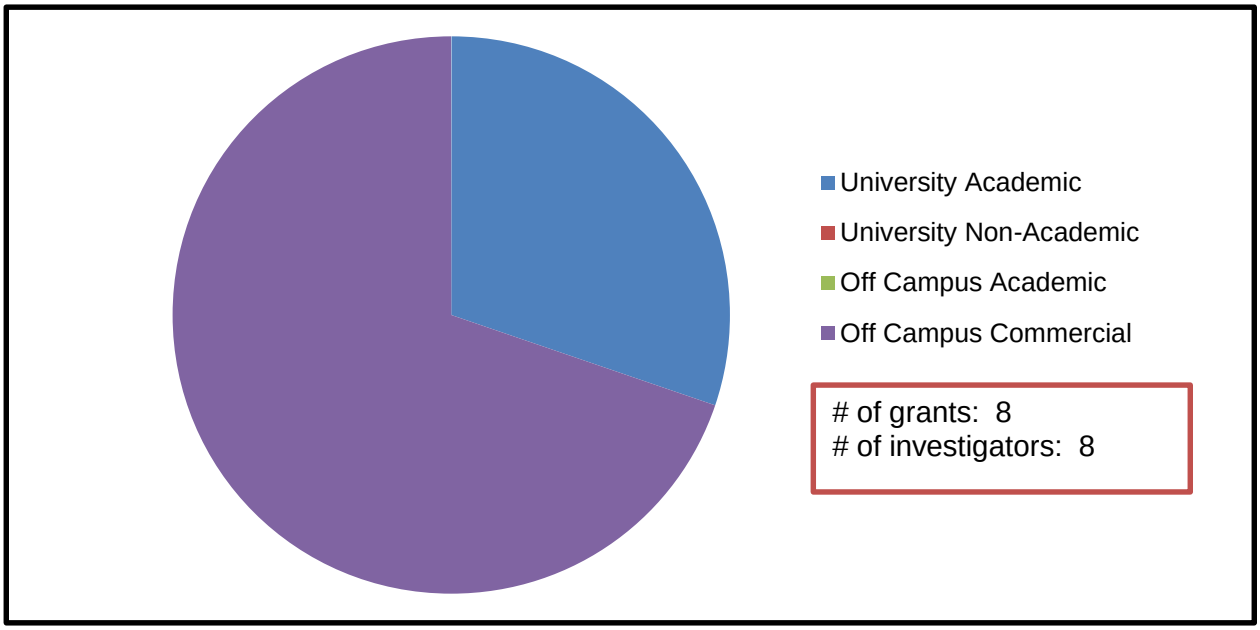
Last meeting date: December 17, 2013

- 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, Assistant Professor, Surgery
- Hari Vankayalapati, Research Assistant Professor, HCI

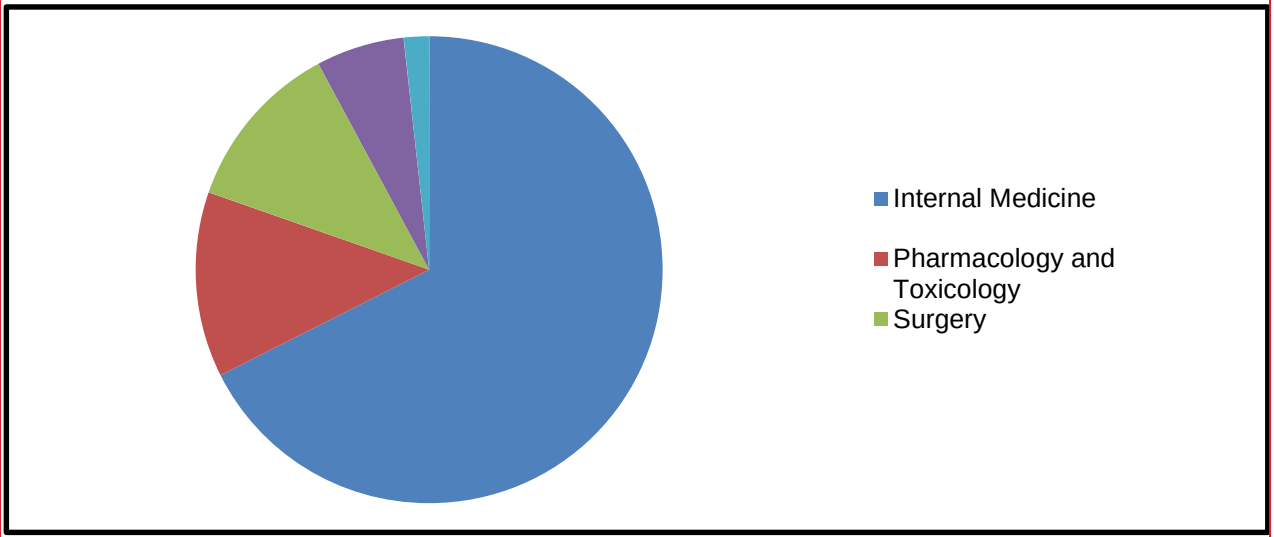
FY14 Scientific Impact

Research Support

- Revenue by Campus Affiliatio



- Revenue by Department



Top Users

Li, Dean	NIH
Schlegel, Amnon	DHHS
Tavtigian, Sean	NIH
Phillips, John	NIH
Longo, Nicola	DHHS
Bild, Andrea	Department
Holmen, Sheri	NIH
VanBrocklin, Matthew	NIH
Navigen Pharmaceuticals Inc.	Off Campus
Recursion Pharmaceuticals Inc	Off Campus

Publications

1. Davis, C.T., et al., *ARF6 inhibition stabilizes the vasculature and enhances survival during endotoxic shock.* J Immunol, 2014. **192**(12): p. 6045-52.
2. El-Chaar, N.N., et al., *Genomic classification of the RAS network identifies a personalized treatment strategy for lung cancer.* Mol Oncol, 2014.

Goals for FY15

Integrate new functionalities

- Synthetic and Medicinal Chemistry Facility
- LC-MS NMR Facility
- Cell Imaging Facility

Expand capabilities

- Upgrade Bio-teq plate reader (7 year old)
- Enhance Utility of UUPCC Library

Expand business

- Move to main campus
- Institutional seed funding
- Library compound sharing with other institutes

Electron Microscopy

Overview

The Electron Microscopy (EM) Facility 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. The EM Facility also prepares specimens for the microscope. The EM facility has 3 spatially distinct locations to best serve the needs of the clinical and research groups, the main facility is in SMBB, the clinical facility is housed in Bldg. 585 and the cryo-EM equipment is located in Biology.

Services

Clinical Services:

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

Research Services:

- Training on the TEMs, SEM, microtomes, sample preparation, and 3D image reconstruction
- Sections ("thick" and "thin") cut on microtome and ultramicrotome
- Record images on transmission or scanning electron microscopes
- Procedures for observing tissues and cellular specimens including embedding, drying, osmification, and storage
- Procedures for observing particulate and macromolecular samples including staining, metal coating, drying, and cryogenic TEM

Equipment

- FEI Tecnai 12, transmission electron microscope
- JEOL JEM-1400 Plus, transmission electron microscope
- Two Hitachi 7100, transmission electron microscopes
- FEI Tecnai F20, transmission electron microscope
- Hitachi S-2460N, scanning electron microscope
- Leica (UC7, UC6, and UCT) and Reichert (Ultracut E), ultramicrotomes
- Leica JUNG RM2055, microtome
- Two FEI Vitrobots, vitrification robots
- Gatan K2 Summit, direct electron detector (with FEI Tecnai F20)
- Two automatic tissue processors
- Laboratory microwave oven
- Sputter coater
- Glow discharger
- High-pressure freezer
- Freeze substitution machine
- Critical-point dryer

Personnel

- David Belnap, Ph.D., Director
- Nancy Chandler, Senior Laboratory Specialist
- Linda Nikolova, Senior Laboratory Specialist
- Jared Stratton, Laboratory Technician

- Megan Kent, Laboratory Technician
- Shiane Escobedo, Laboratory Technician

2014 Annual Update

New Equipment

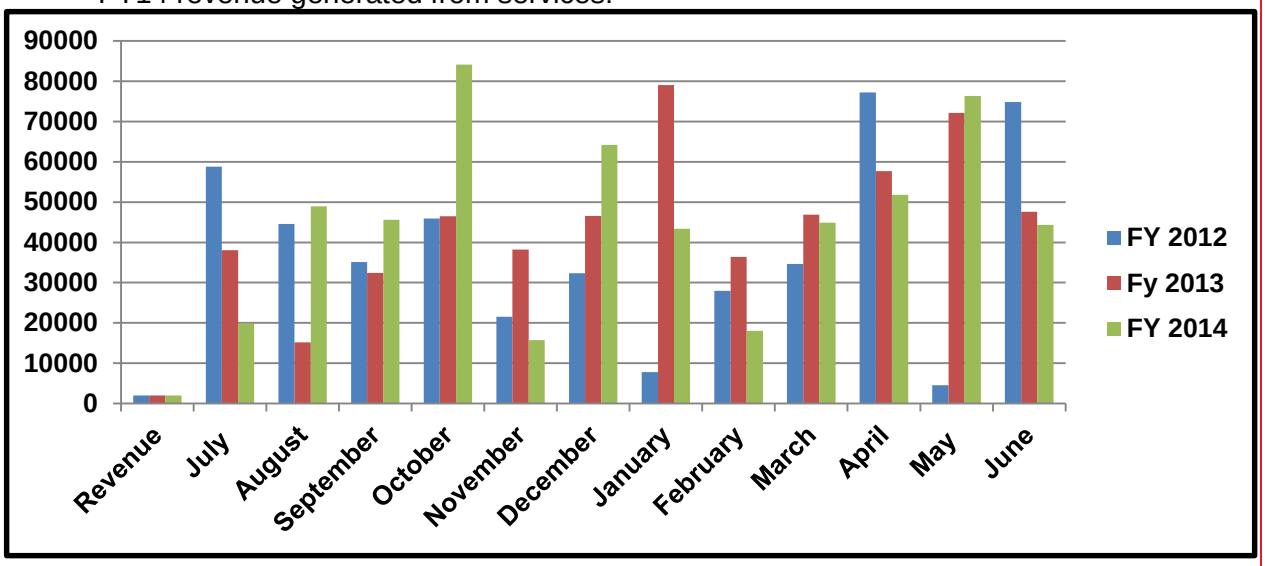
- JEOL JEM-1400 Plus, transmission electron microscope
- Leica UC7 ultramicrotome with cryogenic attachment
- Gatan K2 Summit, direct electron detector, purchased FY14, installed 8/2014.

New Services

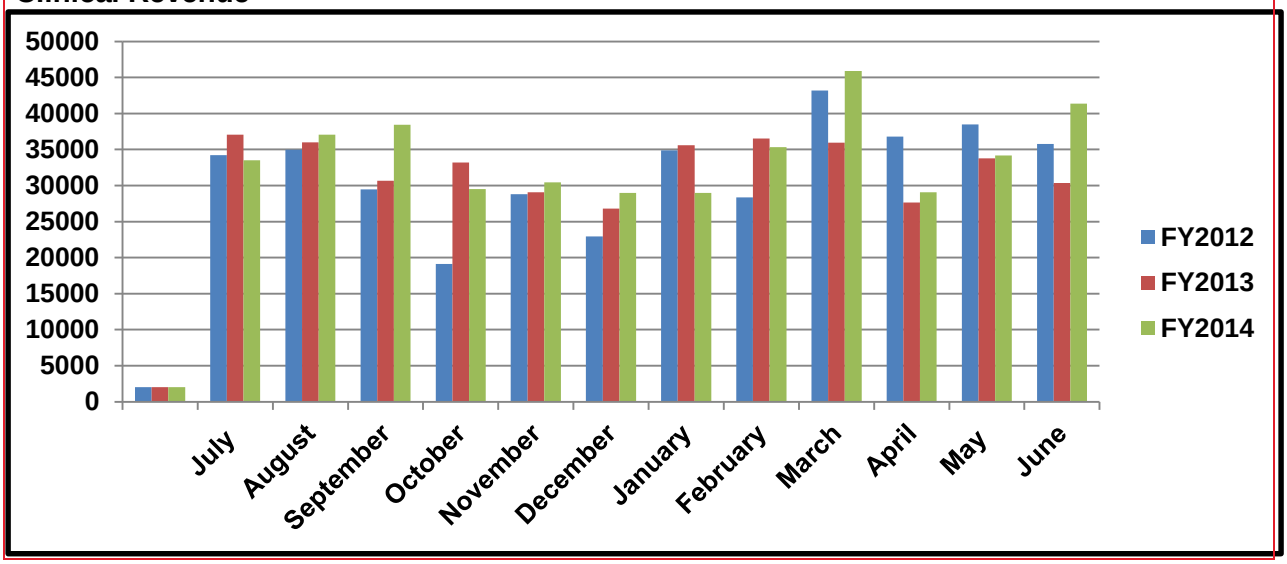
- The Electron Microscopy Facility moved to the Sorenson Molecular Biotechnology Building (USTAR) during FY14
- Cryogenic ultramicrotome sectioning

Revenue/Expenses

- VP of Research Support: $94,000
- FY14 revenue: $557,204
- FY14 expenses: $657,907
- FY14 revenue generated from services:



Clinical Revenue

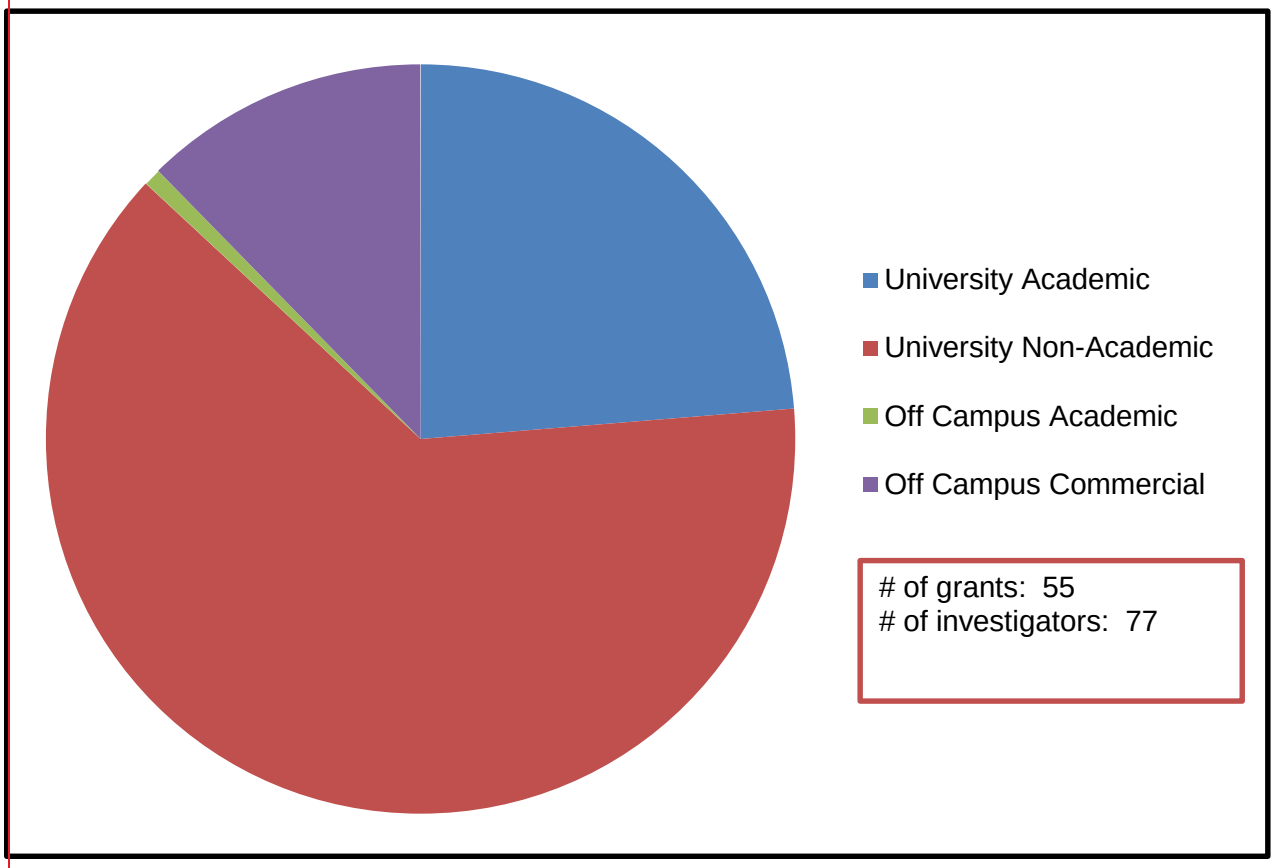


Advisory Board Committee
Last meeting date: October 2, 2013

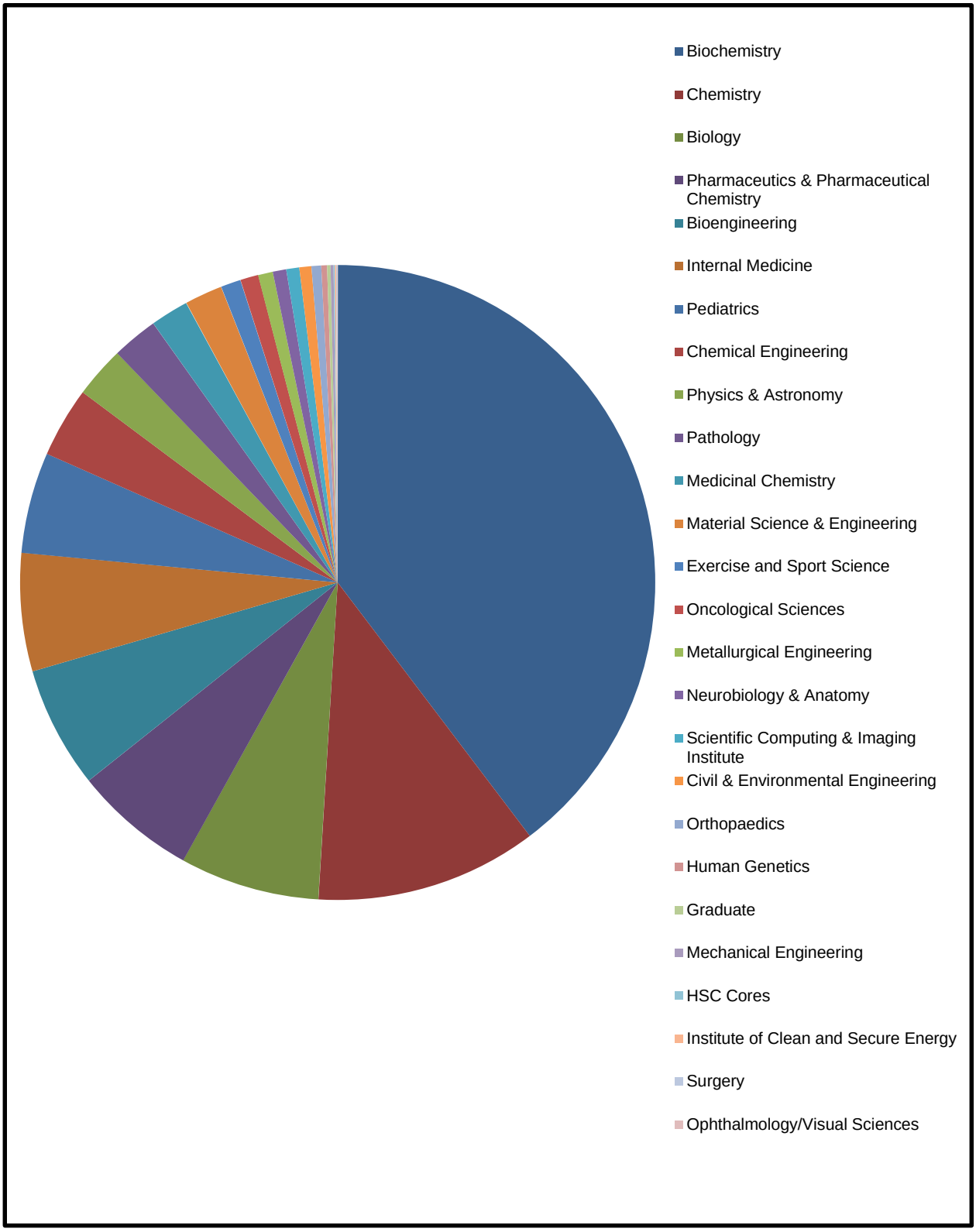
- Adam Frost, Assistant Professor, Department of Biochemistry
- Erik Jorgensen, Distinguished Professor, Department of Biology
- Mary Bronner, Professor, Department of Pathology

FY2014 Scientific Impact
Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

1	ARUP	Off Campus
2	Scripps	Off Campus
3	Frost, Adam	NIH
4	Primary Children's Medical Center	Off Campus
5	Sundquist, Wesley	NIH, DHHS
6	Tricore Reference Labs	Off Campus
7	St. Johns	Off Campus
8	Jorgensen, Erik	HHMI
9	Nano Institute of Utah	NIH
10	Bartl, Michael	NSF

Publications

1. Kalita, M., et al., *A nanosensor for ultrasensitive detection of oversulfated chondroitin sulfate contaminant in heparin.* J Am Chem Soc, 2014. **136**(2): p. 554-7.
2. Lin, C.Y., et al., *Ultrasound sensitive eLiposomes containing doxorubicin for drug targeting therapy.* Nanomedicine, 2014. **10**(1): p. 67-76.
3. Lin, J., et al., *Conformational shift of a major poliovirus antigen confirmed by immuno-cryogenic electron microscopy.* J Immunol, 2013. **191**(2): p. 884-91.
4. Liu, J., et al., *Surface force measurements at kaolinite edge surfaces using atomic force microscopy.* J Colloid Interface Sci, 2014. **420**: p. 35-40.

Goals for FY15

- Obtain high-quality TEM data with FEI Tecnai F20 and Gatan K2 Summit camera
- Establish cryo-sectioning as a frequently used method
- Maintain high-quality clinical services
- Improve clinical services by establishing remote capability
- Establish tomography as a frequently used method

Flow Cytometry Facility

Overview

The Flow Cytometry Facility offers quantitative, multiparameter 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 of all, facility staff is 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 which 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 absolutely 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
- Propel Labs Avalon

Analyzers

- BD FACSCanto
- Cytek DxP
- BD FACScan

Personnel

- James Marvin, Director
- Chris Leukel, Senior Laboratory Specialist

FY14 Annual Update

New Equipment

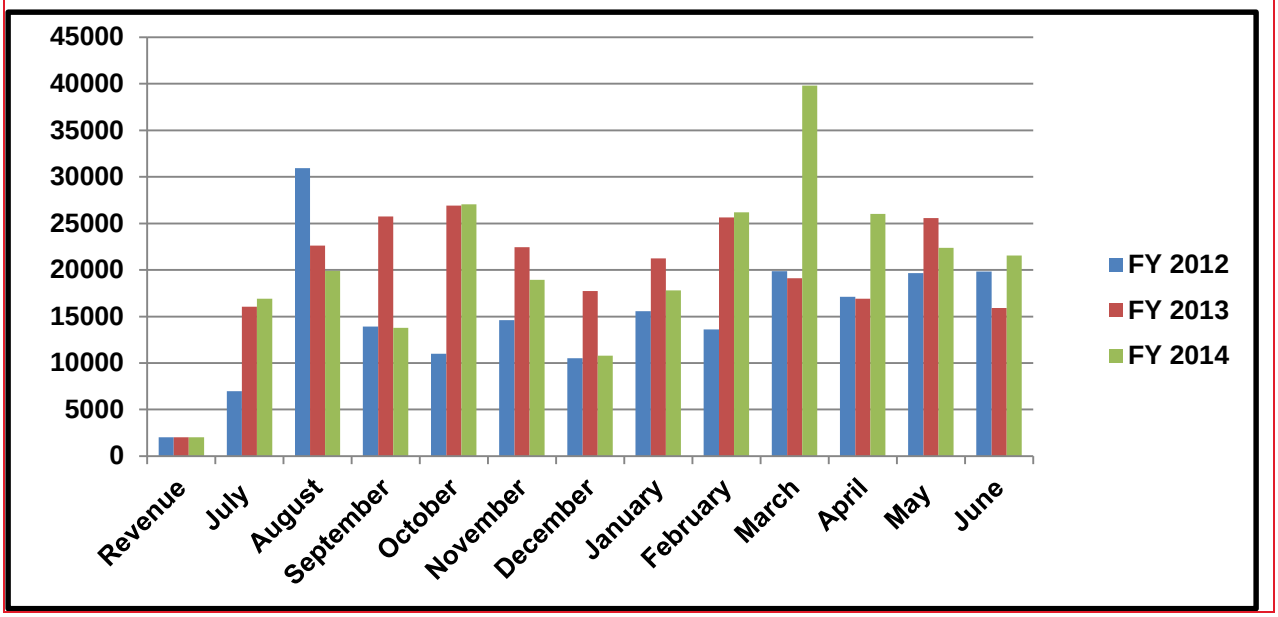
None

New Services

In March 2014, the Flow Cytometry Facility started a service agreement with the Pathology Department. For $20,000 a year, the facility provides instrument quality control, routine maintenance, and management of service contracts for a BD FacsCanto, BD-X20, and a BD Fortessa. In addition to providing maintenance on instrumentation, the facility also provides training for new users.

Revenue/Expenses

- VP of Research Support: $25,000
- FY14 revenue: $261,184
- FY14 expenses: $283,228
- FY14 revenue generated from services:

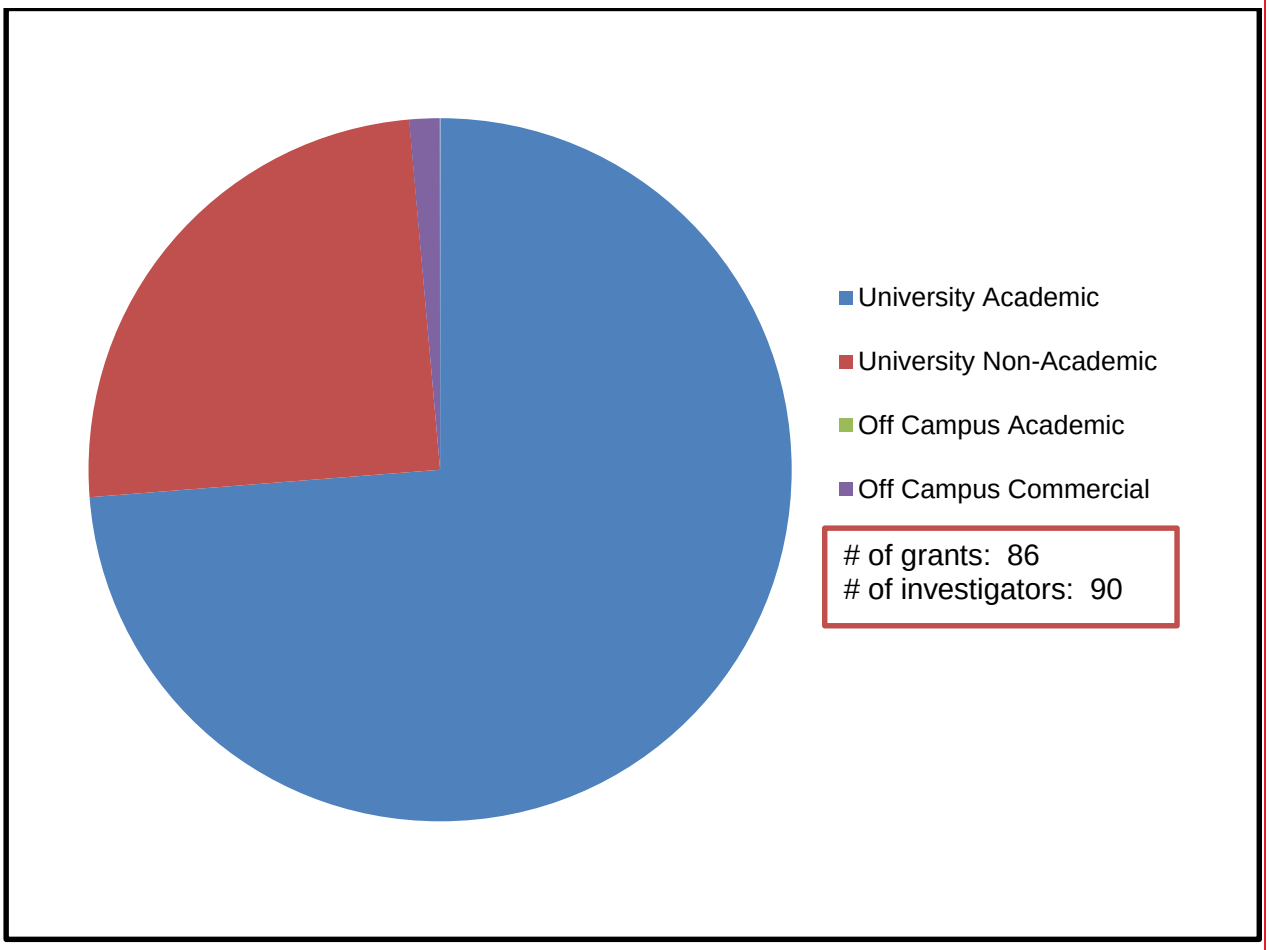


Advisory Board Committee
Last meeting date: June 30, 2014

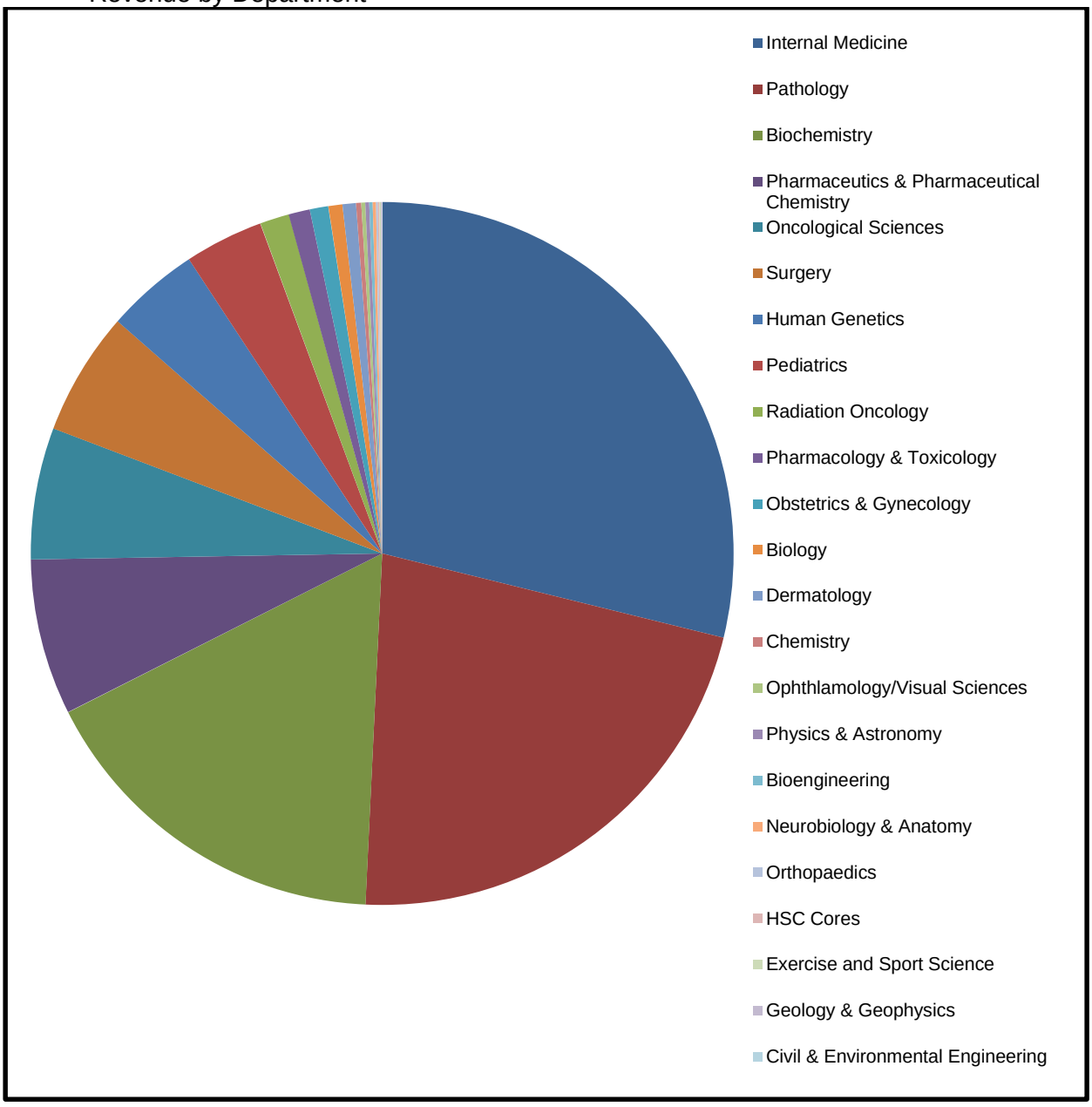
- Ryan O'Connell, Assistant Professor, Pathology
- Thomas O'Hare, Associate Professor, Hematology
- Gerald Spangrude, Professor, Hematology
- Matthew Williams, Assistant Professor, Pathology
- Charles Goolsby, Professor of Pathology, Northwestern University

FY14 Scientific Impact
Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

1	ARUP	Off Campus
2	Prchal, Josef	Leukemia Society, Mount Sinai
3	Williams, Matthew	Department
4	Welm, Bryan	NIH
5	Bhaskara, Srividya	Department
6	4Life Research	Off Campus
7	Zimmerman, Guy	NIH
8	Hildebrandt, Gerhard	Department
9	Westenfelder, Christof	Kidney Foundation Fund
10	Boudina, Sihem	NIDDK

Publications

1. Bruno, B.J., G.D. Miller, and C.S. Lim, *Basics and recent advances in peptide and protein drug delivery.* Ther Deliv, 2013. **4**(11): p. 1443-67.
2. Cusick, M.F., et al., *Infiltrating macrophages are key to the development of seizures following virus infection.* J Virol, 2013. **87**(3): p. 1849-60.
3. Donius, L.R., et al., *Generation of a novel Cr2 gene allele by homologous recombination that abrogates production of Cr2 but is sufficient for expression of Cr1.* Immunobiology, 2014. **219**(1): p. 53-63.
4. Donius, L.R., J.J. Weis, and J.H. Weis, *Murine complement receptor 1 is required for germinal center B cell maintenance but not initiation.* Immunobiology, 2014. **219**(6): p. 440-9.
5. Kohl, K.D., et al., *Herbivorous rodents (Neotoma spp.) harbour abundant and active foregut microbiota.* Environ Microbiol, 2014. **16**(9): p. 2869-78.
6. Kverka, M., et al., *Immunogenicity of coiled-coil based drug-free macromolecular therapeutics.* Biomaterials, 2014. **35**(22): p. 5886-96.
7. Manning, J., et al., *Vitamin C promotes maturation of T-cells.* Antioxid Redox Signal, 2013. **19**(17): p. 2054-67.
8. Matissek, K.J., et al., *The DNA binding domain of p53 is sufficient to trigger a potent apoptotic response at the mitochondria.* Mol Pharm, 2013. **10**(10): p. 3592-602.
9. Matissek, K.J., et al., *Delivery of a Monomeric p53 Subdomain with Mitochondrial Targeting Signals from Pro-Apoptotic Bak or Bax.* Pharm Res, 2014.
10. Okal, A., et al., *Re-engineered p53 chimera with enhanced homo-oligomerization that maintains tumor suppressor activity.* Mol Pharm, 2014. **11**(7): p. 2442-52.
11. Okal, A., et al., *A chimeric p53 evades mutant p53 transdominant inhibition in cancer cells.* Mol Pharm, 2013. **10**(10): p. 3922-33.
12. Pioli, P.D., et al., *Deletion of Snai2 and Snai3 results in impaired physical development compounded by lymphocyte deficiency.* PLoS One, 2013. **8**(7): p. e69216.
13. Ramirez, P.W., et al., *Downmodulation of CCR7 by HIV-1 Vpu results in impaired migration and chemotactic signaling within CD4(+) T cells.* Cell Rep, 2014. **7**(6): p. 2019-30.
14. Rondina, M.T., et al., *Platelet-Monocyte Aggregate Formation and Mortality Risk in Older Patients With Severe Sepsis and Septic Shock.* J Gerontol A Biol Sci Med Sci, 2014.

Goals for FY15

For the most part, the facility is not looking to fill any essential gaps in services or instrumentation over the next fiscal year. However we believe there is room for improvement with the quality of a few of our services. The facility is now providing oversight for the instruments located in the Pathology Department. Although this has been a significant value added for the users in Pathology, we feel that there is an opportunity to streamline training to be more efficient. The initial phases of this agreement turned out to have a large component of IT involvement along with a sizable amount of time dedicated to finalizing expectations. With all of this behind us, we can now focus more attention to standardized training and management. Also, we will be continuing our pursuit of offering the highest quality cell sorting services. As with the Pathology instruments, we have identified a few areas where we can be more efficient and increase productivity on the cell sorters within the lab.

There is also potential for utilizing a significant portion of our surplus budget to revisit the acquisition of a Laser Scanning Cytometer. However this would be a large purchase with a sizable impact to the budget in years to come so this decision will be made in cooperation with the advisory board along with other potential users of the new technology.

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

DNA Sequencing
- Mutation Detection

Real Time PCR
- Gene Expression

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

Personnel
- Derek Warner, Director
- Michael Klein, Manager

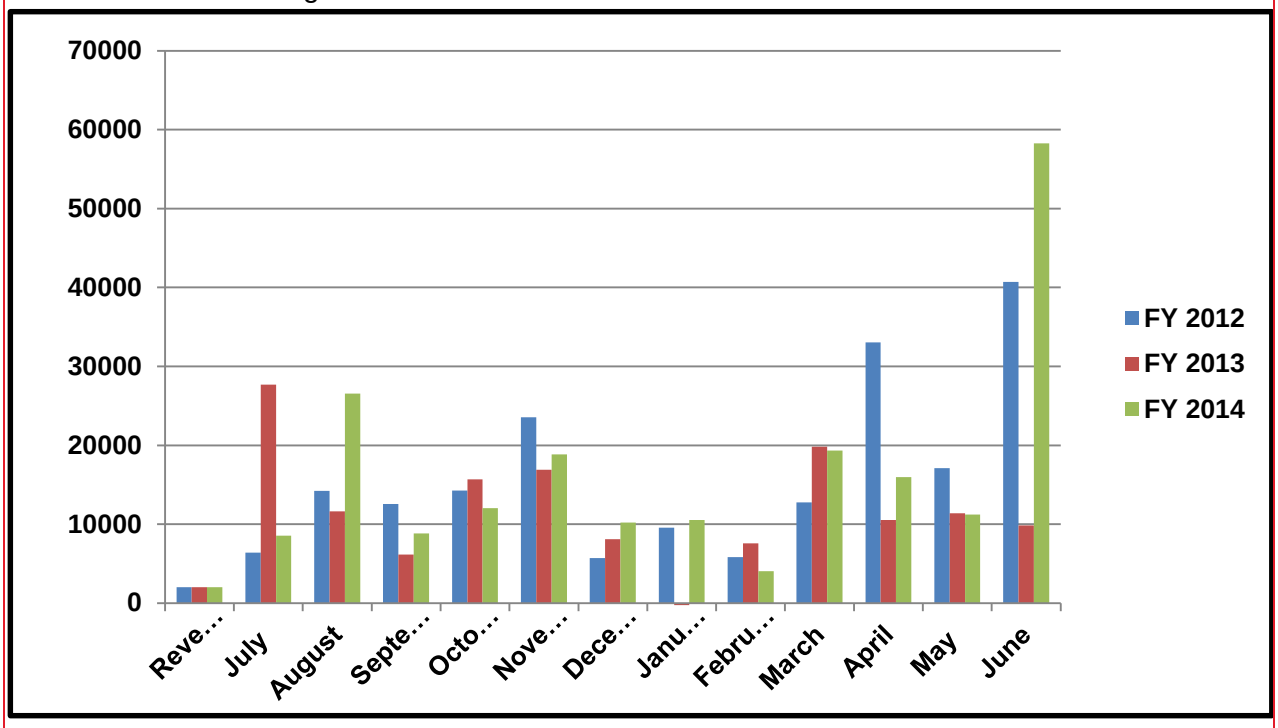
2014 Annual Update

New Equipment
- No new instrumentation for FY14

New Services
- No new services for FY14

Revenue/Expenses
- VP of Research Support: $0
- FY14 revenue: $204,389
- FY14 expenses: $153,787

- FY14 revenue generated from services:



Advisory Board Committee
Last meeting date: June 30, 2014

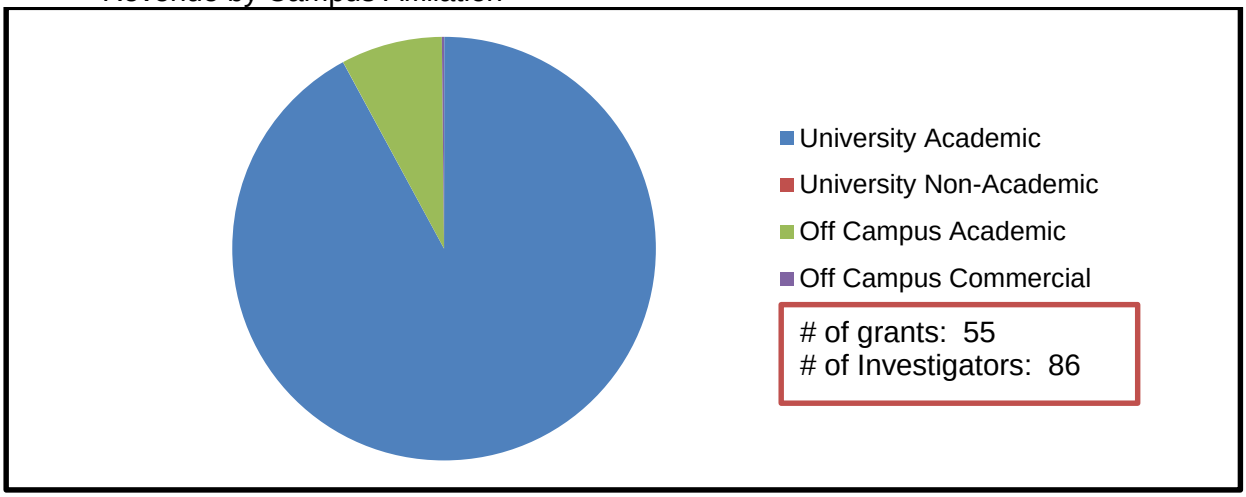
- Gerald Krueger, Professor, Dermatology
- Deborah Neklason, Research Associate Professor, Huntsman Cancer Institute
- Nicola Camp, Professor, Genetic Epidemiology

Addendum

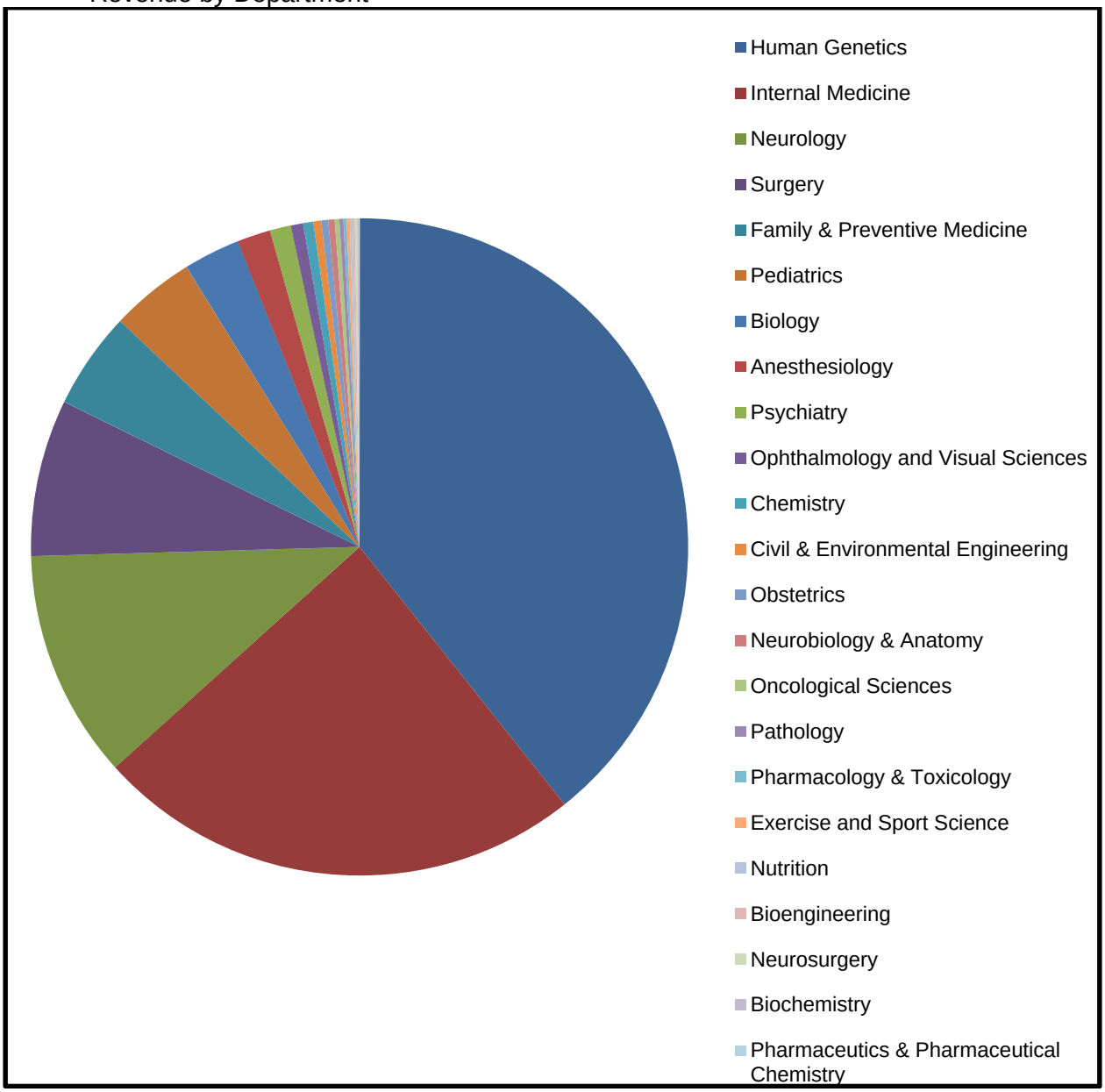
- Faculty Oversight Committee Guidelines
  http://www.cores.utah.edu/?page_id=3725

FY14 Scientific Impact
Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

1	Leppert, Mark	Department
2	Pulst, Stefan	Norda
3	Cannon-Albright, Lisa	American Association for Cancer, U.S. Department of Finance
4	Hunt, Steven	NIH
5	NYU	Off Campus
6	Cannon-Albright, Lisa	DOD W81XWH-11-1-0342
7	Weiss, Robert	DHHS
8	Taylor, Jack	Department
9	Gruber, Peter	Department
10	Carrell, Douglas	Department

Publications

1. Ashizawa, T., et al., *Clinical characteristics of patients with spinocerebellar ataxias 1, 2, 3 and 6 in the US; a prospective observational study.* Orphanet J Rare Dis, 2013. **8**: p. 177.
2. Cannon-Albright, L.A., et al., *Linkage analysis of extended high-risk pedigrees replicates a cutaneous malignant melanoma predisposition locus on chromosome 9q21.* J Invest Dermatol, 2013. **133**(1): p. 128-34.
3. Gibson, S.B., et al., *Familial clustering of ALS in a population-based resource.* Neurology, 2014. **82**(1): p. 17-22.
4. Mu, H.H., et al., *Mycoplasma superantigen initiates a TLR4-dependent Th17 cascade that enhances arthritis after blocking B7-1 in Mycoplasma arthritidis-infected mice.* Cell Microbiol, 2014. **16**(6): p. 896-911.
5. Riddle, E.S., et al., *Intrauterine growth restriction increases TNF alpha and activates the unfolded protein response in male rat pups.* J Obes, 2014. **2014**: p. 829862.
6. Tazen, S., et al., *Amyotrophic lateral sclerosis and spinocerebellar ataxia type 2 in a family with full CAG repeat expansions of ATXN2.* JAMA Neurol, 2013. **70**(10): p. 1302-4.
7. Teerlink, C., et al., *Significant evidence of linkage for a gene predisposing to colorectal cancer and multiple primary cancers on 22q11.* Clin Transl Gastroenterol, 2014. **5**: p. e50.
8. Tezenas du Montcel, S., et al., *Modulation of the age at onset in spinocerebellar ataxia by CAG tracts in various genes.* Brain, 2014. **137**(Pt 9): p. 2444-55.
9. Zinkhan, E.K., et al., *Maternal tobacco smoke increased visceral adiposity and serum corticosterone levels in adult male rat offspring.* Pediatr Res, 2014. **76**(1): p. 17-23.

Machine Shop

Overview

The Machine Shop Facility is equipped with a full complement of lathes, drills, mills, welders, grinders, and CNC systems, staffed by experienced machinists capable of turning an idea into reality. The machinists 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 the devices and parts out of carbon-steel, stainless steel, brass, copper, plastics, and other materials depending upon the requirements of design specifications.

Services

- Device Design/Engineering
- Milling
- Turning
- Drilling
- Grinding
- Soldering
- Welding of steel, aluminum, and other types of fabrication
- Sawing
- Repair and Maintenance

Equipment

- CNC Mills
- Traditional Mills
- Lathes
- Grinders
- Welders
- Wood Working Equipment
- Planers
- Band & Table Saws
- Sharpening Equipment
- Polishing Equipment

Personnel

- Kent Bachus, Ph.D., Director
- Ed Kinder, Manager
- Kim Slusser, Machinist
- Barry Evans, Machinist

2014 Annual Update.

New Equipment

- The Machine Shop Facility did not obtain any additional equipment in FY14

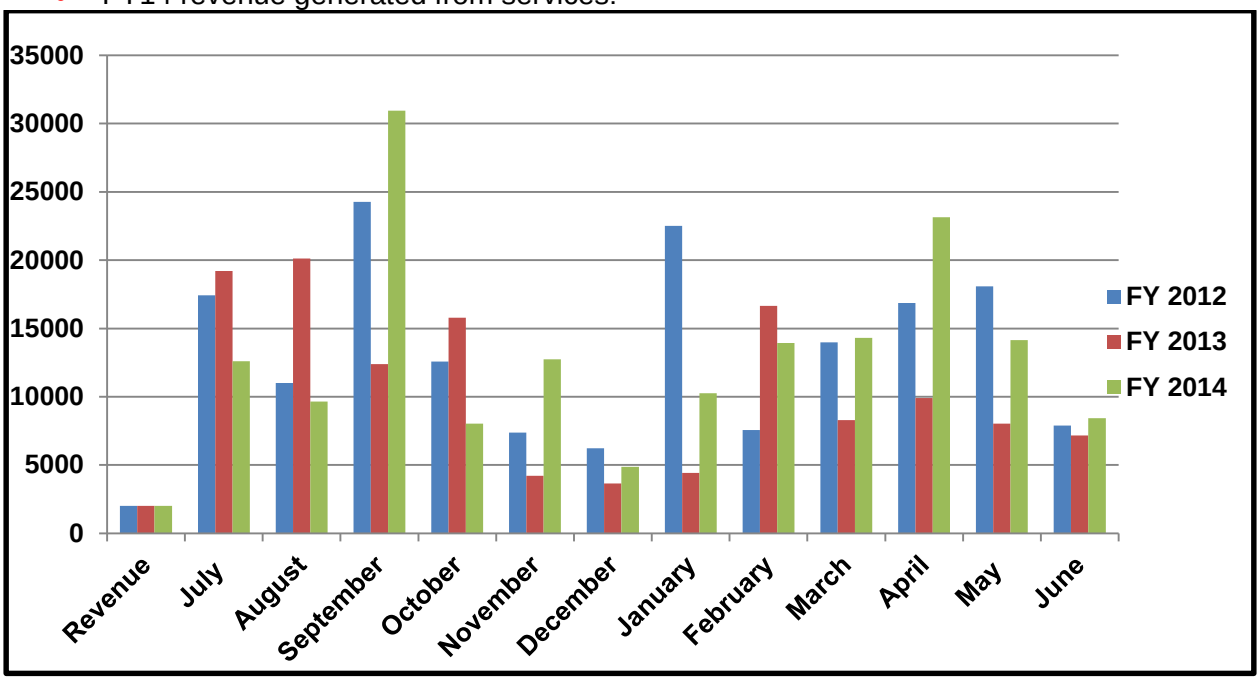
New Services

- The Machine Shop Facility continues to supply improved plastic fabrication

Revenue/Expenses

- VP of Research Support: $45,000
- FY14 revenue: $163,126
- FY14 expenses: $232,107

- FY14 revenue generated from services:



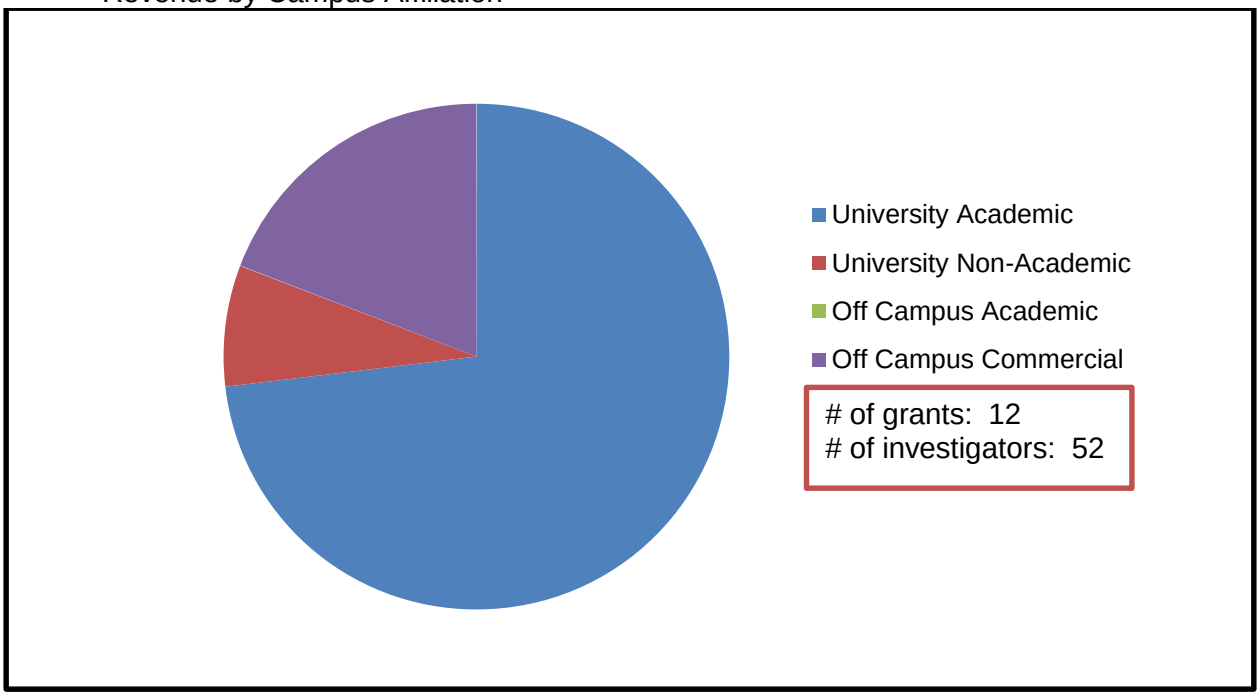
Advisory Board Committee

- Perry Renshaw, Professor, Psychiatry
- Stephen Andrues, Materials Management Facilitator, Facilities Engineering
- Steve White, Professor, ADD Program

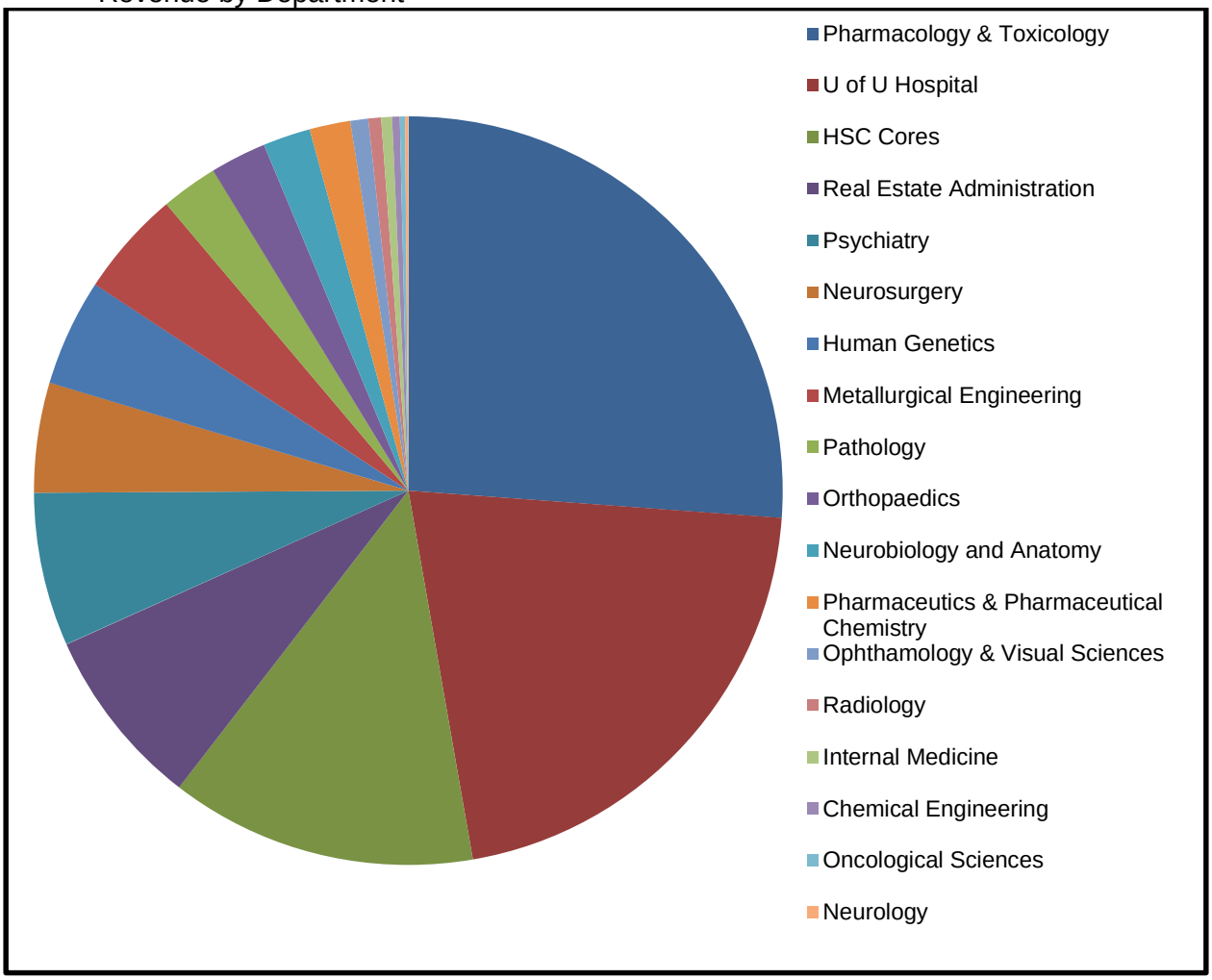
FY14 Scientific Impact

Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

1	White, Steve	University ADD Program
2	Andrues, Steve	University Hospital Surgical Services
3	Myriad Genetics	Off Campus
4	Primary Children's Medical Center	Off Campus
5	Meisner, Steve	University Radiation Oncology
6	Bates, Jonathon	University Real Estate Administration
7	Renshaw, Perry	University Brain Institute
8	Vutara Inc.	Off Campus
9	Clausing, Alishia	University Hospital Operating Room
10	Rodesch, Chris	University Cell Imaging

Publications

- There were no known publications acknowledging this facility in FY14

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

- LTQ-FT
- UltrafleXtreme
- LCQ-Deca
- Voyager DE-STR
- Quattro-II
- Q-ToF-2

HPLC Systems

- Two Eksigent 1D nanoLC systems
- One Eksigent 2D-Ultra system
- Two HP1100 systems
- One Shimadzu 10AD system
- One Leica CM1950 cryostat system

Personnel

- Chad Nelson, Ph.D., Director
- Krishna Parsawar, Ph.D., Assistant Director

2014 Annual Update

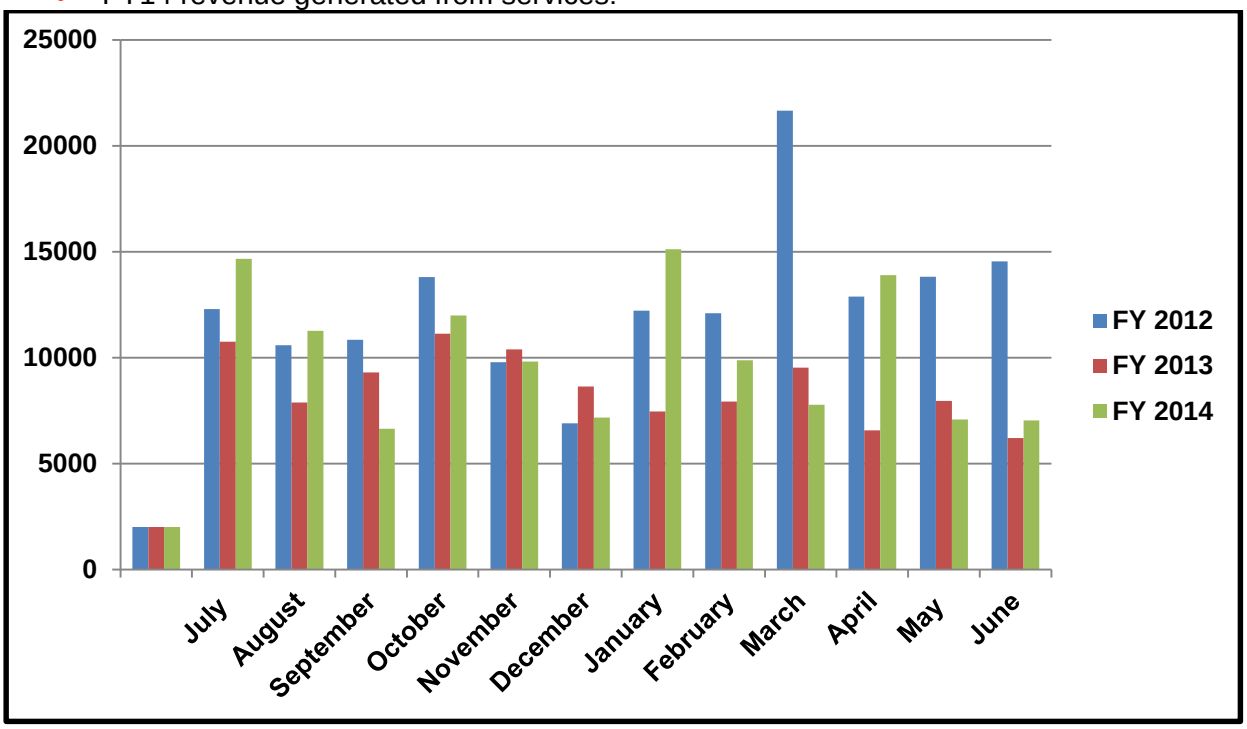
New Equipment

- In May 2014, the Mass Spectrometry & Proteomics Facility received an Internal Equipment Grant award to purchase proteomics software (i.e. Proteome Discoverer (Thermo) and PEAKS Studio 7 (Bioinformatics Solutions, Inc))

Revenue/Expenses

- VP of Research Support: $167,000
- FY14 revenue: $122,408
- FY14 expenses: $ 259,739

- FY14 revenue generated from services:



Advisory Board Committee

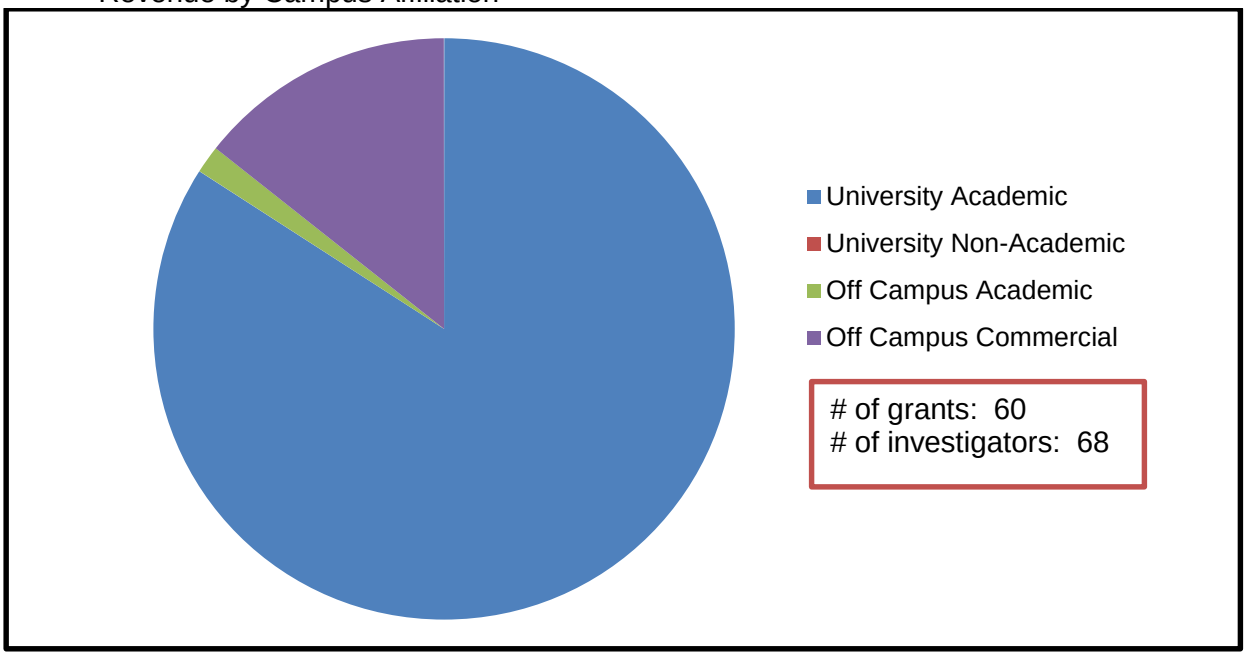
Last meeting date: August 2014

- Darrell Davis, Professor, College of Pharmacy
- Guy Zimmerman, Professor, Associate Chair, Internal Medicine
- Jared Rutter, Professor, HCI

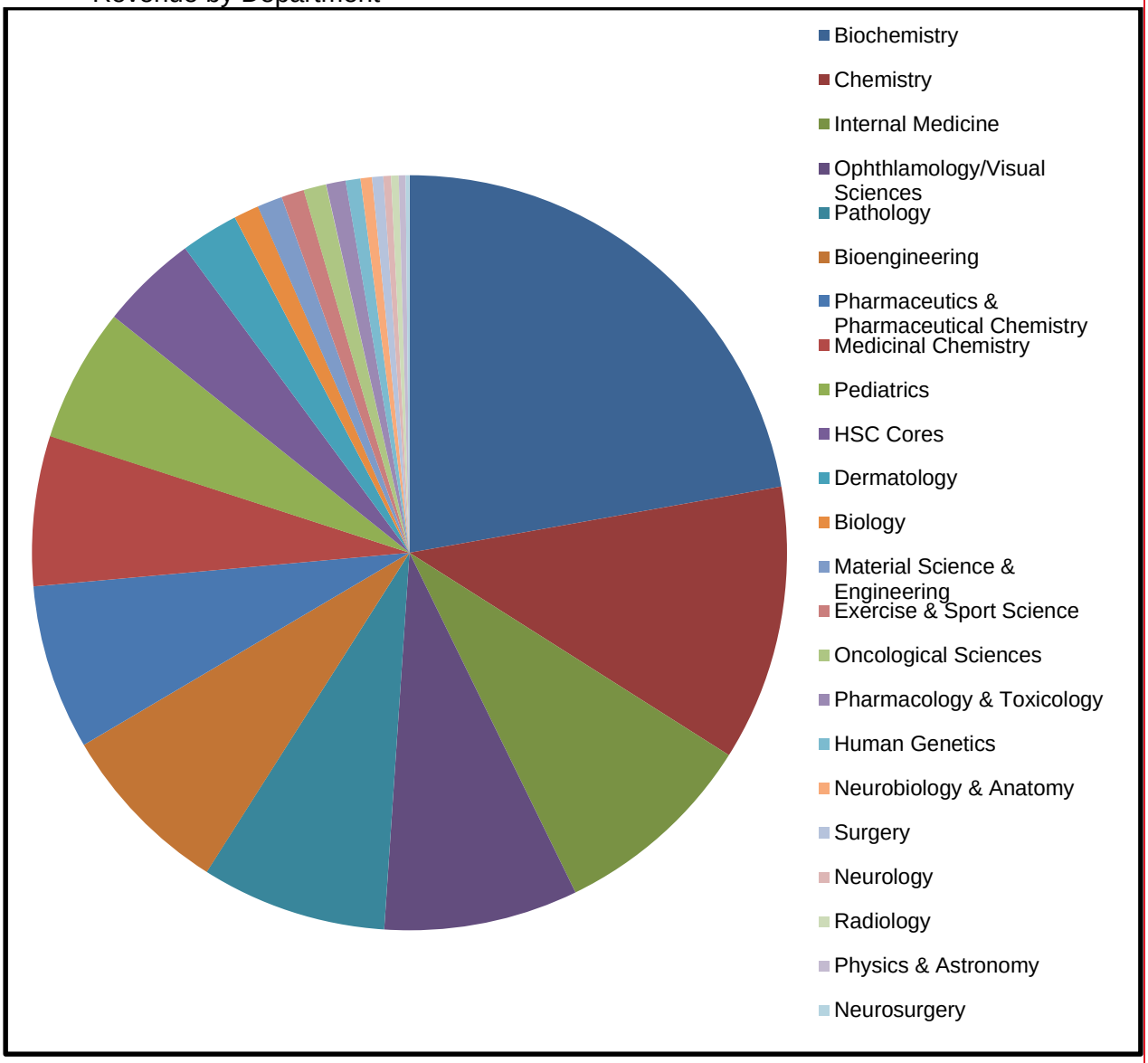
FY14 Scientific Impact

Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

1	Sundquist, Wesley	NIH
2	Singh, Ila	NIH
3	Sharma, Sunil	Department
4	Hageman, Gregory	Department
5	Minteer, Shelley	Department
6	Hanson, Mike	Department
7	Kopecek, Jindrich	NIH, Department
8	MS2 Array LLC	Off Campus
9	Life Technologies	Off Campus
10	Texas Heart Institute	Off Campus

Publications

- There were no known publications acknowledging this facility in FY14

Metabolic Phenotyping

Overview

The Metabolic Phenotyping Facility offers several services to help investigators evaluate metabolic phenotypes in multiple model organisms. Services include mitochondrial bioenergetics (respirometry for tissue and isolated mitochondria, Seahorse XF24 for cells, isolated mitochondria and tissue slices), determination of whole animal energy expenditure using the Columbus Instruments Oxymax Lab Animal Monitoring System, determination of body composition by NMR, determination of circulating metabolite and hormone concentrations using the multiplexing technology (MAGPIX and Luminex 200), Body temperature measurements using telemetry (E-Mitter). The facility also offers services on more complex projects that require detailed in vivo metabolic phenotyping such as glucose and insulin tolerance tests and glucose clamps. In addition, the facility offers protocol consultation and data analysis as needed.

Services

- Mitochondrial Bioenergetics
- Metabolic chambers
- NMR
- Body temperature
- Biomarker quantification with the Luminex MAGPIX and Luminex 200
- Multiplex assays
- Glucose and insulin tolerance tests
- Euglycemic-hyperinsulinemic clamps

Equipment

- Seahorse Flux (XF24) Analyzer
- Six Columbus Instruments metabolic chambers
- NMR
- E-Mitter
- Luminex MAGPIX & Luminex 200 System

Personnel

- Sihem Boudina, Ph.D., Interim Director
- Shaobo Pei, Manager
- Robert Cooksey, Specialist
- Deborah Jones, Specialist

2014 Annual Update

Equipment

- In June 2013, the Metabolic Phenotyping Facility received, via transfer, the Luminex 200 Multiplexing System that can handle up to 100 analytes/well

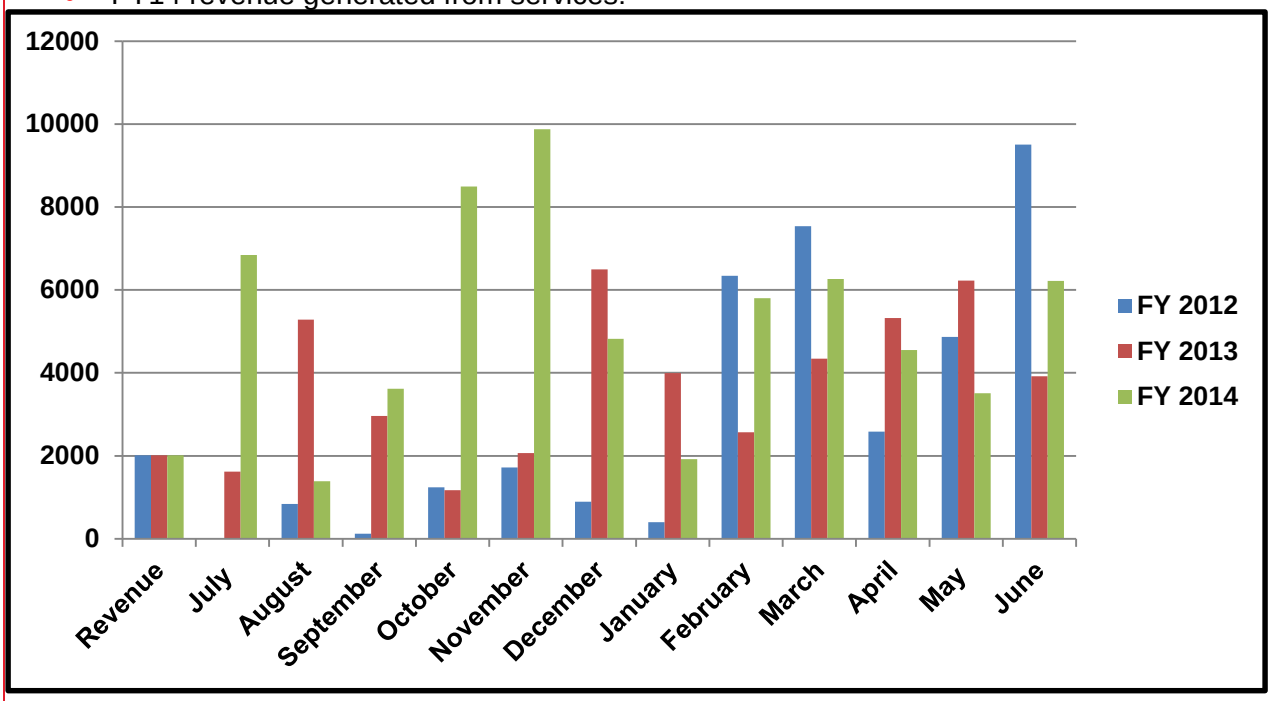
New Services

- The Metabolic Phenotyping Facility can now offer remote body temperature and movement measurement in small rodents
- Gene expression analysis using multiplex technology

Revenue/Expenses

- VP of Research Support: $71,500
- FY14 revenue: $63,312
- FY14 expenses: $101,502

- FY14 revenue generated from services:

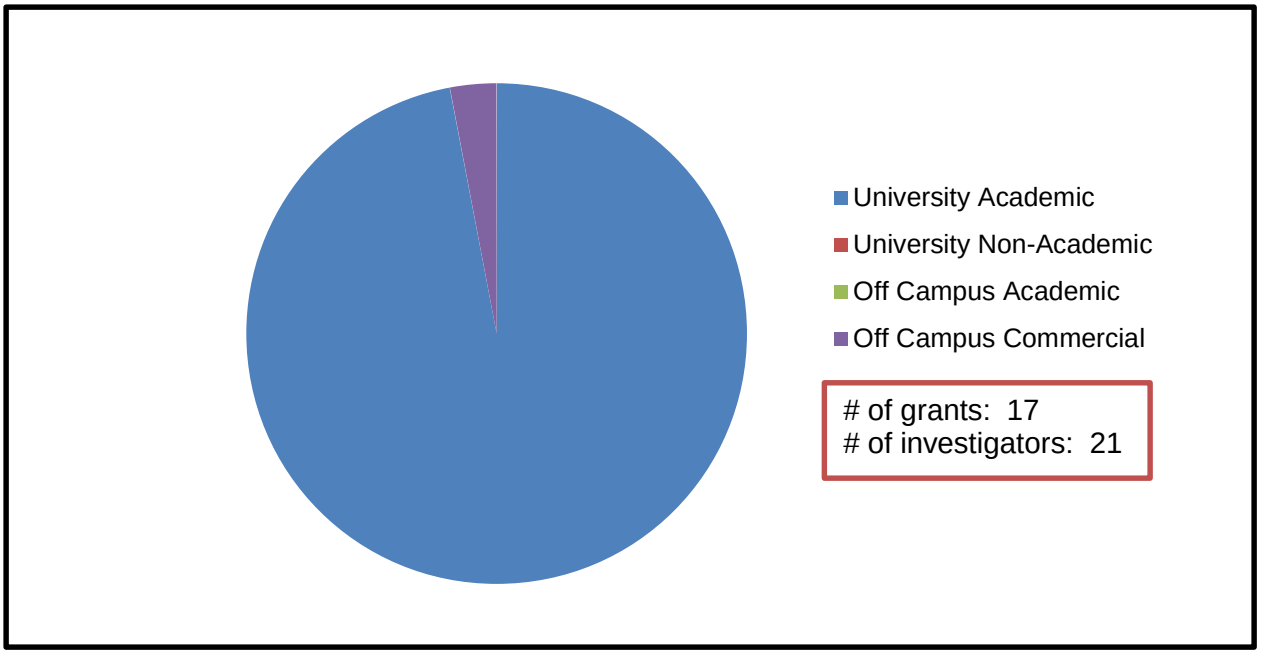


Advisory Board Committee
Last meeting date: August 20, 2013

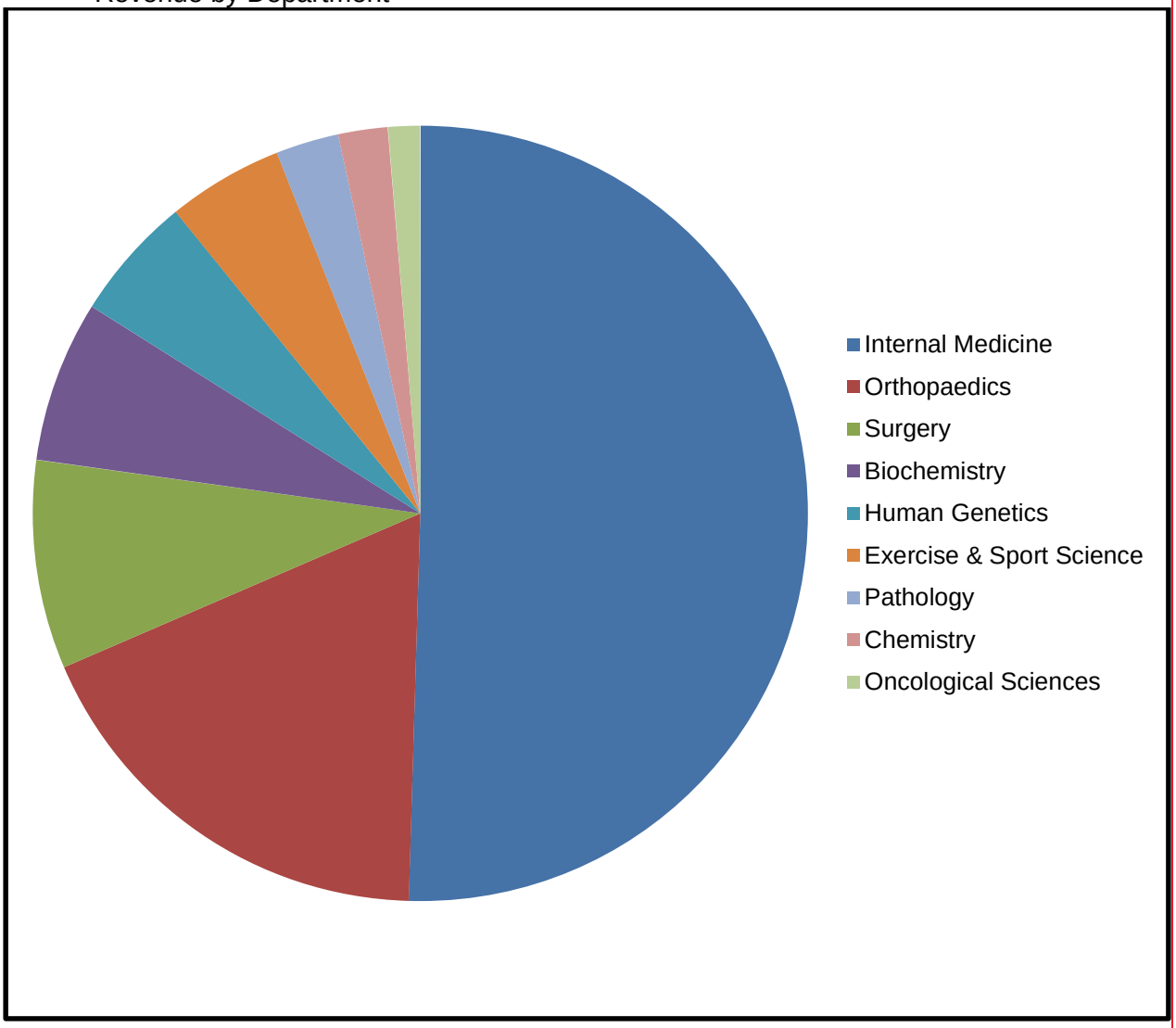
- Don McClain, Professor, Endocrinology, Metabolism & Diabetes
- Jared Rutter, Professor, Biochemistry
- Carl Thummel, Professor, Human Genetics

FY14 Scientific Impact
Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

1	Higgins, Thomas	AO North America
2	Boudina, Sihem	NIH
3	Li, Dean	NIH, Juvenile Diabetes Research Foundation
4	Weyrich, Andy	NIH, NHLB
5	Rutter, Jared	NIH
6	Symons, John	American Diabetes Association
7	Kardon, Gabrielle	NIH
8	McClain, Don	NIH
9	Vettore Bio	Off Campus
10	Jones, Kevin	NIH

Publications

1. Bricker, D.K., et al., *A mitochondrial pyruvate carrier required for pyruvate uptake in yeast, Drosophila, and humans.* Science, 2012. **337**(6090): p. 96-100.
2. Chen, Y.C., et al., *Msp1/ATAD1 maintains mitochondrial function by facilitating the degradation of mislocalized tail-anchored proteins.* EMBO J, 2014. **33**(14): p. 1548-64.
3. Lee, S.H., et al., *Manganese supplementation protects against diet-induced diabetes in wild type mice by enhancing insulin secretion.* Endocrinology, 2013. **154**(3): p. 1029-38.
4. Silva, F.J., et al., *Metabolically active human brown adipose tissue derived stem cells.* Stem Cells, 2014. **32**(2): p. 572-81.

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

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:

- Waters GCT Premier gas chromatograph-mass spectrometer (GC-MS)
- Agilent 5973 gas chromatograph-quadrupole mass spectrometer (GC-MS)
- Agilent 6520 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)
- Varian 500 MHz NMR with data processed by the Chenomx software suite

Personnel

- James Cox, Ph.D., Director
- Ren Miao, Ph.D., Laboratory Technician
- Alan Mascheck, Ph.D., Research Associate

2014 Annual Update

New Equipment

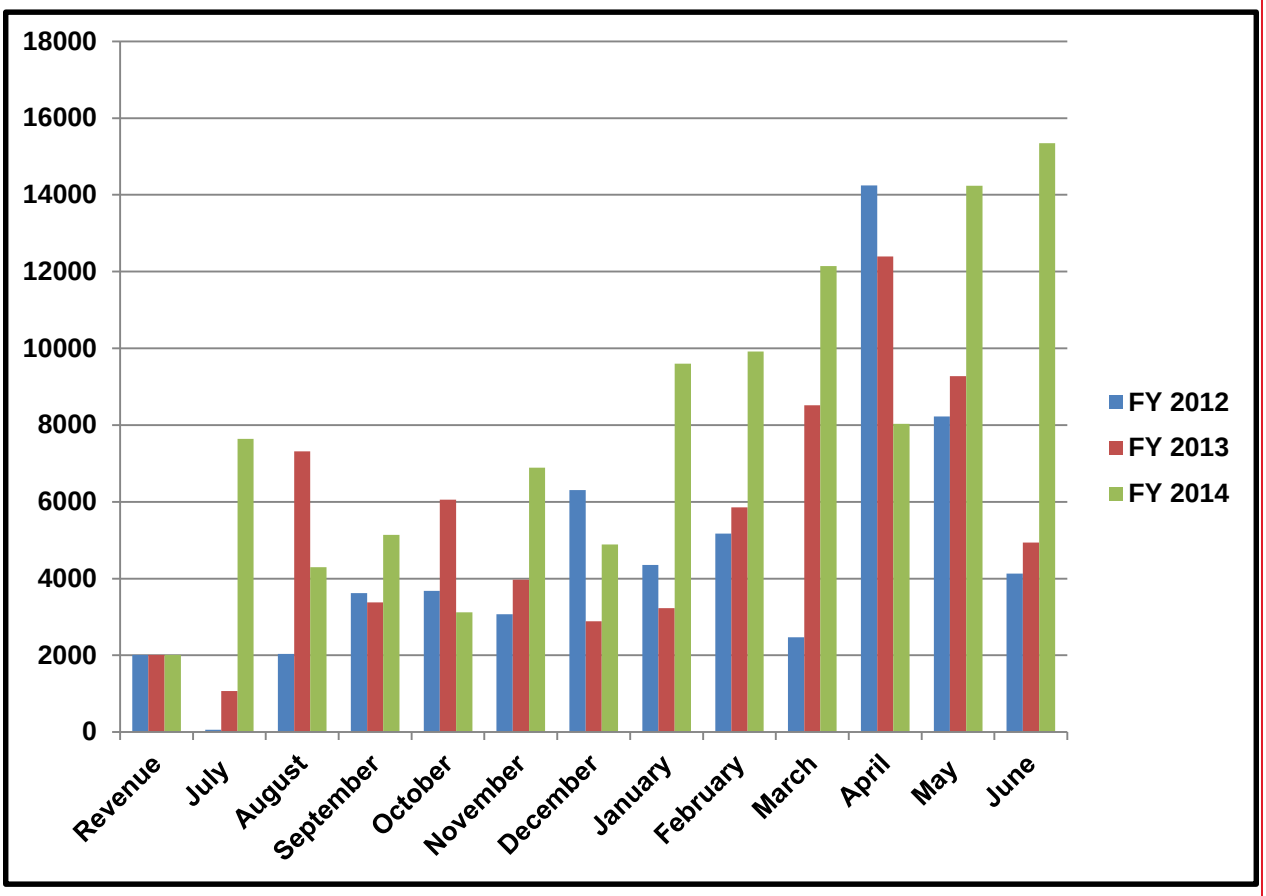
- Agilent 6550 QTOF, which is a highly sensitive and state of the art mass spectrometer for polar metabolite analysis

New Services

- Full lipid profiling by LC-MS
- Stable isotope label flux analysis by GC-MS

Revenue/Expenses

- VP of Research Support : $265,363
- FY14 revenue: $101,272
- FY14 grant revenue: $38,587
- FY14 expenses: $386,955
- FY14 revenue generated from services:



Advisory Board Committee

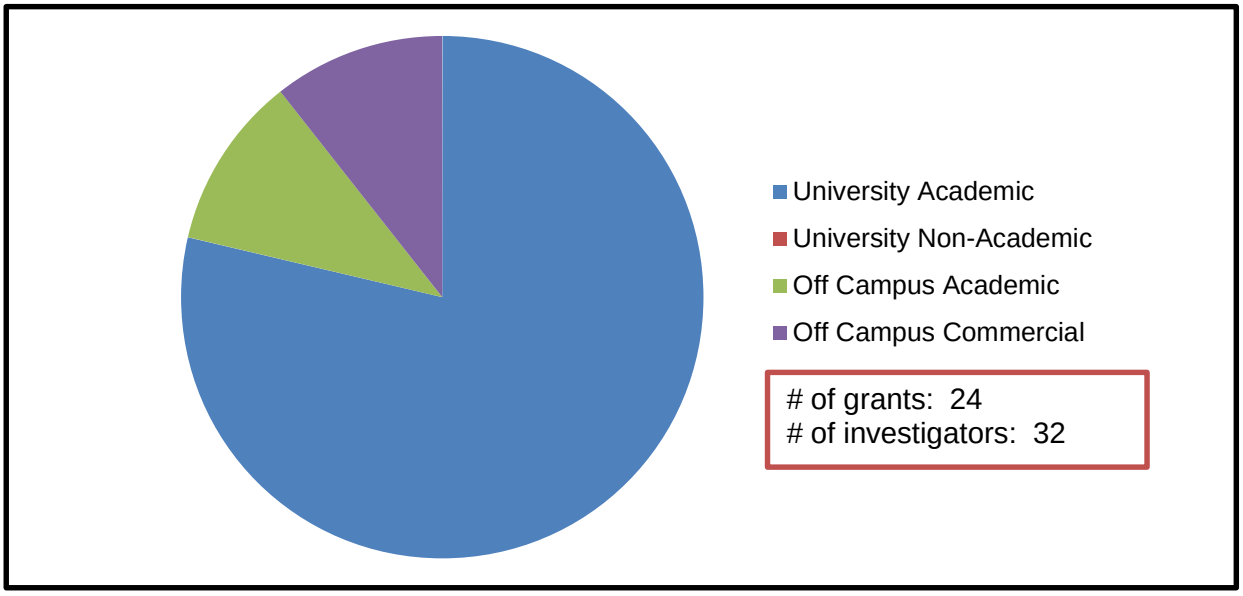
Last meeting date: February 20, 2013

- Dennis Winge, Professor, Hematology
- John Phillips, Research Associate Professor, Hematology
- Carl Thummel, Professor, Department of Human Genetics

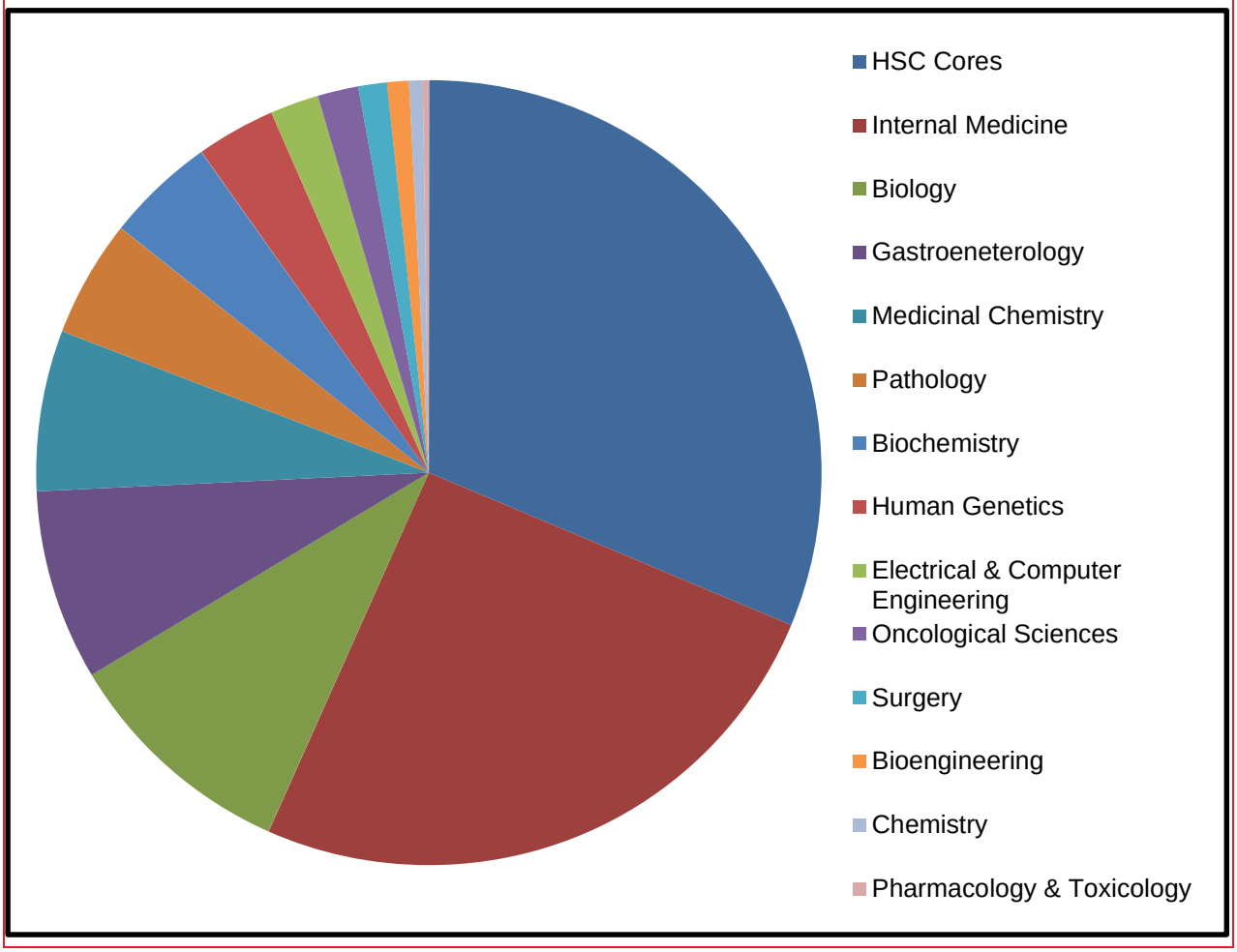
FY14 Scientific Impact

Research Support

- Revenue by Campus Affiliation



- Revenue by Department:



Top Users

1	Diabetes-Metabolomics Pilot Project	Department
2	University of Iowa	Off Campus
3	Wasatch Scientific Services	Off Campus
4	Sieburth, Leslie	NSF
5	Schmidt, Eric	NIH
6	McClain, Don	NIH
7	MD Anderson	Off Campus
8	Weyrich, Andy	NIH
9	University of Arizona	Off Campus
10	Utah State University	Off Campus

Publications

1. Bricker, D.K., et al., *A mitochondrial pyruvate carrier required for pyruvate uptake in yeast, Drosophila, and humans.* Science, 2012. **337**(6090): p. 96-100.
2. Deering-Rice, C.E., et al., *Electrophilic components of diesel exhaust particles (DEP) activate transient receptor potential ankyrin-1 (TRPA1): a probable mechanism of acute pulmonary toxicity for DEP.* Chem Res Toxicol, 2011. **24**(6): p. 950-9.
3. Donia, M.S., et al., *Complex microbiome underlying secondary and primary metabolism in the tunicate-Prochloron symbiosis.* Proc Natl Acad Sci U S A, 2011. **108**(51): p. E1423-32.
4. Fullmer, T.M., et al., *Insulin suppresses ischemic preconditioning-mediated cardioprotection through Akt-dependent mechanisms.* J Mol Cell Cardiol, 2013. **64**: p. 20-9.
5. Fung, C., et al., *Novel thromboxane A2 analog-induced IUGR mouse model.* J Dev Orig Health Dis, 2011. **2**(5): p. 291-301.
6. Gleason, J.E., et al., *Analysis of hypoxia and hypoxia-like states through metabolite profiling.* PLoS One, 2011. **6**(9): p. e24741.
7. Hintze, K.J., et al., *Broad scope method for creating humanized animal models for animal health and disease research through antibiotic treatment and human fecal transfer.* Gut Microbes, 2014. **5**(2): p. 183-91.
8. Huang, J., et al., *Iron regulates glucose homeostasis in liver and muscle via AMP-activated protein kinase in mice.* FASEB J, 2013. **27**(7): p. 2845-54.
9. Kaadige, M.R., et al., *Glutamine-dependent anapleurosis dictates glucose uptake and cell growth by regulating MondoA transcriptional activity.* Proc Natl Acad Sci U S A, 2009. **106**(35): p. 14878-83.
10. Kannan, S., et al., *Nrf2 deficiency prevents reductive stress-induced hypertrophic cardiomyopathy.* Cardiovasc Res, 2013. **100**(1): p. 63-73.
11. Lin, Z., et al., *Burkholdines from Burkholderia ambifaria: antifungal agents and possible virulence factors.* J Nat Prod, 2012. **75**(9): p. 1518-23.
12. Lin, Z., et al., *A bacterial source for mollusk pyrone polyketides.* Chem Biol, 2013. **20**(1): p. 73-81.
13. McClain, D.A., et al., *Decreased serum glucose and glycosylated hemoglobin levels in patients with Chuvash polycythemia: a role for HIF in glucose metabolism.* J Mol Med (Berl), 2013. **91**(1): p. 59-67.
14. Palanker, L., et al., *Drosophila HNF4 regulates lipid mobilization and beta-oxidation.* Cell Metab, 2009. **9**(3): p. 228-39.
15. Price, C.T., et al., *Host proteasomal degradation generates amino acids essential for intracellular bacterial growth.* Science, 2011. **334**(6062): p. 1553-7.

16. Ridges, S., et al., *Zebrafish screen identifies novel compound with selective toxicity against leukemia.* Blood, 2012. **119**(24): p. 5621-31.
17. Shakoury-Elizeh, M., et al., *Metabolic response to iron deficiency in Saccharomyces cerevisiae.* J Biol Chem, 2010. **285**(19): p. 14823-33.
18. Shibayama, J., et al., *Metabolic determinants of electrical failure in ex-vivo canine model of cardiac arrest: evidence for the protective role of inorganic pyrophosphate.* PLoS One, 2013. **8**(3): p. e57821.
19. Stoltzman, C.A., et al., *MondoA senses non-glucose sugars: regulation of thioredoxin-interacting protein (TXNIP) and the hexose transport curb.* J Biol Chem, 2011. **286**(44): p. 38027-34.
20. Tennessen, J.M., et al., *The Drosophila estrogen-related receptor directs a metabolic switch that supports developmental growth.* Cell Metab, 2011. **13**(2): p. 139-48.
21. Tennessen, J.M., et al., *Methods for studying metabolism in Drosophila.* Methods, 2014. **68**(1): p. 105-15.
22. Tennessen, J.M., et al., *Coordinated metabolic transitions during Drosophila embryogenesis and the onset of aerobic glycolysis.* G3 (Bethesda), 2014. **4**(5): p. 839-50.
23. Van Vranken, J.G., et al., *SDHAF4 Promotes Mitochondrial Succinate Dehydrogenase Activity and Prevents Neurodegeneration.* Cell Metab, 2014. **20**(2): p. 241-52.
24. Wang, L., G. Lam, and C.S. Thummel, *Med24 and Mdh2 are required for Drosophila larval salivary gland cell death.* Dev Dyn, 2010. **239**(3): p. 954-64.
25. Wright, J.J., et al., *Mechanisms for increased myocardial fatty acid utilization following short-term high-fat feeding.* Cardiovasc Res, 2009. **82**(2): p. 351-60.

Mutation Generation & Detection Facility

Overview

The Mutation Generation & Detection (MGD) Facility specializes in providing customized Engineered DNA Nucleases in either the TALEN or Crispr systems. These DNA Nucleases are cutting edge technology used to perform targeted genomic engineering that modifies a specific genomic region of interest in multiple model systems, including Zebrafish, Drosophila, C. elegans, Mus Musculus, and mammalian cell lines. The facility also provides customized TALE or Crispr activator or repressor proteins for activation or repression of gene expression. The facility also offers services to identify induced genomic modification using High Resolution Melt Analysis (HRMA). Our support includes hardware, reagents, and expert advice for optimizing and performing HRMA. Lastly, the facility has initiated a partnership with the Mouse Transgenic Facility to provide services to create Knockout Mouse models using either TALEN or Crispr DNA Nucleases.

Services

TALEN Services

- TALEN plasmid pair design and construction
- 2X TALEN plasmid pair design and construction (same gene)
- 0.5X TALEN plasmid design and construction
- Remake Failed TALEN to different exon in same target gene
- Different Destination Vector

Crispr Services

- 1X CRISPR design and construction
- 2X CRISPR design and construction
- Design and Delivery of donor molecules

High Resolution Melt Analysis

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

Equipment

- BioFire LightScanner
- 3X Eppendorf Mastercycler ProS
- Eppendorf Centrifuge 5430
- QWC Mercury Elite-AI Pro External Hard drive
- Illumina Eco

Personnel

- Timothy Dahlem, Ph.D., Director

2014 Annual Update

New equipment:

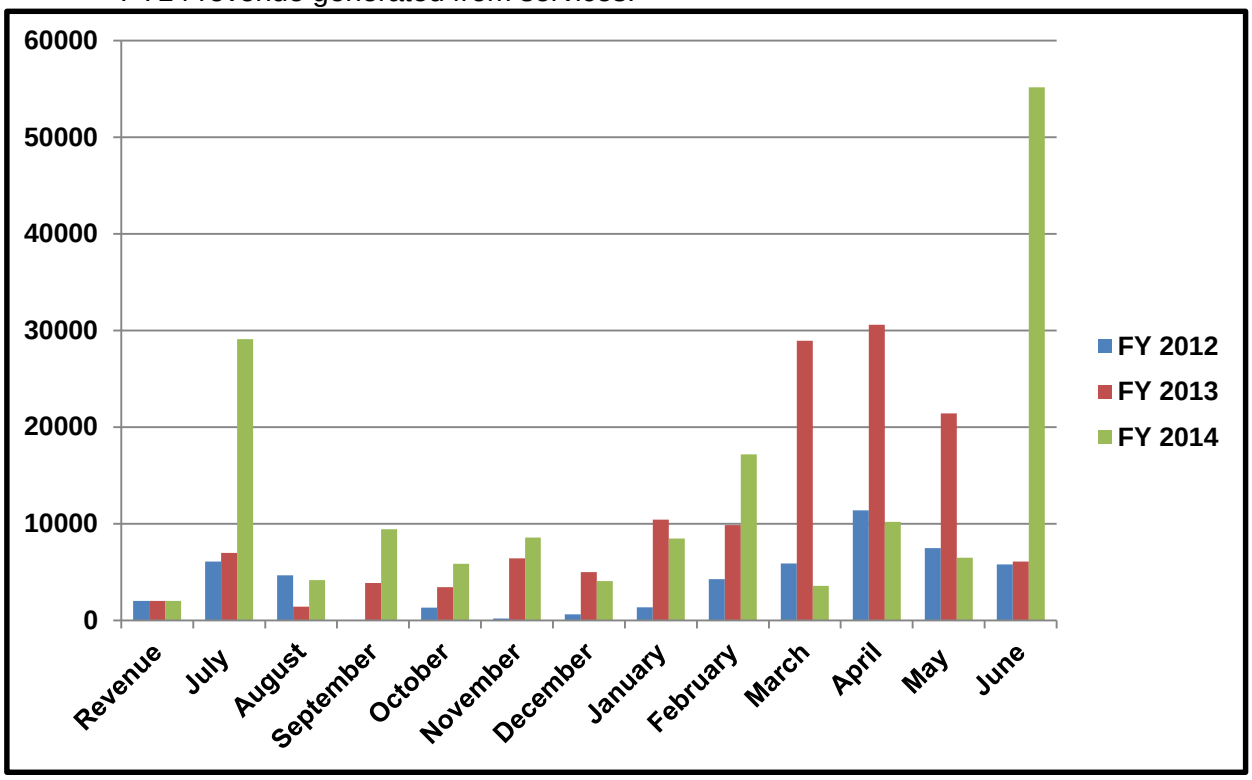
- 2X Eppendorf Centrifuge 5424
- Innova42 Bacterial Shaker
- Innova43 Bacterial Shaker
- 27” iMac Desktop

New Services:

- Fly injection services will no longer be offered
- All CRISPR services were new for FY14
- Custom Mutation Detection Services were new for FY14
- Started partnership with Mouse Transgenic Facility to provide injection services

Revenue/Expenses

- VP of Research Support: $0
- FY14 revenue: $162,300
- FY expenses: $134,324
- FY14 revenue generated from services:



Advisory Board Committee

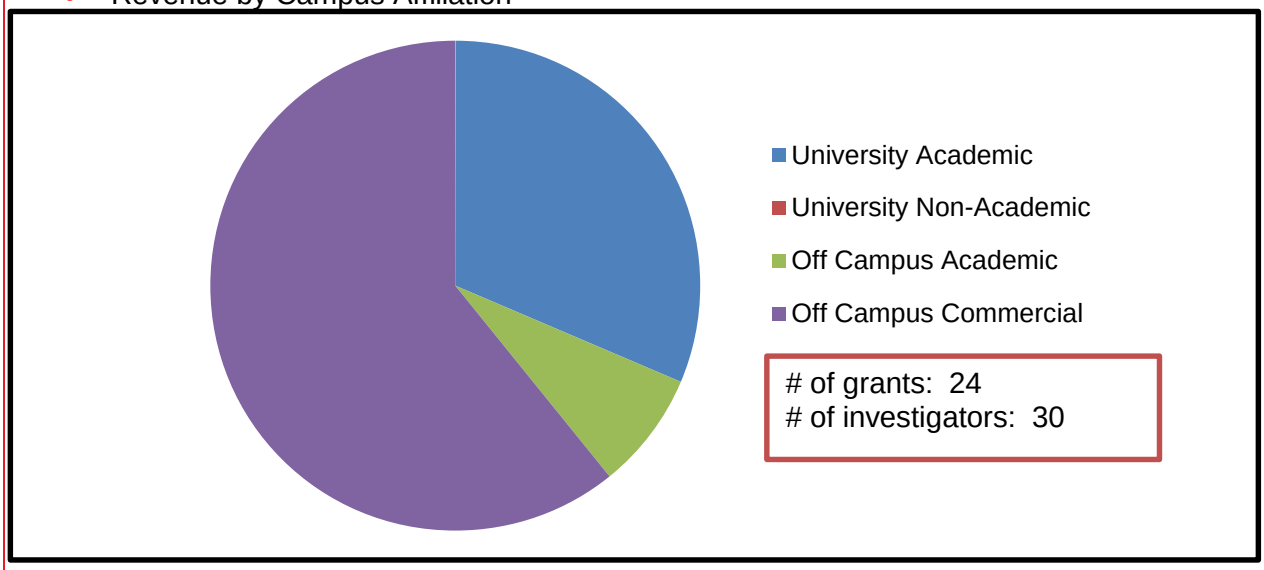
Last meeting date: July 23, 2014

- 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

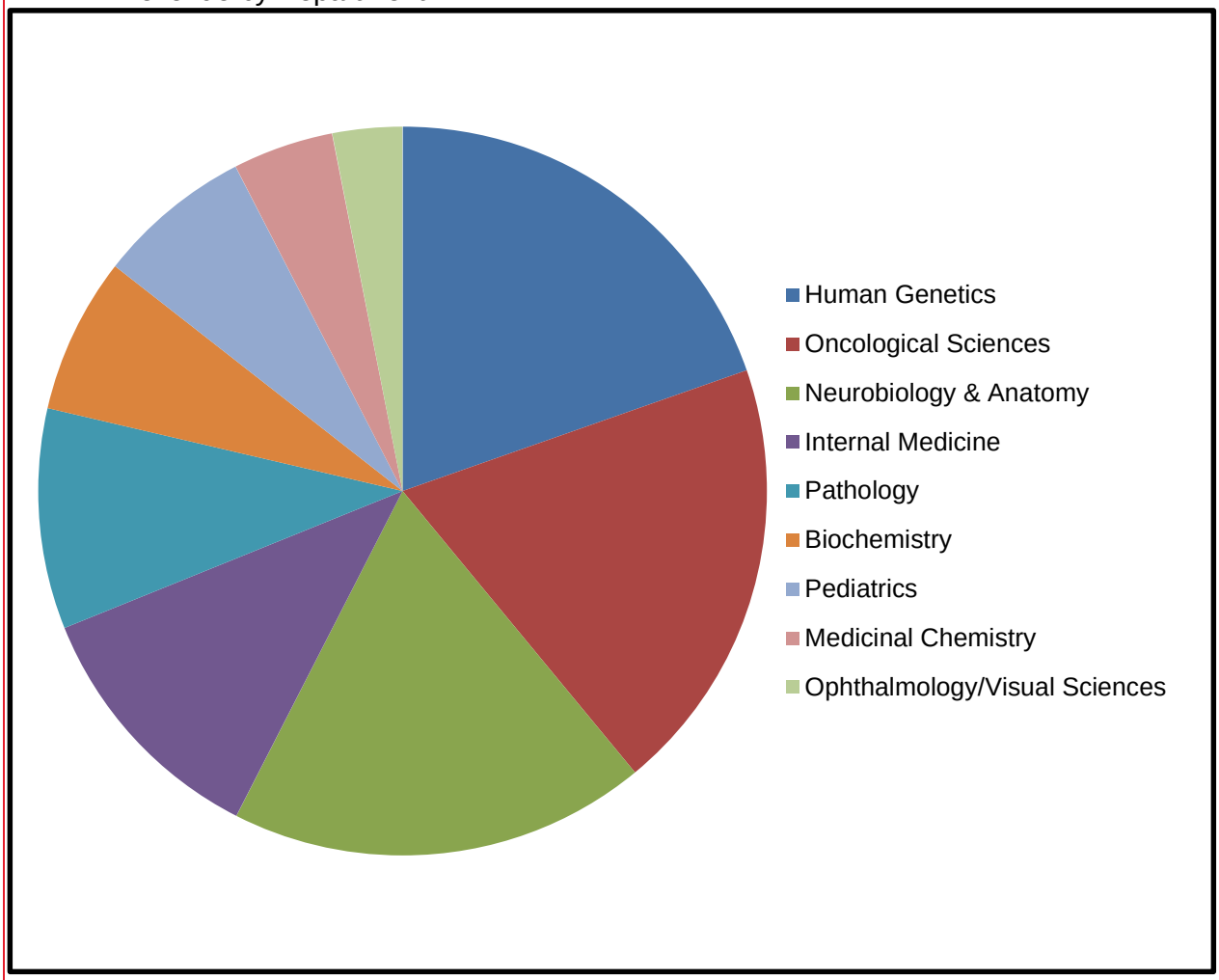
FY14 Scientific Impact

Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

1	Science Exchange Inc.	Off Campus
2	Helmholtz Zentrum Munchen	Off Campus
3	Cairns, Bradley	NIH
4	Yost, Joseph	NIH
5	Weizmann Institute of Science	Off Campus
6	University of Iowa	Off Campus
7	Grunwald, David	NIH
8	O'Connell, Ryan	NIH
9	Karolinska Institute	Off Campus
10	University of Pennsylvania	Off Campus

Collaboration and Support of Other HSC and University Facilities

DNA Sequencing Facility: The MGD Facility spent $6,147 in securing sequencing in FY14.

DNA Peptide Facility: The MGD Facility spent $7,819 in securing DNA reagents in FY14.

Mouse Transgenic Facility: The MGD Facility has directly brought in 5 different projects to the Mouse Transgenic Facility totaling $18,000 in chargebacks. These projects were initiated in the MGD Facility.

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 facility achieves this aim in official ways such as seminars given directly to different departments on campus. However, the central avenue for education by the facility are informal one-on-one, in person communication with researchers. In FY14, the facility spent more than 100 hours teaching University of Utah researchers about Engineered DNA nuclease technology and mutation detection by HRMA.

Known grant applications awarded, submitted, or in preparation mentioning MGD Facility as a crucial resource

Granted:

Grant type: DP2 NIH New Innovator Award
PD/PI: Ryan O'Connell
Grant Title: Utilizing TALEN technology to regulate human microRNAs
Funding Source: NIH GM
Total Project Period: 09/2013-07/2018

Submitted or in Preparation:

1. RO1-A1
   PD/PI: Diane Ward
   Grant Title: Receptor Mediated Endocytosis
   Funding Source: NIHLB
   Grant Award Number: HL26922
   Total Project Period: 06/01/15-05/01/20
   Annual Amount: $250,000 (Total: $1,250,000 direct)
2. RO1
   PD/PI: Amnon Schlegel
   Grant Title: Intestinal Lxr Activation In Delaying Atherosclerosis
   Funding Source: NIH
   Grant Award Number: 1RO1HL126707-01

Total Project Period: 04/05/15-03/31/20
Annual Amount: $250,000 (Total: $1,250,000 direct)

3. K22
   PD/PI: Kenneth K.C. Bramwell
   Funding Source: NIAID
   Grant Title: Impact of Human GUSB Alleles on Experimental Lyme Disease
   Total Project Period: 07/01/15-06/30/17
   Annual Amount: $125,000 (Total: $250,000 direct)
4. NSF 13-510
   PD/PI: Gillian Stanfield
   Funding Source: NSF
   Grant Title: Cellular and Molecular Mechanisms of Sperm Competition in the Nematode C. elegans
   Total Project Period: 07/01/14-06/30/17
   Annual Amount: $123,708 direct $57,374 indirect (Total: $543,245)
5. R21
   PD/PI: John Weis
   Funding Source: NIH (NIAID)
   Grant Title: Role of Ifitm and vATPase function in the innate immune response
   Total Project Period: 04/01/2015-03/31/2017
   Grant Award Number: 1R21AI112719-01A1
   Annual Amount: $150,000 direct (Total: $300,000 direct)
6. RO1
   PD/PI: Michael T. Howard
   Funding Source: NIH/NIGMS
   Grant Title: The effects of dietary selenium on translational control of protein synthesis
   Total Project Period: 04/01/2015 -3/31/2020
   Grant Award Number: Status Submitted- awaiting review
   Annual Amount: $250,000 direct (Total $1,250,000)
7. NSF standard application
   PD/PI: Ellen J. Pritham
   Funding Agency: National Science Foundation
   Grant title: Transposable elements and regulatory evolution
   Total Project Period: 7/1/14-6/30/17
8. RO1
   PD/PI: Kristen Kwan
   Funding Source: NIH/NEI
   Grant Title: Hedgehog Signaling and Cilia in Choroid Fissure Morphogenesis and Coloboma
   Total Project Period: 04/01/15-03/31/20
   Grant Award Number: 1R01EY025378-01
   Annual Amount: $250,000 direct (Total $1,250,000)

Publications

1. Beumer, K.J., et al., *Comparing zinc finger nucleases and transcription activator-like effector nucleases for gene targeting in Drosophila.* G3 (Bethesda), 2013. **3**(10): p. 1717-25.
2. Cruz-Garcia, L. and A. Schlegel, *Lxr-driven enterocyte lipid droplet formation delays transport of ingested lipids.* J Lipid Res, 2014. **55**(9): p. 1944-58.
3. Dahlem, T.J., et al., *Simple methods for generating and detecting locus-specific mutations induced with TALENs in the zebrafish genome.* PLoS Genet, 2012. **8**(8): p. e1002861.
4. Hu, R., et al., *Targeting human microRNA genes using engineered Tal-effector nucleases (TALENs).* PLoS One, 2013. **8**(5): p. e63074.
5. Ota, S., et al., *Efficient identification of TALEN-mediated genome modifications using heteroduplex mobility assays.* Genes Cells, 2013. **18**(6): p. 450-8.
6. Van Vranken, J.G., et al., *SDHAF4 Promotes Mitochondrial Succinate Dehydrogenase Activity and Prevents Neurodegeneration.* Cell Metab, 2014. **20**(2): p. 241-52.
7. Xing, L., et al., *Rapid and efficient zebrafish genotyping using PCR with high-resolution melt analysis.* J Vis Exp, 2014(84): p. e51138.

Nuclear Magnetic Resonance Facility

Overview

The Nuclear Magnetic Resonance (NMR) Facility enables the structure determination of proteins, nucleic acids, and natural products and provides analytical NMR services for the Health Sciences community. Three NMR spectrometers (400, 500, and 600 MHz instruments) are available to researchers in Utah. Through a special arrangement with the Davis and Sundquist research groups, the facility also has access to 800 and 900 MHz instruments located in Colorado. NMR training or demonstration of NMR skills is required prior to scheduling and operating the spectrometers. The NMR Facility has several Linux workstations for offline data processing, analysis, and structure calculation. The staff has substantial expertise in NMR spectroscopy of proteins, nucleic acids, and natural products. The facility collaborates with research groups on and off campus.

Services

- NMR data collection and analysis with our without staff collaboration
- NMR training for individuals and groups as well as formal courses in NMR spectroscopy

Equipment

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

Personnel

- Jack Skalicky, Ph.D., Director
- Dennis Edwards, Technician
- Jay Olsen, Technician

2014 Annual Update

New Equipment

- The NMR Facility upgraded the 600 MHz cryogenic system in FY14
- The NMR Facility upgraded RH LINUX on the NMR computers

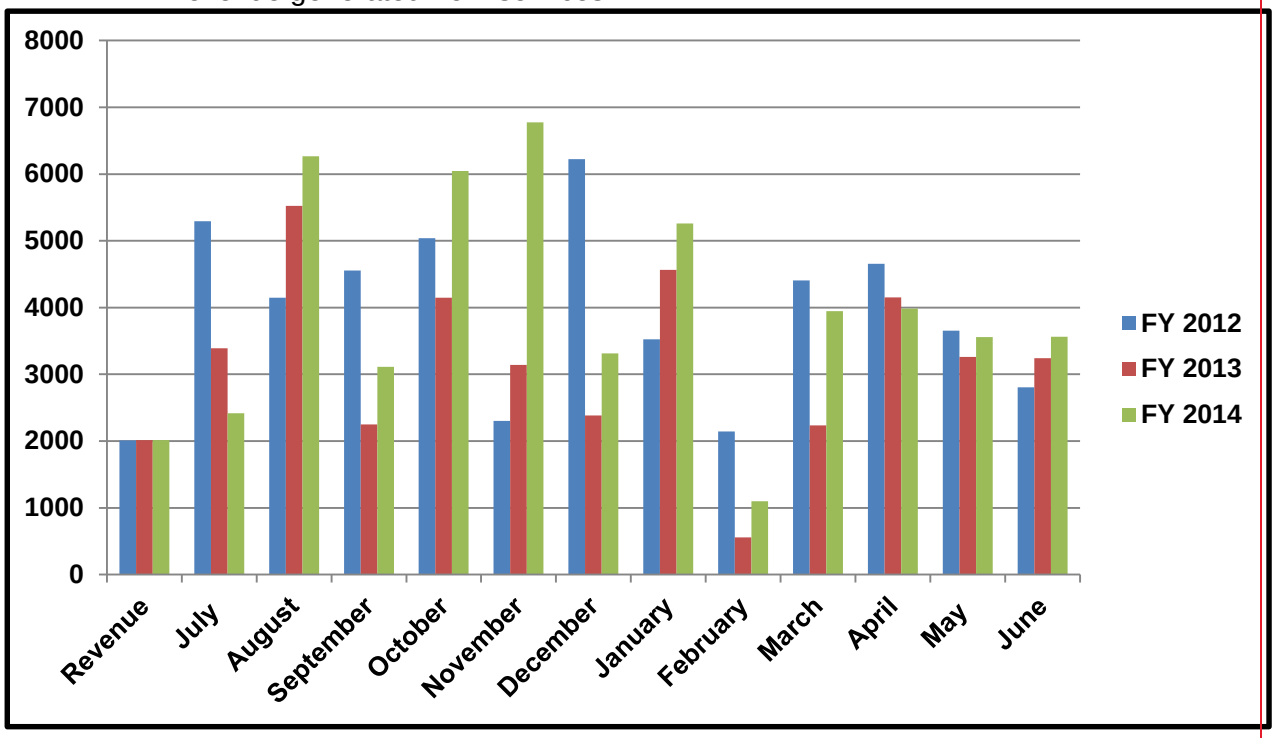
New Services

- The NMR Facility did not implement additional services in FY14

Revenues/Expenses

- VP of Research Support: $92,000
- FY14 revenue generated from services: $49,339
- FY14 expenses: $150,978

- FY14 revenue generated from services:



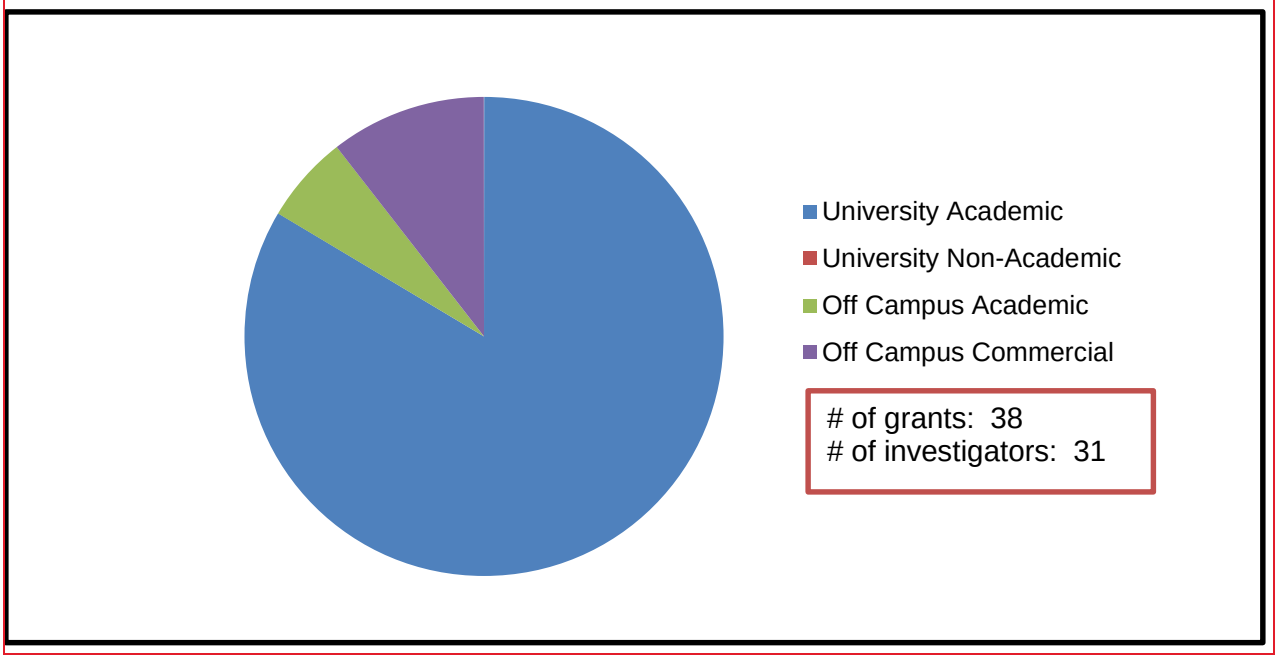
Advisory Board Committee

Last meeting date: April 2013

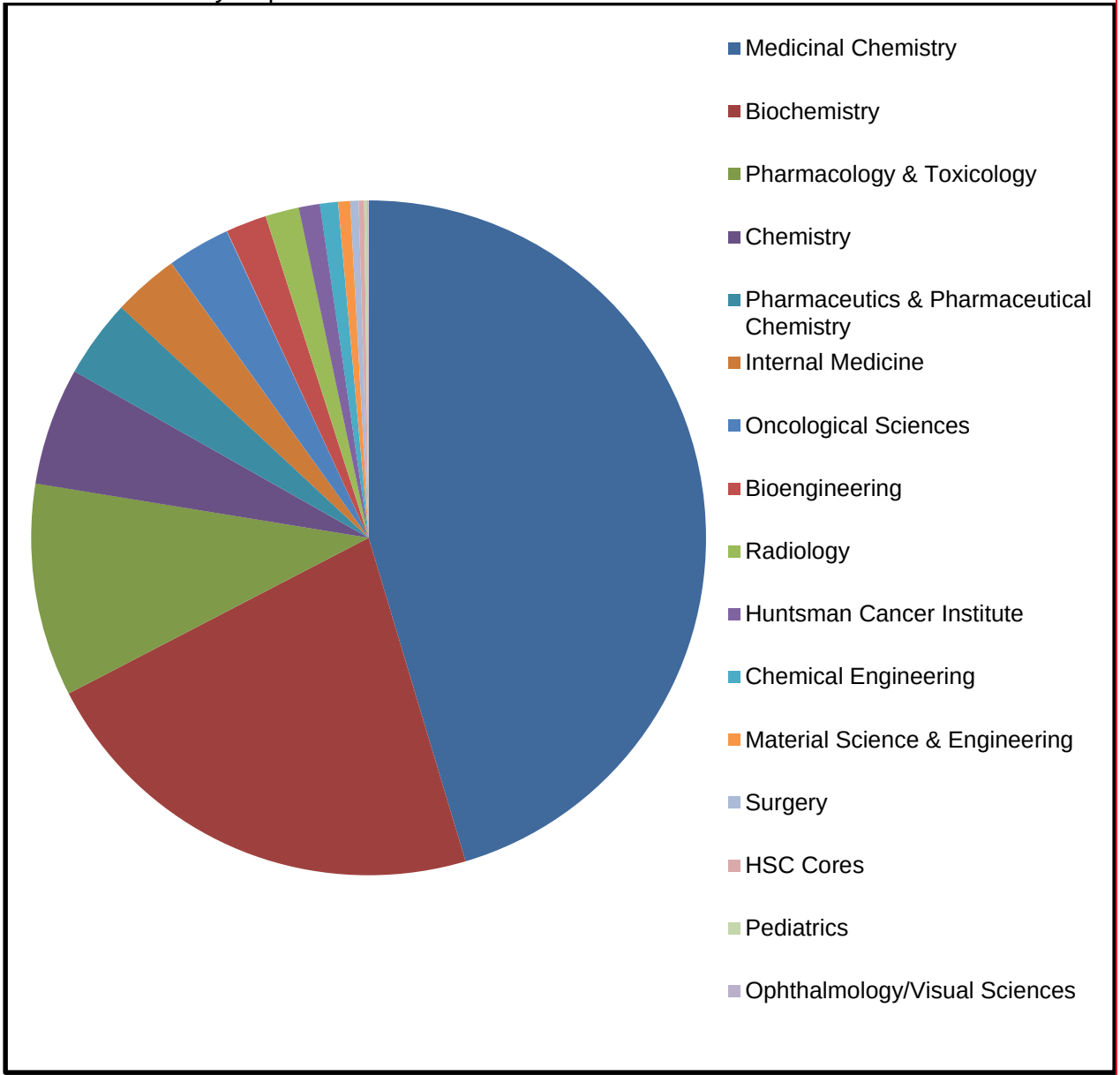
- Darrell Davis, Professor, College of Pharmacy
- Wesley Sundquist, Professor, Department of Biochemistry
- Eric Schmidt, Professor, College of Pharmacy
- Additional member

FY14 Scientific Impact

- Revenue by Campus Affiliation



- Revenue by Departments



Top Users

1	Sundquist, Wesley	NIH
2	Schmidt, Eric	NIH
3	Barrows, Louis	NIH
4	Ireland, Chris	NIH
5	Davis, Darrell	Department
6	Prestwich, Glenn	Department
7	Oregon Health & Science University	Off Campus
8	Poulter, C. Dale	NIH, CHA, University of Il At Urbana-Cha
9	VioGen Biosciences	Off Campus
10	Balagurunathan, Kuberan	Virginia Commonwealth University

Publications

1. Elia, R., et al., *Silk-hyaluronan-based composite hydrogels: a novel, securable vehicle for drug delivery.* J Biomater Appl, 2013. **27**(6): p. 749-62.
2. Gormley, A.J., et al., *Plasmonic photothermal therapy increases the tumor mass penetration of HPMA copolymers.* J Control Release, 2013. **166**(2): p. 130-8.
3. Henriksen, N.M., et al., *Structural and energetic analysis of 2-aminobenzimidazole inhibitors in complex with the hepatitis C virus IRES RNA using molecular dynamics simulations.* J Chem Inf Model, 2014. **54**(6): p. 1758-72.
4. Hu, J., et al., *pH-responsive and charge shielded cationic micelle of poly(L-histidine)-block-short branched PEI for acidic cancer treatment.* J Control Release, 2013. **172**(1): p. 69-76.
5. Hwang, H.S., H.C. Kang, and Y.H. Bae, *Bioreducible polymers as a determining factor for polyplex decomplexation rate and transfection.* Biomacromolecules, 2013. **14**(2): p. 548-56.
6. Jadulco, R.C., et al., *4-Quinolone alkaloids from Melochia odorata.* J Nat Prod, 2014. **77**(1): p. 183-7.
7. Jia, H.Z., et al., *A boronate-linked linear-hyperbranched polymeric nanovehicle for pH-dependent tumor-targeted drug delivery.* Biomaterials, 2014. **35**(19): p. 5240-9.
8. Jiang, G., et al., *Phosphorothioate analogs of sn-2 radyl lysophosphatidic acid (LPA): metabolically stabilized LPA receptor agonists.* Bioorg Med Chem Lett, 2013. **23**(6): p. 1865-9.
9. Kakule, T.B., et al., *Two related pyrrolidinedione synthetase loci in Fusarium heterosporum ATCC 74349 produce divergent metabolites.* ACS Chem Biol, 2013. **8**(7): p. 1549-57.
10. Kalita, M., et al., *A nanosensor for ultrasensitive detection of oversulfated chondroitin sulfate contaminant in heparin.* J Am Chem Soc, 2014. **136**(2): p. 554-7.
11. Khatun, Z., et al., *Oral absorption mechanism and anti-angiogenesis effect of taurocholic acid-linked heparin-docetaxel conjugates.* J Control Release, 2014. **177**: p. 64-73.
12. Kim, H.A., K. Nam, and S.W. Kim, *Tumor targeting RGD conjugated bio-reducible polymer for VEGF siRNA expressing plasmid delivery.* Biomaterials, 2014. **35**(26): p. 7543-52.
13. Kim, J., et al., *Therapeutic efficacy of a systemically delivered oncolytic adenovirus - biodegradable polymer complex.* Biomaterials, 2013. **34**(19): p. 4622-31.
14. Kim, J., et al., *Efficient lung orthotopic tumor-growth suppression of oncolytic adenovirus complexed with RGD-targeted bioreducible polymer.* Gene Ther, 2014. **21**(5): p. 476-83.
15. Lee, C.H., et al., *Enhanced therapeutic efficacy of an adenovirus-PEI-bile-acid complex in tumors with low coxsackie and adenovirus receptor expression.* Biomaterials, 2014. **35**(21): p. 5505-16.
16. Lee, W.Y., et al., *Prevention of anti-microbial peptide LL-37-induced apoptosis and ATP release in the urinary bladder by a modified glycosaminoglycan.* PLoS One, 2013. **8**(10): p. e77854.
17. Lin, Z., et al., *Structure and activity of lobophorins from a turrid mollusk-associated Streptomyces sp.* J Antibiot (Tokyo), 2014. **67**(1): p. 121-6.
18. Lin, Z., et al., *Neuroactive diol and acyloin metabolites from cone snail-associated bacteria.* Bioorg Med Chem Lett, 2013. **23**(17): p. 4867-9.
19. Lin, Z., et al., *A bacterial source for mollusk pyrone polyketides.* Chem Biol, 2013. **20**(1): p. 73-81.
20. Lin, Z., et al., *Griseorhodins D-F, neuroactive intermediates and end products of post-PKS tailoring modification in Griseorhodin biosynthesis.* J Nat Prod, 2014. **77**(5): p. 1224-30.

21. Lu, Z., et al., *Plakinamine M, a steroidal alkaloid from the marine sponge Corticium sp.* J Nat Prod, 2013. **76**(11): p. 2150-2.
22. Lu, Z., et al., *Myristicyclins A and B: antimalarial procyanidins from Horsfieldia spicata from Papua New Guinea.* Org Lett, 2014. **16**(2): p. 346-9.
23. Madan, D., et al., *Non-invasive imaging of tumors by monitoring autotaxin activity using an enzyme-activated near-infrared fluorogenic substrate.* PLoS One, 2013. **8**(11): p. e79065.
24. McIntosh, J.A., et al., *Aestuaramides, a natural library of cyanobactin cyclic peptides resulting from isoprene-derived Claisen rearrangements.* ACS Chem Biol, 2013. **8**(5): p. 877-83.
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26. Moon, H.H., et al., *MSC-based VEGF gene therapy in rat myocardial infarction model using facial amphipathic bile acid-conjugated polyethyleneimine.* Biomaterials, 2014. **35**(5): p. 1744-54.
27. Pan, H., et al., *Efficiency of high molecular weight backbone degradable HPMA copolymer-prostaglandin E1 conjugate in promotion of bone formation in ovariectomized rats.* Biomaterials, 2013. **34**(27): p. 6528-38.
28. Pan, H., et al., *Synthesis of long-circulating, backbone degradable HPMA copolymer-doxorubicin conjugates and evaluation of molecular-weight-dependent antitumor efficacy.* Macromol Biosci, 2013. **13**(2): p. 155-60.
29. Platt, R.J., et al., *From molecular phylogeny towards differentiating pharmacology for NMDA receptor subtypes.* Toxicon, 2014. **81**: p. 67-79.
30. Raman, K., S. Arungundram, and B. Kuberan, *Chemogenesis of an antiangiogenic glycosaminoglycan.* ACS Med Chem Lett, 2014. **5**(6): p. 644-6.
31. Rudolf, J.D., H. Wang, and C.D. Poulter, *Multisite prenylation of 4-substituted tryptophans by dimethylallyltryptophan synthase.* J Am Chem Soc, 2013. **135**(5): p. 1895-902.
32. Sadekar, S., et al., *Poly(amido amine) dendrimers as absorption enhancers for oral delivery of camptothecin.* Int J Pharm, 2013. **456**(1): p. 175-85.
33. Sorna, V., et al., *High-throughput virtual screening identifies novel N'-(1-phenylethylidene)-benzohydrazides as potent, specific, and reversible LSD1 inhibitors.* J Med Chem, 2013. **56**(23): p. 9496-508.
34. Swarup, V.P., et al., *Exploiting differential surface display of chondroitin sulfate variants for directing neuronal outgrowth.* J Am Chem Soc, 2013. **135**(36): p. 13488-94.
35. Tian, L., H.C. Kang, and Y.H. Bae, *Endosomolytic reducible polymeric electrolytes for cytosolic protein delivery.* Biomacromolecules, 2013. **14**(8): p. 2570-81.
36. Tran, V.M. and B. Kuberan, *Synthesis of fluorophore-tagged xylosides that prime glycosaminoglycan chains.* Bioconjug Chem, 2014. **25**(2): p. 262-8.
37. Tran, V.M., et al., *Synthesis and assessment of glycosaminoglycan priming activity of cluster-xylosides for potential use as proteoglycan mimetics.* ACS Chem Biol, 2013. **8**(5): p. 949-57.
38. Won, Y.W., et al., *Targeted gene delivery to ischemic myocardium by homing peptide-guided polymeric carrier.* Mol Pharm, 2013. **10**(1): p. 378-85.
39. Won, Y.W., et al., *Post-translational regulation of a hypoxia-responsive VEGF plasmid for the treatment of myocardial ischemia.* Biomaterials, 2013. **34**(26): p. 6229-38.
40. Xu, Y., et al., *Discovery of Novel Putative Inhibitors of UDP-GlcNAc 2-Epimerase as Potent Antibacterial Agents.* ACS Med Chem Lett, 2013. **4**(12): p. 1142-1147.

41. Yin, H., et al., *Effects of cholesterol incorporation on the physicochemical, colloidal, and biological characteristics of pH-sensitive AB(2) miktoarm polymer-based polymersomes.* Colloids Surf B Biointerfaces, 2014. **116**: p. 128-37.
42. Zhang, R., et al., *Synthesis and evaluation of a backbone biodegradable multiblock HPMA copolymer nanocarrier for the systemic delivery of paclitaxel.* J Control Release, 2013. **166**(1): p. 66-74.

Small Animal Imaging Facility

Overview

The Small Animal Imaging Facility extends the benefits of modern diagnostic medical imaging systems to the studies of anatomy and physiology in small animals. The facility operates an MRI scanner, FMT scanner, and a CT/SPECT/PET scanner. The scanners 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 Small Animal Imaging Facility has a variety of modalities to choose from such as MRI, CT, PET, SPECT, and Fluorescence imaging. Examples of scanning capabilities include the following:

7 Tesla small animal MRI system

- 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 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 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
- Inveon Multimodality System
- VISEN (now Perkin Elmer) FMT 2500™ Fluorescence Molecular Tomography

Personnel

- Edward Hsu, Ph.D., Director
- Osama Abdullah, Ph.D., Imaging Specialist
- Samer Merchant, Imaging Specialist
- Brian Watson, Laboratory Aide
- Huashan Zou, Research Student

2014 Annual Update

New Equipment

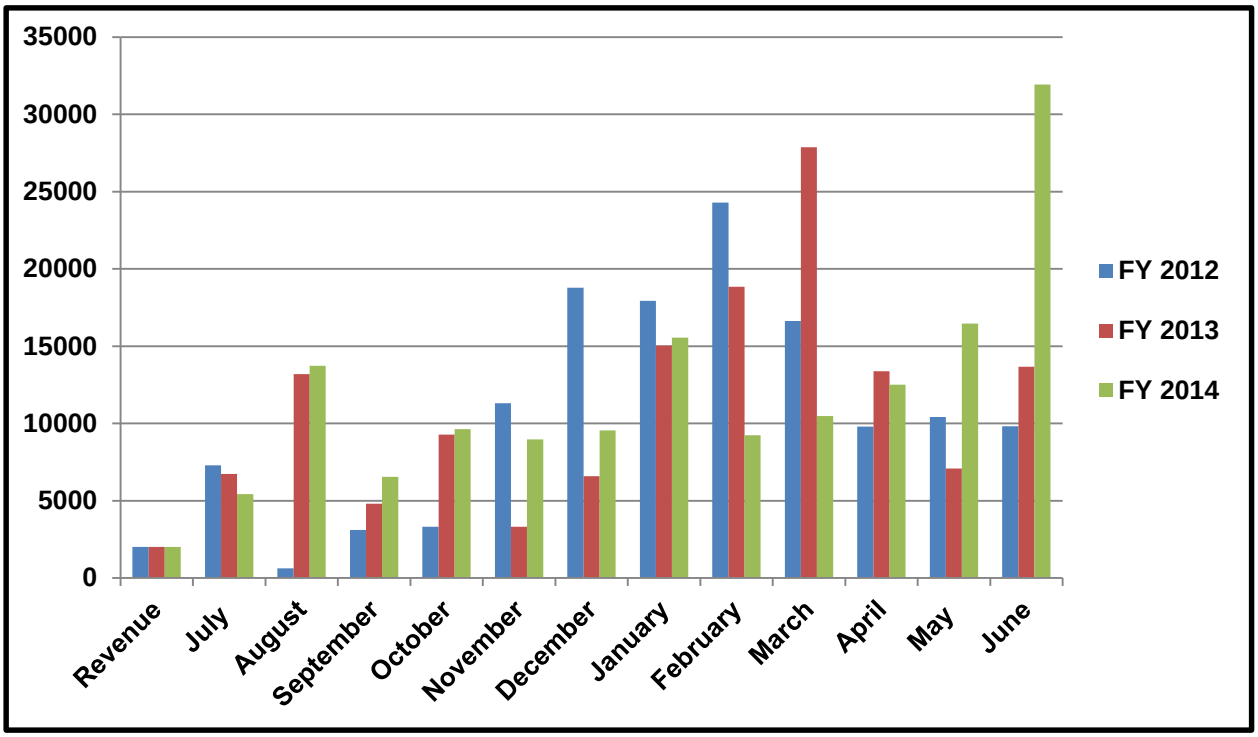
- No major equipment was added in FY14

New Services

- Awake-state functional MRI
- Large-FOV high-resolution CT

Revenue/Expenses

- VP of Research Support: $150,000 ($100,000 from Dr. Tom Parks)
- FY14 revenue: $176,001
- FY14 expenses: $270,265
- FY14 revenue generated from services:

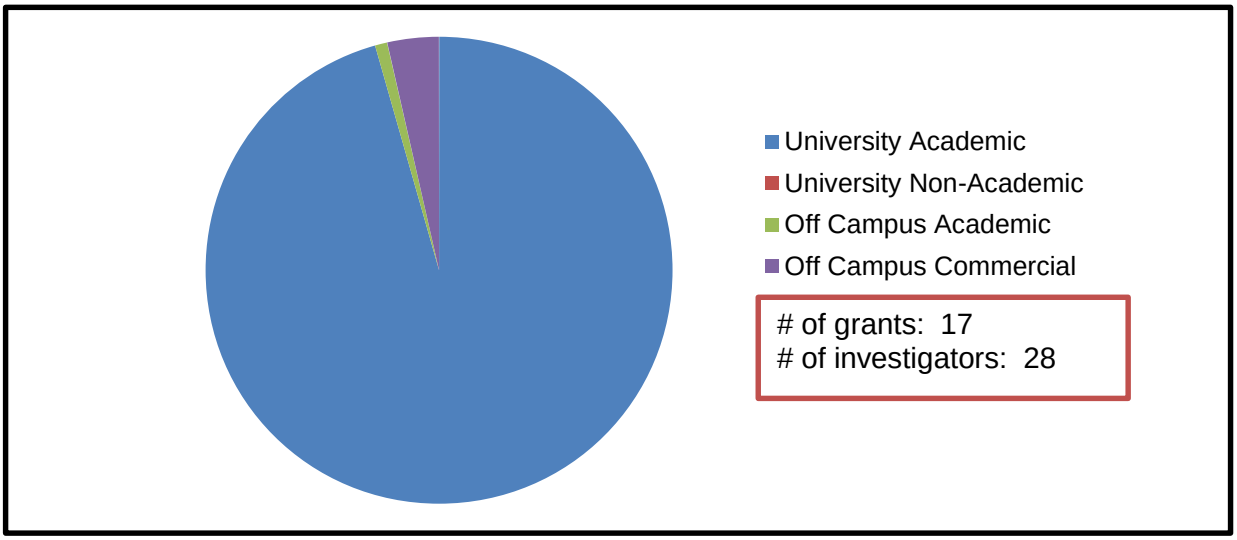


Advisory Board Committee
Last meeting date: March 29, 2013

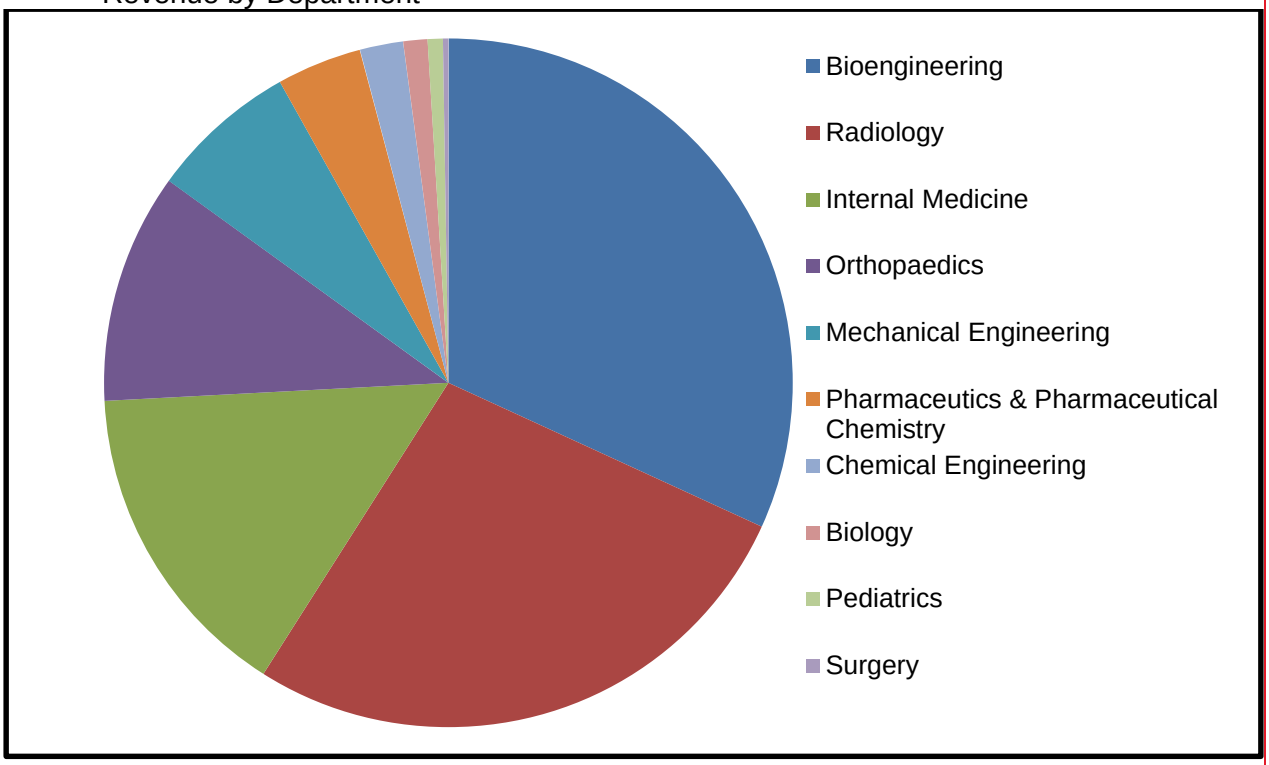
- John Hoffman, Professor, HCI
- John Phillips, Research Associate Professor, Hematology
- Jack Taylor, Director, Office of Comparative Medicine
- Rob MacLeod, Professor, SCI
- Dennis Parker, Professor, Radiology Research

FY14 Scientific Impact
Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

1	Hsu, Edward	NIH
2	Yap, Jeffrey	Sarcoma Alliance
3	Bachus, Kent	Department
4	McKeller, Stephen	Department
5	Coats, Brittany	Knight Templar
6	MacLeod, Rob	Nora Eccles Treadwell Foundation
7	Anderson, Jeffrey	NIH
8	Queensland Museum	Off Campus
9	Kopecek, Jindrich	NIH
10	Ostafin, Agnes	NIH

Publications

1. Bogdanova, O.V., et al., *Neurochemical alterations in frontal cortex of the rat after one week of hypobaric hypoxia.* Behav Brain Res, 2014. **263**: p. 203-9.
2. Gomez, A.D., S.S. Merchant, and E.W. Hsu, *Accurate high-resolution measurements of 3-D tissue dynamics with registration-enhanced displacement encoded MRI.* IEEE Trans Med Imaging, 2014. **33**(6): p. 1350-62.
3. Zinkhan, E.K., et al., *Maternal tobacco smoke increased visceral adiposity and serum corticosterone levels in adult male rat offspring.* Pediatr Res, 2014. **76**(1): p. 17-23.

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

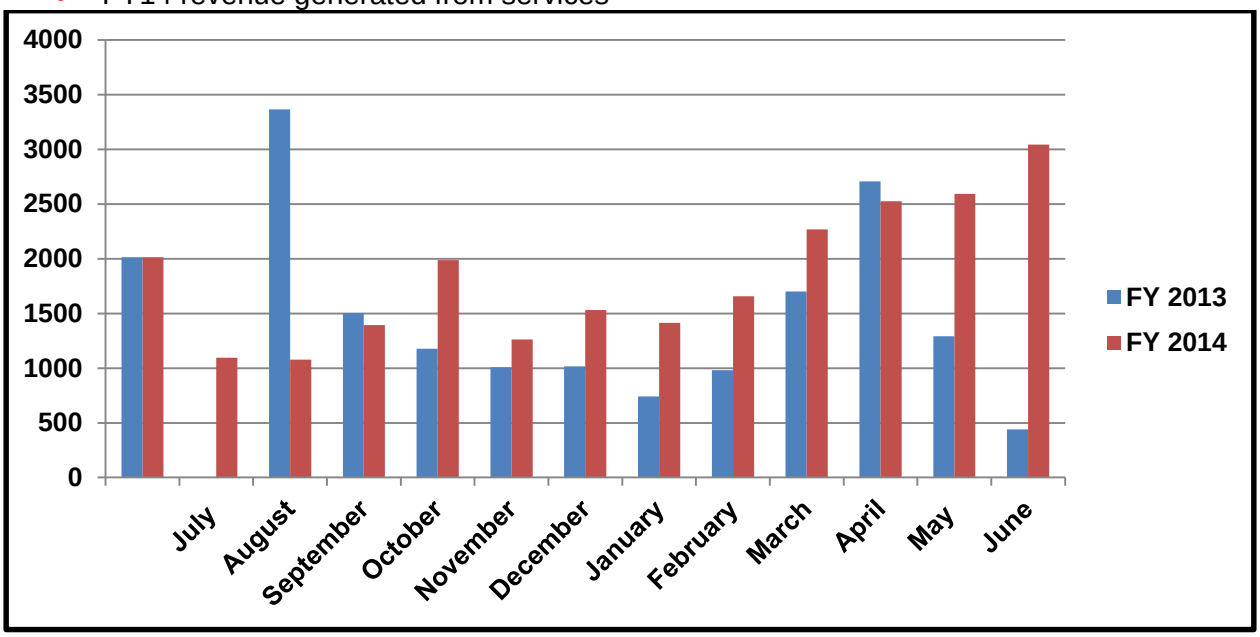
Personnel

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

Revenue/Expenses

- VP of Research Support: $20,000
- Total FY14 revenue: $21,852
- Total FY14 expenses: $30,837

- FY14 revenue generated from services

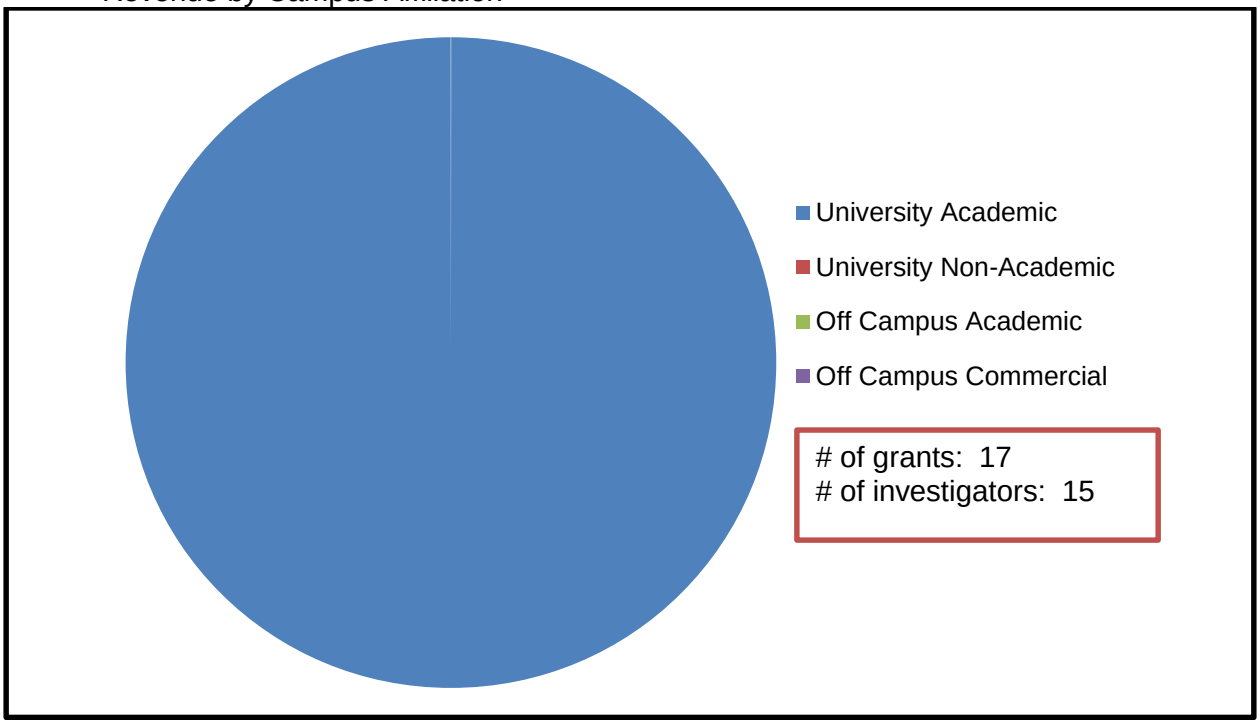


Advisory Board Committee:
Last meeting date: April 15, 2013

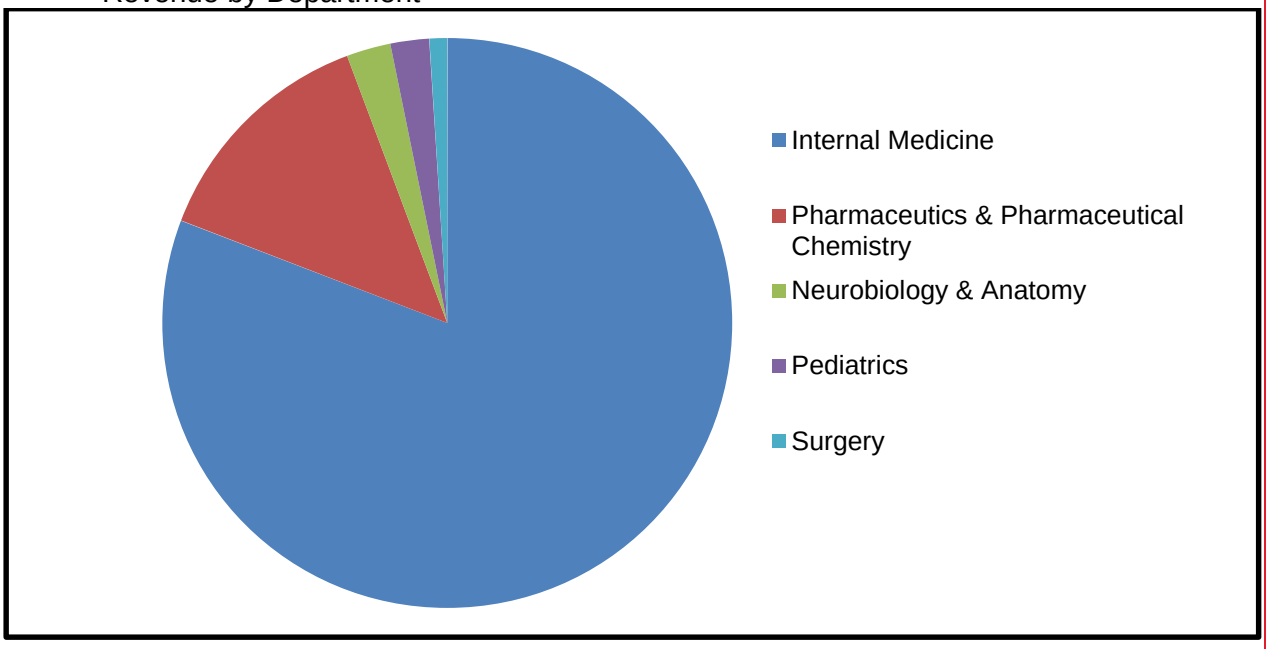
- Andy Weyrich, Associate Dean for Basic and Translational Sciences
- Craig Selzman, Associate Professor, Cardiothoracic Surgery
- Brent Wilson, Assistant Professor, Cardiology

FY14 Scientific Impact
Research Support

- Revenue by Campus Affiliation



- Revenue by Department



Top Users

1	Selzman, Craig	NIH
2	Franklin, Sarah	NIH
3	Li, Dean	NIH
4	Kim, Sung-Wan	NIH
5	Weyrich, Andy	NIH
6	McKeller,Stephen	NIH, NHLBI
7	Soorappan, Rajasekaran	NIH
8	Christian, Jan	NIH
9	Brunelli, Luca	Department
10	Kopecek, Jindrich	NIH

Publications

1. Mleynek, T.M., et al., *Lack of CCM1 induces hypersprouting and impairs response to flow.* Hum Mol Genet, 2014.