"Providing researchers with outstanding research infrastructure that will enhance discovery, productivity and the reputation of the UTHSC research enterprise is a primary focus of the Office of Research. Institutional Research Core Facilities are a key component of the infrastructure, essential to maintaining international recognition of research programs, increasing extramural funding, supporting active research grants, and retention and recruitment of faculty. Institutional Research Cores are defined as fee-for-service resources that are widely used among UTHSC faculty across multiple Colleges and Departments, and are financially supported by the Institution. As of FY17, the Institutional Research Cores include: the Lab Animal Care Unit; the Regional Bio-containment Lab; the Molecular Resource Center; the Flow Cytometry and Cell Sorting Core; the Proteomics and Metabolomics Core; the Molecular Bioinformatics Core; and the Research Histology Core. In a model new to UTHSC, going forward, fee structures for core services will be determined based upon a market evaluation of fees set by our peer academic institutions, with prices at UTHSC selected to rank in the bottom-half to bottom-third as compared to peer academic core facilities. Prices for services will then be escalated by 3% each subsequent fiscal year. The Institutional Research Cores are now managed with a business-like model, using business plans to develop budgets and relying on data-based metrics to measure core successes. The Office of Research will soon implement a new set of core management web-based tools (iLab by Agilent) to facilitate sample submission, sample workflows, invoicing, and generation of core usage metrics. Our new model of functional and financial core oversight will foster the research enterprise at UTHSC to achieve our common goal of doubling research within the next 10 years."

Tiffany N. Seagroves, Ph.D.
Associate Vice Chancellor for Research-Cores

Institutional Research Cores Fast Facts

Flow Cytometry and Flow Sorting Core (FCCS)

- The YETI/ZE5 analyzer has 405, 488, 561, and 640 nm lasers with 21-color detection in a 7, 4, 7, 3 format; high throughput sampling; small particle detection for exosomes or bacteria; and programmable sample handling.
- The FACSAria cell sorter has 4 lasers for 12-color 2-4 way sorting and indexed single-cell sorting
- The Director and new Operator (arriving May, 2017) have > 40 combined years of experience in flow cytometry and FACS.

Laboratory Animal Care Unit (LACU)

- Vets and vet techs available at hourly recharge rates to assist with training or projects
- Provides training and access to equipment to investigators for ultrasound, rodent blood pressure recording, digital radiography and isoflurane anesthesia
- Dedicated equipment and expertise for large animal surgical procedures available

Molecular Bioinformatiocs (mBio)

- Quantitative data analysis, data visualization, clustering, pathway analysis (IPA), and gene ontology (GO) are routine workflows
- Long-term, secure data storage resources available
- Initial consultation for experimental design for all sequencing and PMC projects available at no charge

Molecular Resource Center (MRC)

- High quality NGS services using Ion Torrent (PGM and Proton) and Illumina (NextSeq 500) platforms
- New in 2017: faster NGS library preps with the onboarding of the Hamilton STARlet robot
- Microarray services for gene expression, genotyping, epigenetics and ethnicity available using Affymetrix and Illumina (iScan) platforms

Proteomics and Metabolomics Core (PMC)

- ID proteins from gel bands, or simple (a few) to complex (thousands) mixtures, in most cases with <100 micrograms of starting material
- A demonstrated track record in generating high-quality, differential quantitative proteomics
- Consultation regarding experimental design and sample prep and basic data analyses provided at no charge

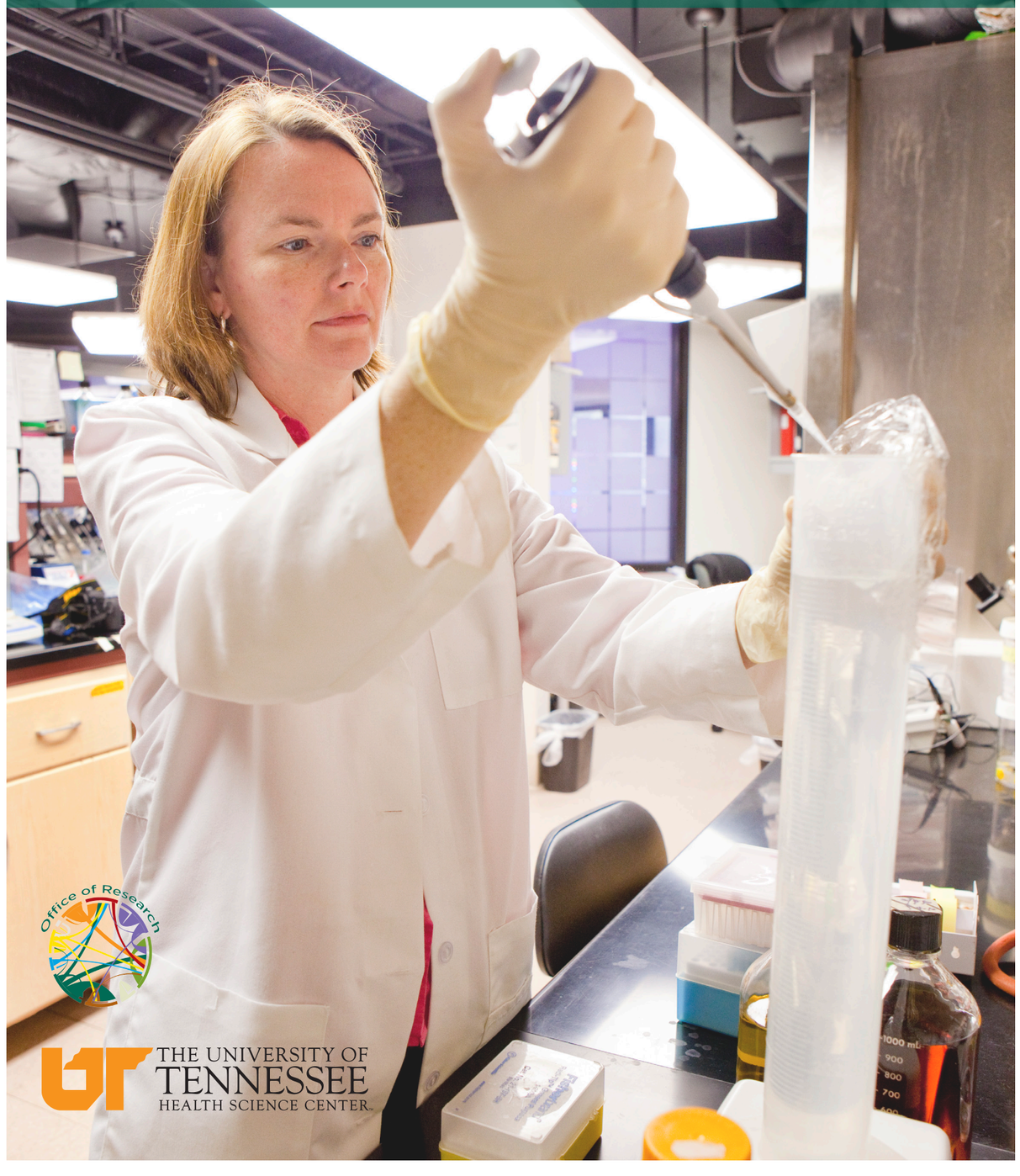
Regional Biocontainment Laboratory (RBL)

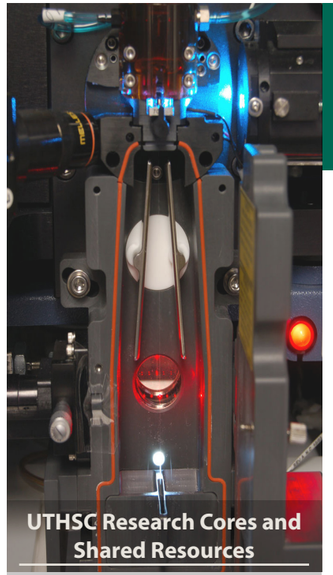
- One of 12 NIAID-funded RBLs in the country
- Houses 6 ABSL-3 suites, eight BSL-3 labs, and one large BSL-2 lab with a cell culture suite; specialized equipment for in vivo and in vitro projects available
- Provides all training and support, including the federal clearance process and in the use of select agents

Research Histology Core (RHC)

- Coming soon in partnership with University Clinical Health (May 2017, expected)
- Competitive pricing for processing, embedding, sectioning and staining paraffin-embedded or fresh frozen samples
- Consultation regarding experimental design and sample handling available with a board-certified pathologist (Dr. Louisa Balazs, Director)

Institutional Research Cores Handbook 2017





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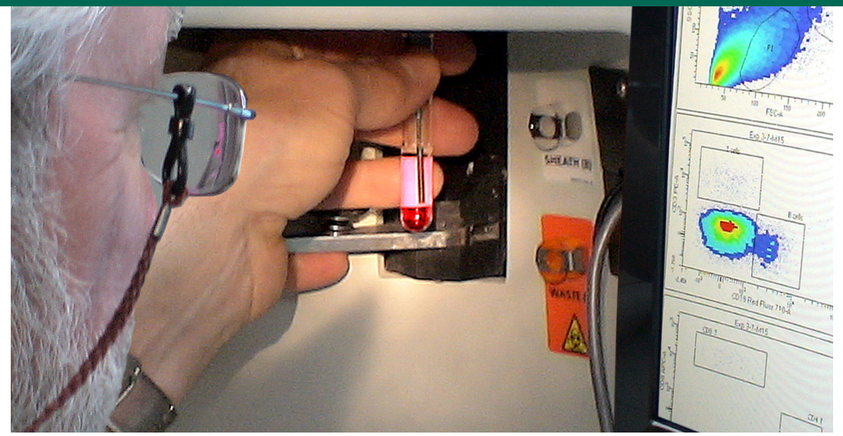
CORE INFORMATION

CORE DIRECTOR:
TONY MARION, PHD
EMAIL: tmarion@utshc.edu

Molecular Sciences Building
858 Madison Avenue, Suite 214
(901) 448-6572

Flow Cytometry & Cell Sorting (FCCS) Core



The FCCS Core's mission is to provide investigators at UTHSC and in the Memphis area with training in flow cytometry principles and access to state-of-the-art flow cytometry and cell sorting technology.

Introduction & Services

The Flow Cytometry and Cell Sorting (FCCS) Core was created to provide the UTHSC and Memphis research community with access to state-of-the-art instruments, expertise, instruction, and assistance with experimental design and data analysis for multicolor flow cytometry and cell sorting, including indexed single-cell sorting. Services include one-on-one consultation with internal investigators at no charge for experimental design, training in the use of the instrumentation (hourly rate), and software resources. The Core Director, a highly experienced immunologist and flow cytometry and cell sorting expert, is also available to analyze investigators' data (hourly rate). Together, these activities are part of the service, educational, and academic missions of the FCCS core.

Equipment and Software

The **BD Biosciences FACSAria II** cell sorter is equipped with four lasers and 12 fluorescence detectors, in addition to forward (FSC) and side (SSC) scatter detectors. The 100 mW, 488 nm blue diode laser has 5 fluorescence, SSC, and FSC detectors. The 30 mW, 638 nm red diode laser has three fluorescence detectors. The 50 mW, 405 nm violet diode laser has two fluorescence detectors, and the 20 mW, 355 nm solid-state UV laser has two fluorescence detectors. The sorter has two-and four-way sort capability into tubes or microtubes. The sorter is also equipped for indexed, single-cell sorting or multiple cell sorting into microwell plates or onto microscope slides. The sorter has temperature controlled sample injection and collection chambers within a biosafety level-2 (BSL2) containment cabinet.

In September 2016, a **new high-performance ZE5** (formerly known as the YETI) **flow cytometer** was purchased to replace the BD Biosciences LSR II. New instrument specifications include a four-laser, 21-fluorescence parameter highly automated flow cytometer, with a 4-7-7-3 configuration for blue, green, violet, and red lasers, respectively, supporting detection of popular "fruit" dyes and standard FSC and SSC light detection. The instrument also has the capability for small particle detection (exosomes, subcellular particles, and bacteria) and will offer operator-independent programmable sample loading and data collection for up to 48 tubes. For comparison, the LSR II offered three lasers with 9 fluorescence, FSC, and SSC detectors. In addition, the EVO software is more user-friendly than FACSDiva (BD Biosciences).

Core Capabilities

The FCCS core supports: detection and quantification of up to 21 cell surface and/or intracellular molecules; detection and quantification of GFP- or mCherry-labeled protein expression; measurement of Ca2+ flux during cell signaling among different cell subpopulations; DNA quantification, cell cycle analysis, and apoptosis detection and quantification; detection and quantification of exosomes; high-speed sorting of viable or fixed eukaryotic or prokaryotic cells into four or fewer defined subpopulations; single or multi-cell sorting into microwell plates or onto microscope slides; indexed single-cell sorting into microwell plates or onto microscope slides; and aerosol containment.

Regional Biocontainment Laboratory (RBL)

The RBL Core's mission is to provide state-of-the-art Biosafety Level 3 (BSL-3) and Animal Biosafety Level 3 (ABSL-3) containment laboratories that support the research community and the National Biodefense Network.

Facility Description

The Regional Biocontainment Laboratory (RBL) is one of 12 such facilities throughout the country that was constructed with funds secured by an extramural (NIH/NIAID) award with a match by the University. The RBL became operational in 2010 and was approved for select agent use through the Centers for Disease Control and Prevention (CDC) and received AAALAC accreditation. The RBL is a 30,000 sq. ft. facility housing six ABSL-3 suites, eight BSL-3 laboratories, and one large BSL-2 laboratory with a cell culture suite. The RBL provides high containment laboratory space as well as specialized equipment and technical services to support campus research needs for in-vitro and in-vivo projects.

Equipment and Services

All labs in the RBL are equipped with essential laboratory equipment: **static and CO_2 incubators, refrigerators, -80 freezers, centrifuges, Class II biosafety cabinets, UV spectrophotometers, vortex, water bath, heat block, pipette aids, etc.** Additional shared equipment is also available for use or fee-for-service including: **FACS Aria II flow cytometer/cell sorter, Luminex Milliplex analyzer, Perkin-Elmer Janus robotics/fluidics** system and **plate reader** for high-throughput multiwell plate-based assays, and a **Delta Vision live-cell deconvolution microscope**.

The ABSL-3 suites each contain a dedicated anteroom, fully equipped animal procedure room, and an adjoining animal holding room. All animals are housed within **Allentown BioContainment Unit (BCU) caging systems** and are monitored via a WiCom system. **Inhalation anesthesia machines** and **induction chambers** are provided free of charge to investigators housing animals in the RBL. Specialized support equipment includes a **Perkin Elmer (Xenogen) IVIS Spectrum** live whole-animal imaging system and a **BioAerosol Nebulizing Generator (BANG)** unit for nose-only aerosol delivery of agents to mice. RBL management staff are AALAS certified at the laboratory animal technologist (LATG) level and may be contracted to assist with or to perform animal work. ABSL-2 projects can also be supported in the RBL, along with housing and care of irradiated/immunosuppressed animal models.

Laboratory and animal space is assigned based on research needs and specific pathogen(s) in use. The RBL provides all training for work within the facility, including the clearance process and training for work with select agents. Other services provided by the RBL to support research includes all required personal protective equipment (PPE), decontamination supplies, biohazard waste disposal products, autoclaving of waste, and laboratory cleaning and maintenance.

RBL staff are also available to **certify biosafety cabinets (BSCs) on campus** and to **repair small laboratory equipment.**

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CORE INFORMATION

CORE DIRECTOR (INTERIM):
MARK A. MILLER, PHD
EMAIL: MAMILLER@UTHSC.EDU

20 S. Dudley Street, STE 900
(901) 448-6752

CORE STAFF

Facility Manager/Responsible Official/Biosafety Officer:
Jennifer Stabenow
jstabenow@uthsc.edu
(901) 448-6649

RBL Building Superintendent:
Rob Benson
rbenson6@uthsc.edu
(901) 448-6976

ABSL-3 Supervisor:
Lillian Zalduondo
lzalduon@uthsc.edu
(901) 448-6408

Proteomics and Metabolomics (PMC)

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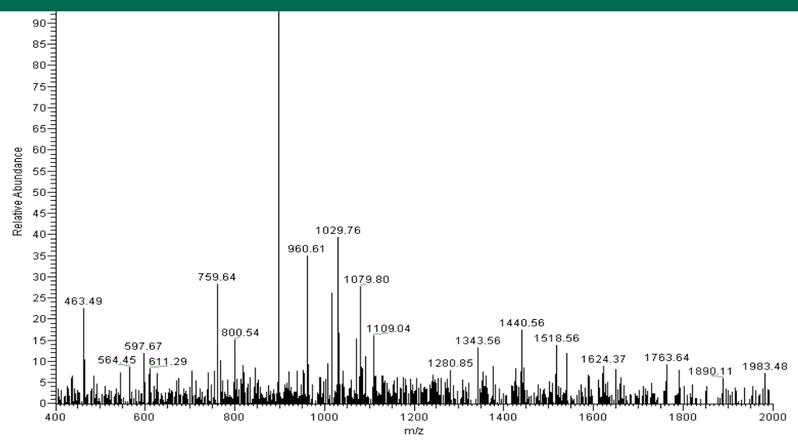
CORE INFORMATION

CORE DIRECTOR:
DAVID KAKHNIASHVILI, PHD
EMAIL: dkakhnia@uthsc.edu

Translational Sciences Research Building (TSRB)
71 S. Manassas, Suite 110
(901) 448-3077



The PMC Core's mission is to provide the UTHSC community with state-of-the-art mass spectral technology and support to facilitate molecular-level discoveries that transform and advance our understanding of biological systems to solve challenging, relevant scientific questions in the life sciences.

Introduction & Services

The Proteomics and Metabolomics Core (PMC) was established through the Office of the Vice Chancellor for Research in 2015. The Core was created to provide resources for the highest quality mass spectrometry-based analysis supporting research needs in the fields of proteomics and metabolomics. The Core provides consultations to optimize experiment design and to interpret generated data. Services include identification and absolute or differential quantification of metabolites, drugs, and other small molecules in body fluids, cell and tissue extracts, identification of individual proteins in simple and highly complex protein mixtures, identification and mapping of posttranslational and other modifications of proteins, differential protein expression analysis based on precursor ion quantification (SILAC, dimethyl labelling), reporter ion quantification (iTRAQ/TMT labelling), and precursor ion area detection (label-free analysis), analysis of protein-protein interactions, and determination of the molecular masses of analytes.

Equipment and Software

The Core is equipped with a Thermo **Orbitrap Fusion Lumos mass spectrometer** - a tribrid mass spectrometer combining a Quadrupole, a Dual Linear Ion Trap, and an Orbitrap mass analyzers able to perform CID, HCD, ETD, ETcID, or EThcD fragmentation, operate in parallel mode, and provide excellent resolution (500,000 FWHM @m/z 200), accuracy (1 ppm), sensitivity (quantification of 1 attomole at CV<15%), and high scan rate (20 Hz). The instrument operates in line with an ultra-HPLC system-Ultimate 3000RSLC Nano for nano-flow applications or Vanquish for micro-flow applications. The software tools for system operation/data acquisition and post-acquisition analysis of raw MS data include **Xcalibur/SII 4.0, Proteome Discoverer 2.1, PMI-Preview 2.11, PMI-Byonic 2.11, Compound Discoverer 2.0, Tracefinder 4.1, Lipidsearch 4.1**, and others.

Core Director

David Kakhniashvili, PhD, is the director of the Proteomics and Metabolomics Core at UTHSC. He earned his MS in Chemistry at Tbilisi State University (Rep. Georgia) and Ph.D. in Biochemistry at the Institute of Protein Research of Russian Academy of Sciences. He completed Mass Spectrometry-Biotech courses at the Thermo Electron Institute of West Palm Beach, Florida. Dr. Kakhniashvili has multiple publications in the field of proteomics related to red blood cells and sickle cell disease. He joined the UTHSC team in 2015.

Laboratory Animal Care Unit (LACU)

The LACU Core's goal is to provide an environment in which our investigators can develop, maintain and advance their specific research needs using animals. We are committed to providing quality animal care and ensuring the humane usage of animals on the UTHSC campus.

Introduction

The Laboratory Animal Care Unit (LACU) functions as a full-service core supported by the Office of Research, serving all animal related research on the UTHSC campus. The core operates several facilitates throughout the campus, to best serve the individual research departments and to maintain health status of the colonies. Our primary focus is to provide high-quality care and housing of study animals. Our program and facilities are accredited by the Association for the Assessment and Accreditation of Laboratory Animal Care (AAALAC) since 1993. Our unit is supported by two clinical veterinarians, two veterinary residents, one veterinary technician, three supervisors and over 30 additional staff members. Administrative staff provide billing and core unit support. We are available for training, fee for service work and collaborations.

Services

1. **Animal Husbandry**: Housing, health status, and day-to-day care of all research animals on campus. Will assist in special housing and diet/water needs of specific research projects.
2. **Study Procedural Space**: Most facilities have contained procedure rooms within the vivariums to allow for quick access to your animals and reduced stress from transport.
3. **Technical Services**: Project support, collaboration, and fee for service work. Includes: ear tagging and notching; blood collection; breeding colony management; anesthesia; surgery; and post-operative care. Management of sentinel program.
4. **Animal Import and Export**: Obtain animals from standard vendors (JAX, Charles River, Envigo), organize transfers between institutions, and handle quarantine program.
5. **Animal Imaging**: Rodent micro-ultrasound (Vevo 2100), digital radiography, and micro-CT.
6. **Study Support**: Protocol pre-review, study design consultation and troubleshooting, drug dosing, and species-specific training opportunities.

Equipment and Software

- **Vevo 2100**, VisualSonics
- **CODA Tail-Cuff Blood Pressure System**, Kent Scientific Inc.
- **IDEXX, RADIL**– Animal Health Monitoring, Pathology
- **ACAP**– bar-coded card printing and colony management system
- **ACIM**– billing, VetCare application system
- **Anprolene**- ethylene oxide sterilization
- **MouseOx**– SPO2 and EKG monitoring
- **Small Animal Imaging**- digital radiography, Xenogen IVIS (CRB), Xenogen Spectrum (RBL).
- **Imtek Micro CAT II**- x-ray computed tomography
- **Abaxis VetScanHm5**- blood analyzer (housed in Rm 269 CRB)

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CORE INFORMATION

INTERIM CORE DIRECTOR:
DAVID HAMILTON, DVM, DACLAM
EMAIL: DHAMILT7@UTHSC.EDU

Coleman College of Medicine Building
956 Court Ave, Room B106
(901) 448-5656

CORE STAFF

Imports/Exports:
David Hamilton, DVM, DACLAM
dhamilt7@uthsc.edu; (901) 448-5451

Animal Imaging:
Ryan Sullivan, DVM
rsulli10@uthsc.edu; (901) 448-2762

Business Hours:
Monday-Friday 8am-5pm

Phone:
Main Office: (901) 448-5656

Emergency Phones:
After hours, weekends, and holidays
Supervisor: (901) 268-0190
Veterinarian: (901) 448-5658

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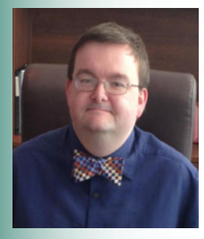
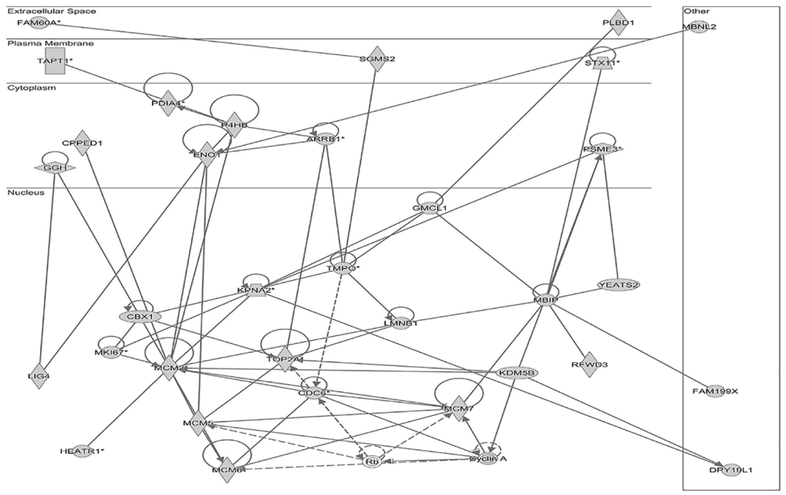
CORE INFORMATION

CORE DIRECTOR:
DANIEL JOHNSON, PHD
EMAIL: djohn166@uthsc.edu

Translational Sciences Research Building (TSRB)
71 S. Manassas, Suite 110
(901) 448-3748



Molecular Bioinformatics (mBIO) Core



The mBIO Core's mission is to provide researchers with access to the latest technologies, workflows, and standards for analyzing molecular data.

Introduction & Services

The Molecular Bioinformatics (mBIO) Core was established through the Office of the Vice Chancellor for Research in 2014 to complement the services offered at the Molecular Resource Center (MRC), allowing one-stop data generation and analysis. The mBIO core offers consultation services during the experiment design phase and performs data analysis after raw data are generated. Services include sequence assembly, sequence alignment, differential expression analysis, and custom software designs. Expertise is also available related to protein structure/function prediction and proteomics/metabolomics.

Equipment and Software

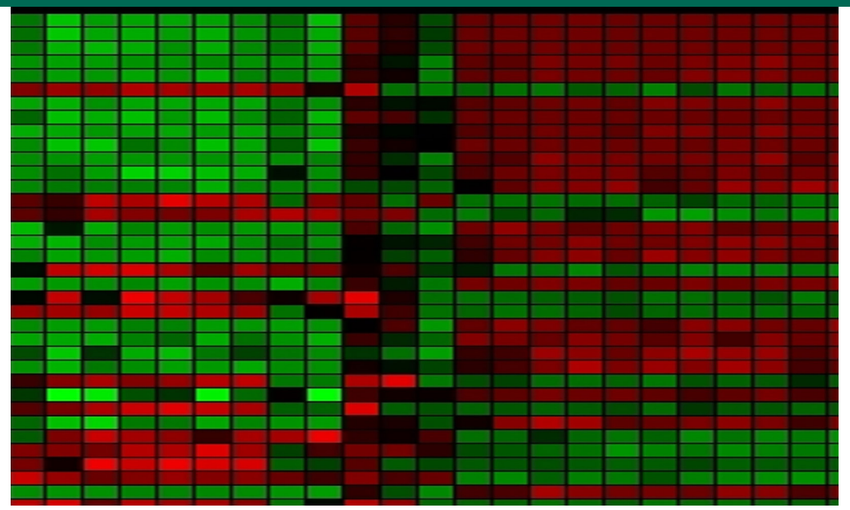
The mBIO core maintains **four AMD 16-core blade servers** to offer researchers the computational power needed to handle the terabytes of next-generation sequencing (NGS) data that is generated every year. **Long-term data storage** is available as a fee for service. A local installation of **GALAXY**, a platform for hosting online bioinformatics analysis tools, is available for UT investigators to use at no charge by establishing an account on the **local Slipstream server**. Additional software includes **Ingenuity Pathway Analysis (IPA)**.

The mBIO Core also provides frequent workshops and hands-on training opportunities for PIs, postdocs, and UTHSC students who are interested in learning the software, analysis pipelines, and statistics needed to perform bioinformatics analysis independently.

Core Director

Daniel Johnson, PhD, is Director of the Molecular Bioinformatics Core. Dr. Johnson earned his BS in Computer Science and Mathematics, his MS in Computer Science, and his PhD in Molecular Biosciences at Arkansas State University. Dr. Johnson was previously the lab manager for Arkansas State University's bioinformatics program. Dr. Johnson has published multiple papers in the field of bioinformatics, focusing on differential expression analysis and protein structure prediction. He joined the UTHSC team in 2015.

Molecular Resource Center of Excellence (MRC)



The MRC Core's mission is to provide scientists with access to the latest molecular technologies for exploring basic biological mechanisms and the molecular basis of human disease.

Introduction

The Molecular Resource Center (MRC) Core, established in 1985, is a Tennessee Higher Education Commission (THEC) Center of Excellence at the University of Tennessee Health Science Center (UTHSC). In order to accomplish its mission, the MRC invests in both state of the art equipment and trained personnel. The MRC houses a full range of equipment that facilitates molecular, genetic, and biochemical studies at the sub-cellular and systems biology levels. In addition to providing technical services, MRC personnel assist and instruct investigators in applying specialized tools of modern molecular biology to basic and clinical research. The MRC's services include sequencing at both the single fragment and whole genome/transcriptome (next-generation sequencing, NGS) levels along with offering Affymetrix and Illumina microarrays. Equipment, reagents, and training for real-time PCR and automated isolation of nucleic acids are also provided.

Services

- **Nucleic acid (DNA/RNA) isolation** (Qiagen QIAcube)
- **Nucleic acid quality analysis** (quantification and quality determination)
- **Sanger sequencing** (Plasmids, Fragments & PCR products)
- **Next-generation sequencing** (ChIP, targeted or whole genome or exome, & microbiome)
- **Gene Expression Analysis** (Affymetrix microarrays, total RNA and miRNA)
- **Gene Expression Analysis** (RNA-Seq)
- **Gene Expression Analysis** (qRT-PCR & digital PCR)
- **Genotyping** (Capillary Electrophoresis for STR & SNP analyses)
- **Genotyping** (Illumina Microarrays)
- **Genotyping** (qPCR & copy number analysis by digital PCR)
- **Genotyping** (Next-generation sequencing- targeted & exomes)
- **Methylation analysis** (Illumina microarrays & Sanger sequencing)
- **Equipment for client use** -Robotic Liquid Handler, Multimode Plate Reader, Fluorescence Microscope

Equipment and Software

Qiacube Robot (Qiagen RNA/DNA isolation) • Agilent Bioanalyzers (2) • Nanodrop 1000 and 8000 Spectrophotometers • Applied Biosystems 3130XL Sequencer • Ion Torrent PGM Sequencer • Ion Torrent Proton Sequencers (2) • Illumina NextSeq 500 • Affymetrix GeneChip System • Illumina iScan System • Roche LightCycler 480 Systems (2) • Fluidigm Biomark • Eppendorf epMotion 5075 Liquid Handling Robot • Spectramax m2e multimode plate reader • Zeiss Axiophot Microscope • Hamilton STARlet robot for automated NGS library preparation

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CORE INFORMATION

CORE DIRECTOR:
WILLIAM TAYLOR, PHD
EMAIL: wtaylor@uthsc.edu

Translational Sciences Research Building (TSRB), 71 S. Manassas, Suite 110
(901) 448-6165

EXECUTIVE DIRECTOR:
TIFFANY SEAGROVES, PHD
tseagro1@uthsc.edu
(901) 448-5018

CORE STAFF

Assistant Director: Tom Cunningham
tcunningham@uthsc.edu
(901) 448-6191

Research Specialists: Lorne Rose
lrose4@uthsc.edu
(901) 448-8229

Felicia Waller
fwaller@uthsc.edu
(901) 448-8746

Caitlin Costelle
ccostel2@uthsc.edu
(901) 448-6191