

CIBR is a novel center that provides the infrastructure and oversight of a collection of 26 scientific core facilities that provide state-of-the-art technologies, high-tech instrumentation, and expertise to support biomedical research, clinical practice and health care to principal investigators in the state of Maryland and the region. Renovation of nearly 30,000 square feet of space was accomplished with \$7.3 M in funding from an NIH award. This newly renovated space allows for the physical consolidation of many core facilities, creating a dynamic environment that facilitates collaboration, maximizes efficiencies and provides our investigators with easy access to cutting-edge instrumentation. In addition, the CIBR offers highly-trained technical staff who can offer support on experimental design, data analysis and interpretation. CIBR also provides training for graduate and medical students, postdoctoral fellows, and faculty within the University and to its collaborators. Investigators can reserve equipment time and services from many of our cores via CIBR's online "cores portal".

CIBR supports wide range of research projects within the School of Medicine via a strong portfolio of cores with cutting edge expertise in the areas of: Animal Models, Bioinformatics & Statistics, Clinical Resources, Cytometrics & Bioassays, Drug Development, Imaging, Nucleic Acids & Genomics and Structural Biology.

BIOMEDICAL RESEARCH SUPPLY CORE (BIORESCO)

MISSION

To conserve time, money, space and effort for the University of Maryland, Baltimore (“UMB”) and UMB BioPark researchers, by maintaining a central supply core facility, e-commerce web site and expediting service which thrives upon its ability to innovate and re-create itself in accordance with the requirements of the University and its research staff. BIORESCO enables scientists to “do science” instead of procurement and accounting. We endeavor to become a “one-stop shop” for researchers and their staff.

CORE SERVICES

All products purchased through BIORESCO are at the lowest possible prices and the researchers pay no Shipping or Handling charges. The BIORESCO web site hosts catalogs from over 45 Vendors. Customers can search and order from over 1.5 million discounted products.

In addition to our Core purpose as stated above, we offer:

- Two large annual vendor shows that bring over 50 vendors and 1200 members from the research community together
- Collaboration with UMB Environmental Health and Safety to minimize the volume and variety of dangerous chemicals on campus by maintaining years of searchable campus purchasing data
- Calibration for pipettors and balances
- Peptide and Oligonucleotide Synthesis
- Emergency Freezer Storage (-20 degrees C, -80 degrees C)
- Free packing and shipping materials for all temperatures
- Dry ice for sale

HIGHLIGHTS

- Based on a 10 year analysis:
- Average savings from List — 27%
- Savings in shipping and handling charges — \$16.1 million
- Administrative Cost per purchase is around \$4, which is much below the national average for a procurement purchase (\$60) or P-card purchase (\$20)
- We take the hassles out of replacements, backorder substitutions, cancellations and returns

BIOSENSOR CORE FACILITY

MISSION

The Biosensor Core Facility's objective is to provide the faculty, staff and students on the University of Maryland, Baltimore, with the latest technology for the quantitative study of binding reactions in real time, specifically with an approach that is versatile, highly sensitive, and "user friendly," with molecules that are label-free. The instruments we use for this purpose are from Biacore® (GE Healthcare).

CORE SERVICES

Biacore® instruments utilize the optical method of "surface plasmon resonance" (SPR), small changes in the interaction of monochromatic light with a metallic surface that occur when a protein or other molecule binds to that surface. Using the T200 or 3000, the core and its staff can provide accurate determinations of "on" and "off" rates for binding reactions, as well as determine affinity constants for binding. Because our instruments use SPR, many different kinds of binding reactions can be studied, often robotically, and a wide range of biological molecules can be examined, including proteins, nucleic acids, carbohydrates and lipids, as well as small molecules. Typical studies can:

- Determine if pairs of molecules bind to each other.
- Determine kinetic constants, binding constants, and specificity of binding.
- Determine if several molecules can bind simultaneously to the same ligand or if they compete for binding.

CORE INSTRUMENTS

Biacore 3000. The Biacore 3000 is designed to study binding of macromolecules to each other, with the possibility of examining molecules as small as ~2 kDa. The instrument accepts a chip with 4 flow cells that can be used in pairs, to compare flow cell 2 with flow cell 1 and flow cell 4 with flow cell 3, or in a single set of 4, to compare flow cells 2, 3 and 4 each with flow cell 1. Software is designed to optimize curve fitting and calculation of kinetic and binding constants.

Biacore T200. The Biacore T200 operates very similarly to the 3000 but it has a very stable baseline signal, which allows it to be used to study the binding of small molecules as well as macromolecules. The instrument accepts a chip with 4 flow cells that can be used in pairs, to compare flow cell 2 with flow cell 1, or flow cell 4 with flow cell 3. The software has been adapted to facilitate kinetics studies in a single cycle, by introducing low to high concentrations over the surface of the chip without intervening wash or regeneration steps.

BIostatISTICS SHARED SERVICE

MISSION

Quantitative biomedical research is a team sport. The biostatistician brings a strong foundation in statistics, mathematics and computational methods, augmented by knowledge of the field of application and familiarity with biomedical concepts and terminology.

CORE SERVICES

We collaborate on all aspects of design, analysis, interpretation, and reporting of quantitative biomedical research. Our most important resource is our team of enthusiastic and competent biostatisticians, bioinformaticians and administrative staff. We have expertise in many fields of ‘traditional’ biostatistics, including study/trial design and multivariable statistical modeling, but also in bioinformatics, high-dimensionality data sets, machine learning, supervised and unsupervised data analysis, mathematical modeling, simulations and much more! We perform statistical programming as needed. Major statistical software available includes SAS, R, Splus, SPSS, Stata, StatXact and East. We also develop customized computer programs for complex statistical problems.

WHAT WE DO

Biostatisticians are involved in the whole chain of quantitative biomedical research: from early formulation of research aims, to the final interpretation and reporting of study outcomes.

We like to be involved all the way. Decisions made at the study design stage will often dictate what you will be able to do when it comes to data analysis — and may ultimately affect what you can conclude from your study.

CLINICAL AND TRANSLATIONAL RESEARCH INFORMATICS CENTER (CTRIC)

MISSION

The purpose is to accelerate the translation of scientific discoveries from the basic science bench to clinical studies, bedside practice, and community intervention, through use of information technologies (IT) and informatics. CTRIC enables and advances research through various services, which support clinical and translational research. CTRIC offers a variety of services to assist University of Maryland Baltimore faculty with their research needs at any stage in the process.

CORE SERVICES

Research Design: CTRIC staff is trained to make recommendations on appropriate study design, selection of suitable measures and variables, and data analytic strategies. CTRIC can also give assistance with power and sample size calculations.

Data Capture.

CTRIC employs both web-based and scannable paper-based form technologies which minimize manual data entry in order to increase the speed and accuracy of collected data entered in the database.

Database Creation and Data Storage.

CTRIC can organize study data from across various locations and software packages into a cohesive, easy to use database, allowing the researcher to have ready access to any collected data. CTRIC can construct databases in a variety of different formats (PostgreSQL, MySQL, Microsoft Access, etc.) based on the needs of the researcher. Databases can be created to accept ongoing data entry or for extraction of datasets from pre-existing databases. CTRIC offers secure, HIPAA compliant data storage.

Data Management.

CTRIC maintains each project's relational database throughout the study including an IRB approved audit log of any data changes. Data can be prepared in tables in a readable format upon request, either at intervals during the study or at the end. Data reports, detailing enrollment, missing values, or other specifications can be created as needed.

Access to data in the University of Maryland Medical System (UMMS) Clinical Data Repository.

Across various facilities, UMMS has more than 600,000 visits every year, with much of the resulting data stored in the data repository. Researchers who are interested in accessing this vast resource can be provided with guidance through the process of obtaining IRB approval, submitting a data request, and analytic strategies.

Quality Assurance/Control.

CTRIC staff can design a quality assurance plan specific to a researcher's study database and run regular reports to indicate improbable and impossible values in the database.

Data Analysis.

CTRIC staff is available to provide a wide range of data analysis services, from *t*-tests and analysis of variance with repeated measures to complex regression analysis. CTRIC provides annotated documentation of the analysis results, ensuring clear understanding of both the statistical tests used and proper interpretation of the results; CTRIC can also prepare graphs and tables, as well as draft appropriate portions of the Results section for a manuscript or scientific poster.

CONFOCAL MICROSCOPY CORE FACILITY

MISSION

The Confocal Core's mission is to provide researchers with a wide array of state-of-the-art confocal imaging equipment to enable acquisition of high resolution images (both *in vivo* and *in vitro*). The Confocal Core offers training and assistance in the use of multiple confocal microscopes housed in our facility. Optimization of data acquisition and image processing are both part of the training, thus enabling researchers to efficiently design studies, acquire image data and extract relevant data features. The confocal facility is available to all UMB researchers and extramural users on a fee-for-service basis.

CORE SERVICES

The facility provides individual instruction on an array of confocal microscopes. The needs of the researcher are considered in choosing which microscope will best suit the experimental design. Facility users can be trained to utilize the machine best matching their respective imaging requirements. In general, imaging of fixed samples, cultured cells, organ slices and small animals can be accommodated. Imaging techniques including FRET, FRAP, photoactivation and uncaging are readily implemented. The microscopes have excitation sources that cover most fluorophores with excitation ranging from 355-633 nm. Multiphoton excitation of fluorophores is also available on select instruments. An image analysis workstation equipped with software packages is available to users.

The Core also has a culture room with an incubator, culture hood and a wide-field fluorescence microscope for use in preparation of cultured and live samples. Preparation of live animals for imaging experiments can also be done in this newly renovated space.

CORE INSTRUMENTATION

Zeiss 710 NLO & Zeiss 7MP

- Upright confocal microscope with single photon and multiphoton excitation capabilities for imaging live cells, slices and whole animals
- Excitation wavelengths 730 to 1300 nm; 2PMT and 2 sensitive GaAsP detectors
- Can be combined with electrophysiology or other measures

Zeiss 5-Live & Zeiss 510

- Point-scanning and slit-scanning confocal microscope
- Fast acquisition frame rates for studying dynamic cellular processes at physiological temperatures
- Dual scan heads (5-Live) allow simultaneous imaging and optical manipulation
- Excitation (488, 543, 560, 633 nm, Ti:Sapphire laser)

Olympus LCV Incubated Microscope

- Widefield inverted microscope allowing continuous imaging of cells for hours or days
- Fluorescence and DIC imaging on multiple positions
- Cell migration, cell division, wounding and repair processes, phagocytosis

Olympus FV300/Atomic Force Microscope

- Inverted confocal microscope capable of multicolored imaging
- Equipped with an Atomic Force Microscope accessory (AFM, Bruker)
- Combines the capabilities of confocal imaging with atomic force microscopy to enhance experiments

CYTOGENETICS LABORATORY

MISSION

Our laboratory offers cytogenetic and molecular genomic diagnosis for both constitutional and acquired chromosome abnormalities. We focus on the detection and characterization of subtle chromosome abnormalities in hematological malignancies/ stem cells, as well as roles of telomere biology in cancer and human aging.

CORE SERVICES

The Cytogenetics Laboratory is a CLIA-certified and CAP accredited facility that offers comprehensive cytogenetic diagnosis for both constitutional and acquired chromosome abnormalities. It provides conventional karyotype analysis and fluorescence *in situ* hybridization (FISH) studies for the detection and characterization of chromosome abnormalities in clinical specimens and in established cell lines. The Cytogenetics Laboratory includes an American Board of Medical Genetics-certified clinical cytogeneticist/clinical molecular geneticist, highly knowledgeable laboratory supervisors, and well-experienced staff.

SERVICES OFFERED

- Chromosome studies on multiple sample types including peripheral blood, bone marrow, fibroblasts and solid tissues (Karyotype)
- FISH testing
- Microarray data analysis

CORE INSTRUMENTATION

Automatic Interphase and Metaphase finder

- Metasystems Metafer Slide Scanner and Ikaros/Isis Analysis software
- Automatic export of high resolution images for analysis

Chromosome Studies (Karyotype)

FISH Testing

- Whole chromosome painting
- Centromere probes
- Subtelomere probes
- Microdeletion probes
- Cancer probes
- Other locus-specific probes

Cytogenomic Microarray Analysis

CYTOKINE CORE LABORATORY

MISSION

The UM SOM Cytokine Core Laboratory (CCL) is an academic-based, fee-for-service laboratory dedicated to providing a high-quality, low-cost cytokine, chemokine and growth factor measurement service for both intramural and extramural investigators.

CORE SERVICES

The CCL offers an extensive list of human, mouse, and rat cytokine, chemokine and growth factor assays. We offer two assay platforms, ELISAs and Multiplex. Both platforms have their own unique advantages and disadvantages.

The lab offers in-house ELISA protocols utilizing validated commercial reagents and have the ability to order commercial kits for those less common biomarkers. Using in-house protocols allows us to greatly reduce costs while still upholding high standards in quality.

We utilize a Luminex™ 100 system for our multi-analyte assays using high quality fully customizable commercial kits from the country's leading vendors in multiplex technology.

The CCL is here for every investigator from beginning to end. We are happy to help with experimental design all the way through to data interpretation.

Our turnaround time is approximately 10 business days, and data are emailed to the investigator in a user-friendly Excel format.

CORE INSTRUMENTATION

Luminex 100 Multi-analyte system

- This system allows for the simultaneous measurement of up to 100 analytes in a single well. The machine utilized two lasers, a reporter laser at 532 nm and a classification laser at 635 nm, to detect and measure fluorescently dyed microspheres. This allows for smaller sample requirements with a larger data output. Bio-Rad's Bio-Plex Manager software is used for data requisition and analysis.

Molecular Dynamics Precision Microplate Reader

- The reader is used for all ELISA applications. It has 8 filters with the ability to change to others as required to read plates at multiple wavelengths. It reads 96-well plates in a matter of seconds and paired with the SoftMax Pro software it becomes a powerful machine to cover all ELISA needs.

BioTek ELx50 Plate Washer

- BioTek's ELx50 Microplate Washer is a fully programmable instrument that allows for full control of plate washing required for ELISA assays. Automated plate washers allow for higher throughput and for lower CV% over standard manual washing.

Results for both the ELISA and Multiplex can be customized to your needs. Results can include individual measurement results, means, standard deviations, and coefficient of variation.

If you are generating preliminary data, contact us to discuss our Pilot Development Program, which allows for data for a smaller number of samples for one set price.

All of our assays are run with an internal control to ensure optimal assay function and every plate includes a 6- to 7- point standard curve.

ELECTRON MICROSCOPY CORE IMAGING FACILITY

MISSION

The Electron Microscopy Core Imaging Facility provides electron microscopy related research, consultation and imaging services to all faculty and staff of the University of Maryland Baltimore campus and the academic and industrial community in the Washington, D.C. and Baltimore areas. The objective of this facility is to provide affordable electron microscopy research services using the modern EM techniques and state-of-the-art instrumentation from sample processing to image acquisition and analysis.

CORE SERVICES

- Conventional TEM sample preparation, including embedding in various types of resin and ultrathin sectioning
- Conventional SEM sample preparation, including chemical dehydration, critical point drying and sputter coating
- Cryo-sample preparation for both TEM and SEM, including high pressure freezing, freeze substitution, cryo-ultramicrotomy, plunge freezing and freeze fracture
- Immuno electron microscopy using pre-embedding, post embedding or Takuyasu methods
- Negative staining of purified macromolecular complexes, bacteria, viruses, liposomes, nanoparticles, or viral like particles (VLP)
- Advanced microscopy techniques, such as cryoEM, correlative LM/EM (CLEM) and 3D EM
- Electron microscopes imaging for trained or novice users
- Advanced consultation and training of electron microscopy related techniques and equipment usage
- Annual Current Electron Microscopy Techniques workshop
- Annual Ultramicrotomy Minicourse
- Instrument demonstration

CORE INSTRUMENTATION

Transmission Electron Microscope

FEI tecnai T12 is a high performance, high resolution transmission electron microscope equipped with a tungsten filament. It is well suited to be a general purpose instrument in a multi-user facility. The tecnai T12 is also equipped with a Gatan 626 cryo transfer holder for observing frozen hydrated biological sample at liquid nitrogen temperature.

Scanning Electron Microscope

The FEI Quanta 200 is a versatile high performance, low-vacuum scanning electron microscope with a tungsten electron source. It can be operated in three different vacuum modes, High Vacuum (HV), Low Vacuum (LV) and Environmental Mode (ESEM), thus accommodate a wide range of sample of any SEM system. The Quanta 200 is also equipped with a Gatan Cryo transfer unit (ALTO2100) for cryo SEM imaging and freeze fracture.

Automated Specimen Processor

ASP01000 is a multifunctional robotic specimen processing platform. The instrument is controlled through a bioreaction automation software, COBRA, and can be programmed to perform specimen fixation, dehydration, embedding, negative staining and immunogold labeling, etc., in automation.

Cryo Sample Preparation Instruments

- High Pressure Freezer
- Automated Freeze Substitution
- Plunge Freezer
- Cryoultramicrotome
- Gatan TEM Cryotransfer Holder
- Gatan SEM Alto Cryo Chamber

FLOW CYTOMETRY AND MASS CYTOMETRY CORE

MISSION

To ensure that University of Maryland investigators have access to flow cytometry and mass cytometry services for their research. A facility with dedicated operators ensures well-performing instruments and optimal results with a minimal outlay of expenses. Established in 1991, this facility has state-of-the art equipment and a highly-trained and experienced staff.

CORE SERVICES

Multichromatic flow cytometry

- Including markers for:
 - Lineage
 - Maturation
 - Activation
 - Homing
 - Intracellular cytokines

Cell sorting (up to 6-way) based on GFP and/or multichromatic staining

Mass Cytometry (>60 parameters)

Serum/supernatant cytokine levels using bead kits (e.g. BD Pharmingen CBA kit)

Cell cycle analysis (PI, DAPI)

Cell proliferation (CFSE, PCNA, BrdU and Ki67)

Apoptosis (Annexin V vs. PI; TUNEL; subG0/G1 peak analysis)

Green fluorescence protein (GFP) (eukaryotic and prokaryotic)

Advice with experimental design and data analysis

CORE INSTRUMENTATION

BD LSR II Flow Cytometer

- **4 lasers:** 407, 488, 552, and 641 nm
- **16 parameters** (14 colors plus forward and side scatter)

Beckman Coulter MoFlo Astrios Cell Sorter

- **4 lasers:** 355, 407, 488, and 641 nm
- **21 parameters** (19 colors plus forward and side scatter)
- **Up to 6-way high speed sorting**
- **CyCLONE single cell sorting**

Fluidigm CyTOF Mass Cytometer

- **>35 parameters** based on mass spectrometry detection of metal isotope-labeled antibody staining
- No need for single color controls or fluorescence compensation

Fluidigm Helios Mass Cytometer

- **>60 parameters** based on mass spectrometry detection of metal isotope-labeled antibody staining
- No need for single color controls or fluorescence compensation

FLOW CYTOMETRY SHARED SERVICES

MISSION

The University of Maryland Greenebaum Comprehensive Cancer Center Flow Cytometry Shared Service (FCSS) offers equipment and technical expertise to the entire campus, as well as outside clients in conducting research in all areas of basic and applied biomedical sciences. The FCSS provides full-scale, state-of-the-art flow cytometry services from sample acquisition through data analysis to cell sorting.

CORE SERVICES

The FCSS provides state-of-the-art instrumentation and technical support for sample acquisition and cell sorting, data analysis and interpretation, as well as training and experimental consultation and strategic planning.

- Operator-assisted sample acquisition
- Sample acquisition by user
- High throughput sample acquisition
- Operator-assisted data analysis with FlowJo or FACSDiva
- Data analysis by user on FCSS workstation
- Operator-assisted cell sorting
- Training for sample acquisition on analytical instruments
- Training on FACSDiva operating system
- Experimental planning and consultation

CORE INSTRUMENTATION

The facility has state-of-the-art analysis instruments used for quantitative analysis.

- **BD LSRII Flow Cytometer with High Throughput Sampler Option**
- **BD FACS CANTO Cytometer**
- **Amnis FlowSight**

The facility is also equipped with a state-of-the-art high speed cell sorter.

- **BD FACSAria II**

CENTER FOR FLUORESCENCE SPECTROSCOPY

MISSION

The Center for Fluorescence Spectroscopy (CFS) provides state-of-the-art fluorescence instrumentation for studies of structure, function, and dynamics of biological macromolecules. CFS also provides the expertise on applications of fluorescence for bioassays and cellular imaging.

CORE SERVICES

The CFS makes available state-of-the-art spectroscopic instrumentation and techniques for fluorometric bioassay development and cellular imaging.

Techniques include:

- Fluorescence energy transfer (FRET)
- Fluorescence polarization (FP)
- Fluorescence correlation spectroscopy (FCS)
- Single molecule detection (SMD)
- Time-resolved spectroscopy
- Fluorescence lifetime imaging microscopy (FLIM)

Facility also provides technical expertise on all aspects of fluorescence techniques used in basic science and biological/medical applications.

Cell imaging and studies of biomolecule interactions of assemble molecules and on single molecule basis are available with fluorescence microscopies.

CORE INSTRUMENTATION

Fluorescence Lifetime Imaging Microscope

State-of-the-art imaging system, Alba V (FLIM and FCS) is designed for cellular imaging and bioassay readout and quantitative analysis. The system is equipped with multiple lasers, multiple channels, dual scanners and dual lifetime imaging capability (TD and FD).

Single Molecule Fluorescence Microscope

- Multiple lasers
- Lifetime capability
- FCS

Time-Resolved Fluorescence Spectrometer

- Super Continuum Laser
- Automated system

Atomic Force Microscope and NSOM WITec alpha300S

- Contact Mode
- AC Mode
- Confocal capability

GENOMICS RESOURCE CENTER (GRC)

MISSION

The Genomics Resource Center (GRC) is a high-throughput core laboratory and data analysis group supporting the scientific programs of the Institute for Genome Sciences, University of Maryland Baltimore and its collaborators utilizing state-of-the-art technology to generate high quality genomic data in a cost effective manner.

ABOUT GRC

Led by Dr. Lisa Sadzewicz, Administrative Director, and Mr. Luke Tallon, Scientific Director, who together have more than 40 years' experience in managing high-throughput sequencing and analysis operations, the multi-disciplinary GRC group includes scientists, bioinformatics software engineers, bioinformatics analysts, project managers, and research specialists who have extensive experience in planning and managing projects, ranging in scope from small-scale amplicon and plasmid sequencing to large-scale comparative genomic and transcriptome sequencing.

The laboratory services offered by the GRC include sample quality assessment, library construction, sequencing and analysis of a broad range of sample types.

APPLICATIONS AND SERVICES

Sequencing Applications

- *de novo* Whole Genomes
- Comparative Genomes
- Human Genomes & Exomes
- Transcriptomes
- Custom Capture
- ChIP-Seq
- Methylation & Base Modification Detection
- Ecological and Organismal Metagenomes
- Amplicon Sequencing
- Custom Applications

Analysis Services

- Genomic and Metagenomic Sequence Assembly
- Comparative Genome Analysis
- Phylogenomic Analysis
- SNP, Indel, and Structural Variant Detection
- Epigenomic Analysis
- Pathway & Network Analysis
- Sequence Data Storage and Distribution
- Custom Data Analysis

Our Sequencing Platforms

- Illumina HiSeq 2500 & 4000
- Illumina MiSeq and MiSeqDx
- PacBio RS II & Sequel
- Oxford Nanopore MinION
- NanoString nCounter MAX
- 10x Genomics Chromium System

GENOMICS CORE FACILITY (BASIC AND CLINICAL SERVICES)

MISSION

The mission of the Genomics Laboratory is to provide the expertise, state-of-the-art resources and training necessary to promote cutting edge basic, translational and clinical genomic research, as well as clinical molecular testing under Clinical Laboratory Improvement Amendments (CLIA) and College of American Pathologists (CAP).

ABOUT

The Genomics Laboratory is committed to maintaining technologically advanced methodologies and instrumentation. We also provide an educational environment to instruct faculty, staff, fellows and students on the latest technologies and how they can positively impact on their research. Our staff are available to share their extensive knowledge and expertise in order to successfully support the research being conducted within the institution. Two separate laboratories make up the Genomics Shared Services: RGL and TGL.

RESEARCH GENOMICS LABORATORY SERVICES (RGL)

- Cytogenomic Arrays
- Extraction of Nucleic Acid
 - DNA
 - RNA
- Gene Expression Arrays
 - Global Expression Profiling
 - miRNA Expression Profiling
 - Transcriptome Analysis
- Genotyping
 - Taqman Assays
 - SNP Arrays (targeted or GWAS studies)
- Next Generation Sequencing (NGS) Gene Panels
- Sanger DNA Sequencing

TRANSLATIONAL GENOMICS LABORATORY SERVICES (TGL)

- *BTD* Sequencing
- Confirmation of a Research Finding
- *CYP2C19* Genotyping
- *CYP2C19* Sequencing
- Cytogenomic Microarray
- Extract and Hold
- FLT3
- *IDH1* R132_ *IDH2* R140 and R172
- Site-specific Familial variant analysis

CORE INSTRUMENTATION

- Affymetrix GeneChip 3000 systems
- Agilent Bioanalyzer model 2100
- Applied Biosystems Model 3730XL DNA Sequencers
- Applied Biosystems Model 7900 rtPCR System
- Ion Torrent Personal Genome Machine (PGM) Sequencers
- Ion Torrent Chef System
- Ion Torrent S5
- Nanodrop single-channel and 8-channel spectrophotometers
- ThermoFisher QuantStudio

INFORMATION RESOURCE CENTER

INTRODUCTION

The Informatics Resource Center (IRC) under the direction of Anup Mahurkar provides genomics and bioinformatics services to the UMB campus. Mr. Mahurkar works closely with Owen White, PhD, the Director of Bioinformatics for School of Medicine and the Associate Director of the Institute for Genome Sciences, and Michelle Gwinn Giglio, PhD, Associate Director for Analysis.

The IRC includes a staff of over 30 scientists, engineers, systems administrators, and analysts that work together to conduct research and development in bioinformatics and provide analysis services. The IRC staff is organized along scientific platforms and functional areas of expertise. The major scientific platforms supported by IRC include prokaryotic, eukaryotic, viral, and mammalian genomics; metagenomics, informatics, and systems biology.

ANALYSIS SERVICES

The IRC has developed and maintains several analysis tools and pipelines that facilitate research at the UMSOM. These include:

- **Genome assembly and annotation.** Pipelines for both prokaryotic and eukaryotic organisms are available. These include both reference-based and reference-independent protocols
- **Differential expression analysis.** The IRC has pipelines to conduct gene and isoform level differential expression analysis using microarrays or RNA-Seq
- **Genome variation analysis.** Pipelines for single nucleotide polymorphism (SNP) and copy number variant (CNV) detection and visualization
- **Metagenome/Metatranscriptome Analysis.** Pipelines are available for analysis of microbiome community composition and functional dynamics from 16S, Whole Metagenome Shotgun sequence, and metatranscriptome sequencing
- **Custom Programming and Analysis.** IRC staff have expertise to develop custom pipelines, analysis tools, websites, databases, and custom applications

OUTREACH AND EDUCATIONAL PROGRAMS

The Institute for Genome Sciences offers regular professional development workshops.

Workshop topics include:

- Genomics
- Metagenomics
- Transcriptomics
- Programming

More information can be found at <http://www.igs.umaryland.edu/education/workshops.php>

CORE FOR TRANSLATIONAL RESEARCHING IN IMAGING @MARYLAND (C-TRIM)

MISSION

To provide full-fledged access to research using Magnetic Resonance Imaging for humans and large animals to discover new imaging markers, understand brain function, and to translate basic science to the clinic.

Objective: To provide a collaborative environment to imaging researchers, that leads to innovation that can be rapidly translated to the clinic.

CORE SERVICES

The staff of C-TRIM provides consultation on all imaging related research. Assistance is available for the design of experiments and to optimize imaging techniques. The staff also provides assistance in image processing and image analysis. Training is provided to users upon request. The core conducts an annual retreat where specific areas of imaging research are highlighted.

One aspect of the core is to develop new technologies with the goal of making available state-of-the-art techniques to investigators. Through this core, investigators have access to facilities at the Center for Metabolic Imaging & Therapeutics (CMIT).

CORE EQUIPMENT

Siemens Prisma^{fit} 3 Tesla Whole Body MRI System

- Siemens Prisma^{fit} 3 Tesla whole body MRI System with high-speed gradients (XR 80/200)
- 64 receiver channels with head, body array, knee, wrist coils
- High-resolution anatomic imaging (~70-mm resolution) for CNS and body applications
- Tumor kinetics
- Metabolomic studies
- Fat/Water imaging and quantification
- High-resolution Diffusion Tensor and Diffusion Kurtosis Imaging for detecting microstructural and cellular changes
- Cardiac Functional Analysis and Vascular studies
- Cerebral blood flow studies using endogenous contrast
- Functional MRI and Resting state brain networks
- Interventional Imaging

GE SpinLab Dynamic Nuclear Polarizer

- Hyperpolarization of C-13 substrates (pyruvate, fumarate, glutamine etc) for detection *in vivo*
- Four sterile sample sizes up to 100 mL of 250 mM C-13 substrates for human applications
- Detection of downstream metabolic products *in vivo* in real-time
- Ability to determine metabolic fluxes, for example to determine aggressiveness of tumor
- Metabolic response to therapeutic drugs

MR guided Focused Ultrasound (MRgFUS)

- Insightec Neuro ExAblate system for neuro-interventions
- 1024 element high-intensity focused ultrasound (HIFU) system
- Ability to focus ultrasound beam within 2 mm radius
- MR temperature mapping to facilitate brain interventions
- Neuromodulation Studies
- Blood brain barrier opening for delivery of nanoparticles
- Translational studies

NUCLEAR MAGNETIC RESONANCE CENTER

MISSION

The objective of the UMB NMR Center is to promote the use of nuclear magnetic resonance spectroscopy for use in ongoing and new research projects at the University of Maryland School of Medicine.

CORE SERVICES

We offer assistance and training for:

- Collecting NMR data
- Processing NMR data
- Analysis of NMR data

ADDITIONAL CORE SERVICES

- Linux and Apple workstation access for data processing and analysis
- Lab space for sample handling
- Assistance with NMR-related computer software including Bruker Topspin, NMRView, mrPipe, nmrDraw, xplor-NIH, and several others

CORE INSTRUMENTATION

- 600 MHz Bruker Avance III NMR Spectrometer with TCI cryoprobe
- 800 MHz Bruker Avance Spectrometer with TXI cryoprobe and BACS 60 automatic sample changer
- 950 MHz Bruker Avance III Spectrometer with TCI cryoprobe

PATHOLOGY BIOREPOSITORY SHARED SERVICE

MISSION

Pathology Biorepository Shared Service (PBSS) provides access to a collection of high quality banked patient samples while maintaining patient confidentiality. PBSS provides pathology, histology, and histotechnology services to assist with procurement, analyses, and clinicopathologic correlations of human tissue specimens. Access to a high-quality bank of patient samples permits UMGCCC investigators to perform studies aimed at understanding the biology of normal and diseased tissues with an ultimate goal of translating this knowledge into diagnostic and clinical applications

ABOUT PBSS

Pathology and Biorepository Shared Service was established by UMGCCC in 2006 as a developing core. PBSS has both the unique advantage of the long-standing expertise gained under the well-established relationship with the NCI as well as the advantage of existing expertise and archives of the Pathology Department.

PBSS is the only tissue bank shared service for specimens removed at surgery on the campus. We have an integrated relationship with the Anatomic Pathology Department, which is essential for obtaining well-characterized tissue samples as well as for pathology and histology expertise. Frozen tissue archives of PBSS consist of more than 7,000 frozen tumor samples, 5,900 of which are paired with normal tissue from the same patient, and more than 22,000 frozen mononuclear cell isolates, plasma, and serum samples.

CORE SERVICES

TISSUE PROCUREMENT AND PROCESSING SERVICES

- Fresh or Frozen tissue
- Plasma and serum collection
- Bone marrow and peripheral blood mononuclear cell isolation
- Biospecimen storage and retrieval
- Rapid collection and storage methods
- Project/protocol-specific procurement

TRANSLATIONAL RESEARCH SUPPORT

Histology Services

- Tissue processing and embedding
- Sectioning and staining
- Immunohistochemistry (IHC), including antibody work-up and control tissues
- Special Stains
- Tissue Microarray (TMA) Construction

Digital Image Analysis Services

- Aperio digital IHC and TMA software
- Quantitative IHC

Data Services

- Association of archived and prospectively collected tissue with clinical data
- Prospectively maintained and queryable database for all collections

Consultation Services

- Pathology consultations
- Interpretation support
- IRB application assistance
- Material Transfer Agreement (MTA) submission support

PHYSIOLOGICAL PHENOTYPING CORE

MISSION

The Physiological Phenotyping Core (PPC) provides cutting-edge phenotyping services with a focus on cardiovascular and respiratory systems. The core has a 10-year track record of services, including microsurgery, telemetry recordings, high-frequency ultrasound, and pressure-volume loop analysis.

CORE SERVICES

- Microsurgery and animal models: catheter and device implanting; coronary artery ligation; aortic banding; artery wire denudation or ligation; chronic hypoxia
- Biomicroscopy (high-frequency ultrasound) of the hearts, large or small vessels, tumors, or abdominal organs
- Acute *in vivo* measurements: hemodynamics, pressure-volume loop analysis, respiratory mechanics, sympathetic nerve activity
- Long-term recordings: blood pressure, aortic or organ blood flow, sympathetic nerve activity, ECG, EEG, EMG, temperature
- Equipment Rent

CORE INSTRUMENTATION

- Vevo 2100 High-frequency Ultrasound System (VisualSonics), the most updated system that allows high-resolution imaging under B-, M-, color and pulse-wave Doppler mode, 3-D construct, and Vevo strain. (Figures: Mouse Echo; Tumor Imaging)
- Telemetry System (DSI) allows long-term recordings of blood pressure, biopotential (ECG, EEG, EMG), sympathetic nerve activity, and blood glucose concentration. It can be interfaced with flowmeters (Transonic), e.g., for simultaneously long-term recordings of blood pressure and cardiac output (Figure: Long-term BP and CO)
- MP150 Acquisition System (BioPac): 16-channel modular system interfaced with various transducers or amplifiers of pressure, volume, flow, biopotential, and temperature, as well as Mikro-tip catheters (Millar), flowmeters (Transonic), and cardiac output computer (Columbus Instruments)
- Environment System (Kent Scientific) allows customized exposure of hypoxia or hyperoxia (Figure: CIH setup)
- Pressure-volume loop system (Transonic) for comprehensive analysis of cardiac function *in vivo* or in isolated heart preparation
- Tailcuff Blood Pressure System (SC1000, Hatteras)

TRANSLATIONAL LABORATORY SHARED SERVICE

MISSION

The University of Maryland Greenebaum Comprehensive Cancer Center Translational Shared Service (TLSS) offers pre-clinical and clinical experimental support to basic researchers and physicians in the UMGCCC community. We work in areas across the entire spectrum: cell biology, *in vitro*, *in vivo* and human trials.

CORE RESOURCES

- Access to 50+ human cell lines
- Luciferase-expressing breast, leukemia, ovarian and prostate cancer cell lines
- IACUC approved umbrella protocol
- Access/Knowledge in Using Xenogen/IVIS Imaging Mice
- Primary Xenograft Models
- Breast
 - Leukemia (under development)
 - Ovarian (under development)

Access to IRB approved protocol for tissue acquisition

Clinical Trial Support

We isolate:

- Plasma
- Serum
- Tumor Biopsy
- Whole Blood (isolation of PBMC, DNA, RNA, protein)
- Bone Marrow (isolation of marrow cells)
- Buccal Mucosa

CORE SERVICES

In Vitro Assays

- IC50 generation
- Cell cycle (propidium iodide)
- Viability (trypan blue exclusion)
- Apoptosis
- Potentiation/Synergy
- ROS
- Western Analysis
- Angiogenesis
- Mycoplasma testing

Xcelligence

Real time proliferation/invasion/migration

In Vivo Assays

- IACUC approved umbrella protocol
- Tolerability
- Tumor Growth
- Pharmacokinetics: generation of plasma
- Efficacy (flank models)
- Efficacy (orthotopic models)
- Pharmacodynamic Endpoints
- Imaging of cells with Xenogen System

Pharmacodynamic (PD) Endpoints

- in-patient samples, tumor or surrogate tissues, preclinical samples
- Endpoint dependent on target (e.g., ELISA, flow cytometry, Western, unique assay)

UNIVERSITY OF MARYLAND MEDICINE (UMM) BIOREPOSITORY

MISSION

The objective of the UMM Biorepository is to provide the resources and support for large-scale studies to empower basic and clinical researchers to make discoveries in genomics and 'omics' science and to translate these discoveries to more effective diagnostics and therapeutics.

ABOUT

The UMM Biorepository is a resource building effort that includes banking of blood samples from UMMS patients as well as collections of various biospecimens from collaborating UM researchers. State-of-the-art robotic freezer and liquid-handling equipment offers a secure and managed environment for biospecimen processing, storage and distribution. Data connected to the samples is obtained through the electronic health record and/or study-specific data collection, allowing for multi-disciplinary research that can impact a range of health issues.

CORE SERVICES

Laboratory

- Sample processing & banking
- DNA/RNA extraction & banking
- Sample storage
- Sample retrieval

Clinical Research Support

- IRB protocol preparation assistance
- Consenting
- Phlebotomy/sample collection
- Survey administration

MAJOR EQUIPMENT

Hamilton Biorepository (BiOS) Freezer System

- state-of-the-art automated, ultra-low temperature (-80°C) freezer system
- equipped to accommodate over 900,000 biospecimens

Microlab chemagic STAR liquid handling system (Hamilton)

- DNA/RNA extraction

Microlab STAR liquid handling system (Hamilton)

- Sample aliquoting and set up specific assays using retrieved samples

μQUANT CORE FACILITY (IHV)

MISSION

The μQUANT Core Facility housed within the Institute of Human Virology provides quality immunological analyses of biological analytes to researchers at the UM SOM, as well as other collaborators locally and nationally. Our aim is to provide consistent service that allows researchers to compare results generated this week with those gathered last month or a year ago.

CORE SERVICES

Services offered include, but are not limited to:

- ELISAs
- PBMCs
- Immunoassay setup & protocol establishment
- Luminex assays
- Mycoplasma & endotoxin testing
- Monoclonal antibody and recombinant protein screening, production, purification, & labeling
- HIV, SIV, & SHIV culture
- TCID50 and neutralization assays
- Quantitative PCR

CORE INSTRUMENTATION

SPECTRAMAX M2 6-96 WELL PLATE READER

- 6-well to 96-well plate reading capability
- Built-in absorbance and fluorescence
- Absorbance wavelength between 200 nm and 1000 nm, excitation wavelength between 250 nm and 850 nm, and emission wavelength between 360 nm and 850 nm

WALLAC VICTOR 2 MULTI-ANALYTE PLATE READER

- Complete platform for quantitative detection of light-emitting or light absorbing markers
- Luminescence, fluorescence, time-resolved fluorescence (DELFI), and photometer

VERITAS MICROPLATE LUMINOMETER

- Read glow and flash luminescent reactions in 96-well plates

BIO-PLEX 200 SYSTEM

- Simultaneously quantitate up to 100 analytes per sample from culture media and serum
- Automatically analyze up to 96 samples in 30 min
- Instantly customize your assay by mixing Bio-Plex assay, or create your own assays
- Dramatically increase the amount of useful data obtained from a single sample

StepOnePlus REAL-TIME PCR SYSTEM

QuantStudio 3 Real-Time PCR SYSTEM

- 96-well Real-Time PCR instrument with sensitive 4-color optical LED recording system

SimpliAmp PCR THERMAL CYCLER

VETERINARY RESOURCES/PROGRAM OF COMPARATIVE MEDICINE

MISSION

Our mission is to study the characterization of animal models of human disease; provide accredited services for laboratory animal care through collaborative research, professional development of veterinarians through specialty training with American College of Laboratory Animal Medicine (ACLAM); achieve continuous certification through compliance with The Association for Assessment and Accreditation of Laboratory Animal Care International (AAALACi), the United States Department of Agriculture (USDA); and the Office of Laboratory Animal Welfare (OLAW) (Public Health Service, NIH) and to act as a resource for information and instruction on the use of laboratory animals.

CORE SERVICES

- Wide range of animal models from mice to non-human primates
- GLP support for FDA/EPA-regulated studies
- Generation of polyclonal/monoclonal antibodies and induced pluripotent stem cells
- Maintain mouse colonies (SCID-NOD/NSG/NRG, nude, C57BL/6)
- Pre-research consultations with researchers on development of animal models
- Technical services provided for blood withdrawal, anesthetic support, and weaning
- Transgenic Services
- Germ-Free Laboratory - gnotobiotic mice

The University School of Medicine Program in Comparative Medicine was established in 1989. All Program faculty members hold joint appointments in other departments; conduct independent and collaborative research; and have expertise in the fields of clinical laboratory animal medicine, surgery, comparative pathology, microbiology, immunology, genetics and infectious diseases.

Comparative Medicine faculty members are available for consultation on animal research protocols, laboratory animal management and development of grant applications proposing the use of animals. Members participate in the teaching of medical students, graduate students, and postdoctoral fellows and provide postdoctoral residency and graduate training programs for veterinarians in the fields of Laboratory Animal Medicine and Veterinary Pathology.

As members of the University of Maryland School of Medicine's Veterinary Resources, we also provide veterinary supervision for husbandry and health care related to facilities management, diagnosis, treatment and prevention of intercurrent disease in research animals.

TRANSGENIC RESOURCES

Transgenic Resources and the University of Maryland School of Medicine exists to facilitate all aspects of customized production of genetically engineered rodent models. Transgenic Resources has developed a partnership with Jackson Laboratories (JAX) (you may contact George Scheer, UMB, Senior Buyer, 410-706-8305, for Terms & Conditions, Pricing) which is a proven leader in conducting transgenic knockout rodent services. The services offered are extensive and include standard transgenics, nuclease-mediated (CRISPR) knockout and knock-in mouse services, as well as ES cell injections. The mission of Transgenic Resources is to ensure that these established partnerships provide the best pricing, customization and the highest product quality to support our world class research. Louis DeTolla, VMD, PhD, will serve as Director, Transgenic Resources. DeTolla's Ph.D. is in immunogenetics and he has directed transgenic core facilities previously, both at UMB and Merck Sharp and Dohme Laboratories.

Researchers may contact our resource or directly contact the following vendors (listed below) for information and quotes for generation of their transgenic model(s).

X-RAY CRYSTALLOGRAPHY SHARED SERVICE

MISSION

The X-ray Crystallography Shared Service provides the expertise, training and equipment to help determine important proteins structures as part of the UMGCCC mission to understand the molecular basis of cancer-causing cellular defects. The X-ray Crystallography Shared Service will be most valuable in helping the UMB research community understand underlying causes of diseases and develop novel therapeutic interventions.

CORE SERVICES

The facility makes state-of-the-art robotic crystallization and automated documentation of crystallization experiments available to UMGCCC researchers.

Members of the X-ray Crystallography Shared Service are available to consult with investigators regarding sample preparation, yields, and quality.

Data collection and structure solution can also be carried out by the core for a fee.

We are also willing to consult with investigators who want to perform the structure determination themselves.

CORE INSTRUMENTATION

Alchemist DT screen maker (Rigaku)

- This instrument is a liquid-handling robot that can automatically aliquot reagents for crystallization optimization trials.

Gryphon LCP Drop Setter (Art Robbins)

- Combines an automated syringe dispenser and the pipetting head into one compact crystallization robot capable of highly accurate, precise and rapid automated plate set up. It is accurate to as low as 25 nL volumes and scaled up from there.

Minstrel DT UV automated microscope (Rigaku)

- Allows automated imaging of crystallization experiments with uV fluorescence imaging. The image takes advantage of tryptophan fluorescence to determine whether a position in the plate has protein (i.e. and not salt) crystals. The results are stored on a file server that allows remote access. This allows the investigator to see the results of their crystallization experiment from anywhere in the world.

X-ray Diffraction System

- Our Rigaku-MSM Micromax 7 generator has recently been upgraded with a VariMax-HF optical system. With the system, the beam is 50% smaller and 14.5x brighter.
- Raxis-4++ image plate detector
- Oxford cryosystems cryocooling system