

The University of Toledo has invested substantial resources to develop, maintain, and expand Core Laboratories. This brochure is designed to make the UT Core Labs more visible in the community. The UT Core Labs include the Advanced Microscopy and Imaging Center, Flow Cytometry Core, Genomics Core (College of Medicine and Life Sciences), Instrumentation Center, Nuclear Magnetic Resonance Facility (College of Natural Sciences and Mathematics), Center for Drug Design and Development (College of Pharmacy and Pharmaceutical Sciences), and Center for Materials and Sensor Characterization (College of Engineering). These Core Labs are equipped with state-of-the-art instruments and offer cutting-edge technological services in various research fields.

Major instruments include: multiphoton laser scanning microscope, confocal microscopes, laser capture microdissection system, in vivo imaging systems, multicolor high-speed cell sorter, microarray scanner, MALDI-TOF/TOF mass spectrometers, scanning and transmission electron microscopes, robotics for protein crystallization, nuclear magnetic resonance spectroscopies, X-ray diffractometer, and a confocal Raman spectrometer. The UT Core Labs are staffed with experts in the fields, and can provide core users with basic and advanced on-site training. Depending on user needs, they also can process and analyze samples.

Please contact individual Core Labs for specific inquiries.

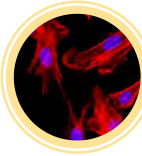
The University of Toledo

# Core Laboratories

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# Advanced Microscopy & Imaging Center (AMIC)

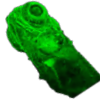


The University of Toledo Advanced Microscopy and Imaging Center on the Health Science Campus is a 3,000 square foot facility designed to bring together advanced light and fluorescence microscopy systems and “state-of-the-art” image analysis software to perform biomedical research. The AMIC consists of a 1,000 sq. ft. general microscopy laboratory that contains the following instrumentation.



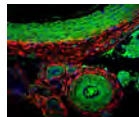
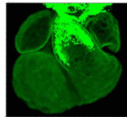
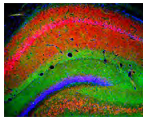
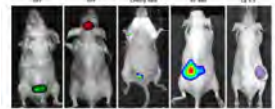
## TCS SP5 Laser Scanning Confocal Microscope

with MP is equipped with both conventional and high-speed resonance scanners. This includes conventional lasers plus multi-photon excitation (458, 488, 514, 561, 633, and a tunable Ti:Sapphire MP laser 710-990nm). This system is capable of collecting up to five colors simultaneously for quantitative confocal image analysis in both live cell and animal imaging, fixed tissue and includes the capabilities for 3-D reconstruction, FRAP, FRET, animation, stereo imaging, single layer projection, time lapse collection, and co-localization analysis.



## IVIS Spectrum whole animal fluorescence imaging system

developed by Xenogen/Caliper Life Sciences. The IVIS Spectrum is a multimodal bioluminescent and fluorescent imaging system specifically designed for noninvasive longitudinal imaging of cells and tissues in small animals. This instrument facilitates the study of biological processes via fluorescence in small animals, including tumor growth, cancer metastasis, bacterial infections, immune responses and inflammation, and regulation of tissue-specific gene expression.

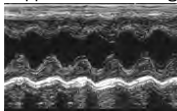


## OLYMPUS Fluoview™ FV1000 Confocal Microscope

is a next-generation imaging system designed for high-resolution, confocal observation of both fixed and living cells. The FV1000 offers advances in confocal system performance while providing the speed and sensitivity required for live cell imaging with minimal risk of damage to living specimens.

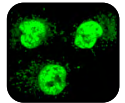
## SIEMENS ACUSON Sequoia C512 cardiac ultrasound imaging system.

This Echocardiography system is a valuable tool for studying cardiovascular disease processes in small animals, including ischemic heart disease, heart failure, cardiac hypertrophy and remodeling, hypertension and diabetic cardiomyopathy. Capabilities include high-resolution imaging, tissue harmonic imaging, differential echo amplification, spectral Doppler (pulsed and continuous wave), color Doppler (for measurements of velocity energy and tissue Doppler imaging) and color-Doppler M-mode imaging.

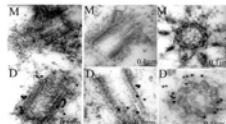


## TIRF (Total Internal Reflection Fluorescence) Microscopy

is available on an Olympus IX81 inverted microscope/imaging system that allows the visualization of fluorescent molecules either in wide-field (conventional) or exclusively at the cell-glass interface (TIRF). This latter capability allows selective, real-time tracking of single molecule or particle dynamics at the



A state-of-the-art Electron Microscopy Laboratory is part of the Advanced Microscopy & Imaging Center. The EM facility is directed by Dr. William Gunning who specializes in ultrastructural diagnosis of human disease and also provides research support to the University of Toledo. The EM lab is equipped with two transmission electron microscopes, one being used for clinical diagnostic purposes and the other available for use by researchers.



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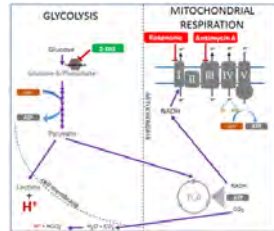
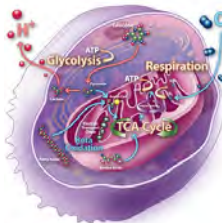
# Advanced Microscopy & Imaging Center (AMIC)

## MEASURE GLYCOLYTIC FUNCTION IN LIVE CELLS

with Agilent Seahorse XF Technology



Two Seahorse XFe Analyzers (8 and 96-well format) measure the oxygen consumption rate (OCR) and extracellular acidification rate (ECAR) of live cells in a multi-well plate to interrogate key cellular functions such as mitochondrial respiration and glycolysis. The instruments perform compound addition and mixing, label-free detection, and automatic calculation of OCR and ECAR in real time.



The Cytation™ 5 by BioTek is a cell imaging and plate reader system that combines automated digital widefield microscopy with conventional multi-mode microplate reading. With 4X, 20X and 40X magnification, the imaging module provides high-quality cellular and sub-cellular imaging in fluorescence, brightfield, color brightfield and phase contrast. The multi-mode microplate reader incorporates variable bandwidth monochromator optics and high sensitivity filter-based detection optics. Live cell imaging and multi-mode assays are optimized with incubation to 65 °C with shaking, and dual reagent injectors with Gen5 software.

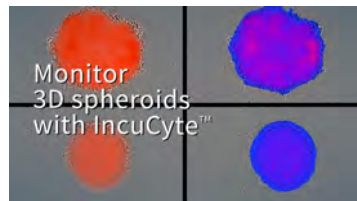
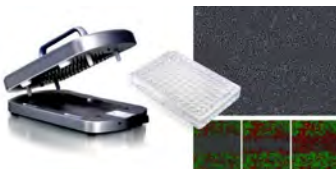


**IncuCyte®**  
by SARTORIUS



The IncuCyte S3 Live-cell analysis system is a real-time system that sits inside a standard tissue culture incubator and automatically acquires and analyzes HD, phase and fluorescent images of living cells, around the clock, for days, weeks, or months, while cells remain undisturbed. Kinetic, image-based measurements ensure you never miss a relevant response allowing for cell monitoring and surveillance, cell health and viability, migration and invasion, plus a wide range of phenotypic cell-based assays.

### Wound Healing Assays



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# Center for Materials and Sensor Characterization (CMSC)

The Center for Materials and Sensor Characterization (CMSC) is a state of the art materials and chemical characterization and research facility. CMSC has multiple laboratories housing high end characterization equipment and highly trained personnel to operate them and to perform materials related research. The mission of CMSC is to advance research and education and to serve as a transformative partner for industries. CMSC has a vision to produce competitive researchers, advance materials characterization and research, and promote economic growth in the region.

## Microscopy

- Hitachi S-4800 UHR Scanning Electron Microscope (SEM)
- FEI Quanta 3D FEG Focused Ion Beam and ESEM (FIB/ESEM)
- Hitachi HD-2300A Scanning Transmission Electron Microscope (STEM)
- Bruker Nanoscope IIIa Multimode Scanning Probe Microscope (AFM)



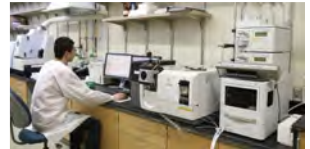
## Spectroscopy

- Perkin Elmer Frontier FTIR/NIR imaging system with array detector
- Varian Excalibur Series FTIR with FTS-4000 and UMA- 600 microscope
- Jobin Yvon Horiba Confocal Raman Spectrometer
- Bruker FT-Raman Spectrometer
- Varian 320-MS LC-MS/MS triple quadrupole mass spectrometer
- Thermo Scientific XSeries2 ICP-MS
- SensiQ Discovery Surface Plasmon Resonance (SPR)
- Shimadzu UV-2450 UV/Vis Spectrophotometer



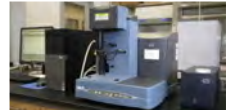
## Thermal Analysis

- PerkinElmer Diamond Differential Scanning Calorimeter (DSC)
- TA Instruments Q800 Dynamic Mechanical Analyzer (DMA)
- TA Instruments Q50 Thermogravimetric Analyzer (TGA)

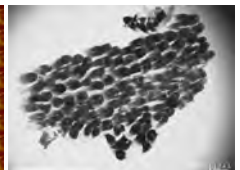
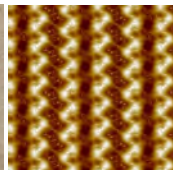
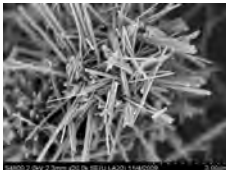


## Other Instrumentation

- Micromeritics ASAP 2020 particle and porosity analyzer
- Micromeritics gas Pycnometer
- Mars 230/60 Microwave System
- Microfluidic based particle imaging velocimetry (PIV) system
- YSI 2300 STAT PLUS Glucose and Lactate Analyzer
- Gamry Instruments Reference 600 Potentiostat with RDE710
- Tantec Model CAM-Micro contract angle meter
- Rigaku Ultima III X-ray Diffractometer (XRD) with Small Angle X-ray Scattering (SAXS)
- Shimadzu Gel Permeation Chromatography (GPC)
- Perkin Elmer Gas Chromatography (GC), with Turbomatrix ATD and Turbomatrix 40
- Instron 5566 Universal tester
- ZetaCompact automated Zeta Potential



Instruments to support analyses, such as sputter coater, ultramicrotome, critical point drier, precision saw, ultrasonicators, fluorescence microscopes and optical microscopes are also available.

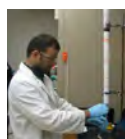
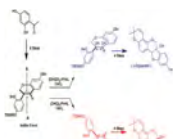
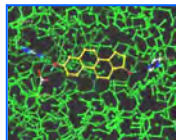


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# Center for Drug Design and Development (CD3)

The CD3 assists with the design and/or development of potential small molecule diagnostics, biomarkers, therapeutics and preventative agents, and facilitates the translation of such agents towards clinical application.



## Chemistry

### Drug Design

- X-ray structure analysis
- Computational modeling
- Virtual screening
- Structure/ligand-based design
- Prodrug/softdrug strategies

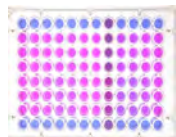
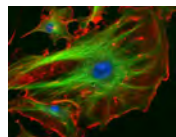
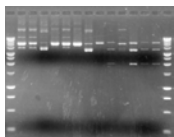
### Chemical Synthesis

- Compound libraries
- Small to pilot scale
- Analytical standards, decomposition products, metabolites

## Analytical

### Bioanalytical Chemistry

- HPLC and LC-MS/MS
- Method development/validation
- GLP compliant assays
- Formulation/stability testing
- Biological matrix analyses



## Biology

### Molecular Biology

- DNA cloning/manipulation
- Protein expression (bacteria, mammalian, insect cells)
- Protein isolation/characterization
- Real-time PCR

### In Vitro Screening

- Biochemical/cell-based assays
- Assay development/validation
- Moderate to high throughput screening
- ADMET testing

### In Vitro Testing

- Blood/tissue/urine collection
- PK testing/analysis
- Xenograft tumor models
- Fluorescence/luminescence and ultrasound imaging
- Implantable pumps



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# Genomics Core

The Genomics Core Laboratory (GCL) provides researchers and students with advanced analytical tools and approaches for biomedical research utilizing microarray technology. Microarrays can track tens of thousands of molecular reactions in parallel to detect specific genes or to measure the activity of genes. The massive amounts of data produced from these studies require “mining” or the systematic application of statistics to determine significant findings.

## Microarray Scanning

Affymetrix GeneChip® System



Hybridization Oven 640



Fluidics Station 450



3000 Scanner (6G)

PerkinElmer ScanArray® System



ScanArray 4000

## Microarray Data Analysis

There is high and increasing demand for analysis of data from microarray experiments. Statistical analysis is available by Dr. David Weaver and in some cases, consultation with Dr. Sadik Khuder, statistician in the Department of Medicine. This includes data from experiments done on the Affymetrix or PerkinElmer systems here at UT or on Illumina Bead-Array equipment through our contract with the Cleveland Clinic Foundation. Analysis can also be accomplished with data from third-party vendors or other laboratories.

### Affymetrix GeneChip® System

Users will provide biotin-labeled, fragmented cRNAs and arrays. The GCL will be responsible for hybridization, washing/staining and scanning of arrays.

### PerkinElmer ScanArray® System

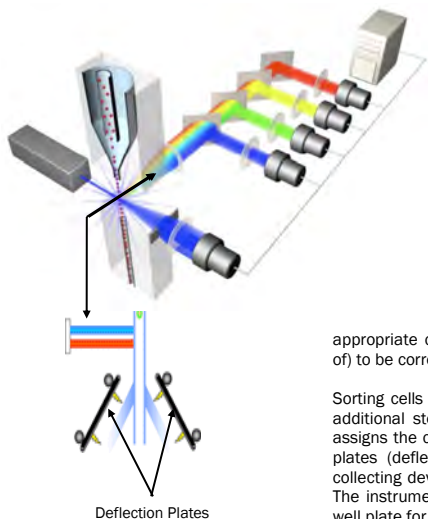
Hybridized slides, in a microscope slide array format, can be brought to the GCL for scanning. The PerkinElmer system uses lasers with 543 nm and 633 nm excitation intensities for generation of the image.

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# Flow Cytometry Core

Flow cytometry technology allows measurement and purification of cell populations or particles of interest. In combination with many fluorochromes, dyes and other flow cytometry tools, users can characterize and purify any particular cell types. Parameters that can be measured include cell surface and intra-cellular antigen expression, size, internal complexity, apoptosis, proliferation, cell cycle and many others. Cells can be analyzed or sorted at a rate of 45,000 to 50,000 events per second on the FACSria (three lasers - 488, 633, 405). The Flow Cytometry Core offers sorting of human, rodent and bacterial cells.



Staining procedures are very user friendly, and many protocols are listed on the Flow Cytometry Core website. Users can stain populations of cells in their own labs and bring them to the HSC Flow Core for analysis or purification.

As the cells pass in front of the lasers, they are examined one-by-one so that multiple parameters can be measured for individual cells. The lasers emit light in distinct wavelengths to excite the cell's inherent qualities such as size and internal complexity, along with any fluorochromes or dyes with which the cells may be stained.

The emitted light from the cells or dyes is captured by detectors, and with the help of a computer workstation, users can measure certain aspects of cells. The use of the appropriate controls (positive and negative) allow fluorescence (or lack of) to be correctly measured.

Sorting cells is just as easy and based on the same principles with one additional step. If the cell passing the lasers is of interest, the sorter assigns the cell or particle with a positive or negative charge. Electrified plates (deflection plates) push or pull the cells into the appropriate collecting device so that they can be purified based various parameters. The instrument can collect bulk cells or place 1 cell per well into a 96 well plate for cloning.

## BD FACSCalibur 488nm, 633 lasers

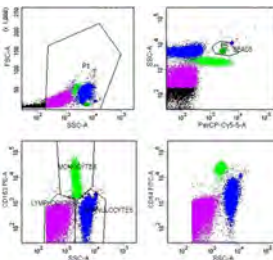
- Easy to use
- 4 color analysis
- BD High Throughput System (HTS) allows direct sample acquisition from 96 and 384 well plates
- Users can be trained on instrument for self-assist analysis 24/7

## BD FACS Canto II 488nm, 633 lasers

- Easy to use
- Up to 6-color analysis
- Users can be trained on instrument for self-assist analysis 24/7

## BD FACSria 488nm, 633nm and 405nm lasers

- 13 color, 15 parameter sorting and analysis
- Aerosol Management system for containment of pathogens
- 1, 2, 3, and 4 population sorting at one time
- ACDU option allows direct cell sorting into 6, 12, 24, 48, 96, and 384 well plates
- High viability and purity of



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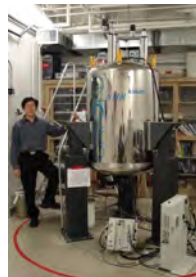
# Nuclear Magnetic Resonance Facility (NMR)

NMR spectroscopy is a powerful tool for the determination of molecular structure, the study of molecular dynamics, and the characterization of materials at the molecular level. The NMR Facility mission is to support research and teaching at the University of Toledo. Instrumentation training and consultation are available to companies that use the NMR spectrometers. The NMR Facility is located in the basement of Bowman-Oddy Laboratories. It houses 4 NMR spectrometers: Bruker Avance 600MHz, Varian Inova 600MHz, VXR 400MHz and Gemini 200MHz.

Varian Unity Inova 600 Mhz with a Penta,  $^1\text{H}\{^{13}\text{C},^{15}\text{N},^{31}\text{P},^2\text{D}\}$  probe  
It is an indirect detection probes designed for versatility in biomolecular applications. It is tuned to allow decoupling of up to four different nuclei including  $^2\text{H}$  lock.

Other probes:

- Triple Resonance,  $^1\text{H}\{^{13}\text{C},^{15}\text{N}\}$  indirect detection probe with triple axis (XYZ) gradients for superior solvent suppression
- Double Resonance Indirect,  $^1\text{H}\{^{15}\text{N} - ^{31}\text{P}\}$  probe, outer coil is tunable over the frequency range ( $^{15}\text{N} - ^{31}\text{P}$ )
- Dual Broadband ( $^{15}\text{N} - ^{31}\text{P}\}$   $^1\text{H}$ ) 5mm and 10mm probes Multinuclear probes optimized for superior sensitivity for nuclei in the typical frequency range of  $^{15}\text{N} - ^{31}\text{P}$



Bruker Avance 600 MHz with a Dual resonance 5mm Cryoprobe, DCH with Z gradient. CryoProbes. While it is optimized for  $^{13}\text{C}$  detection, the  $^1\text{H}$  sensitivity is also very good. The Cryoprobe delivers the single largest increase in NMR sensitivity in the last few decades. This enables an increase sample throughput by up to 16- fold.



Other probes

- 4 mm Top-loading DVT Multinuclear Double Resonance MAS probe tunable from 15N to 31P, with 50 $\mu\text{L}$  active volume and 15 kHz maximum spinning speed. VT range -50°C to +120°C
- 5 mm SMARTProbe™ sample diameter with actively shielded Z-gradient and digital tuning for observation over the range from 15N to 31P as well as 19F with 1H decoupling

Varian Vxrs 400MHz with versatile AutoSwitchable ( $^{13}\text{C}/^{31}\text{P}\}$   $^1\text{H}/^{19}\text{F}$ ) probes

Other probes: Dual Broadband ( $^{15}\text{N} - ^{31}\text{P}\}$   $^1\text{H}$ ) 5mm and 10mm probes

Varian Gemini 200MHz with versatile AutoSwitchable ( $^{13}\text{C}/^{31}\text{P}\}$   $^1\text{H}/^{19}\text{F}$ ) probes.

Esquire-LC (Bruker-HP) routinely configured with ESI source and manual injection. This system combines Hewlett Packard's HP1100 series HPLC with Bruker's multipole ion trap MS and MSn analyzer.

Other resources:

Atmospheric Pressure Chemical Ionization (APCI)

Nanospray



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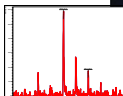
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# Instrumentation Center

In 1985 the state of Ohio appropriated money for the creation of the Instrumentation Center at the University of Toledo. The purpose of the center is to support faculty research, provide access and training for graduate students in the use of advanced instrumentation and provide a scientific support base for local industries through technical advice and sophisticated problem solving capabilities. The Center also offers outreach programs that allow cyber-access to instruments. Areas of advanced technologies include scanning electron microscopy (SEM), mass spectrometry (MS), and crystallography.

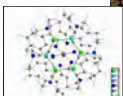
MALDI/TOF/TOF MS with a PROTEINER for LC-MALDI and ImagePrep system



SEM with a STEM detector, EDS, and EBIC applications



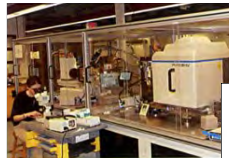
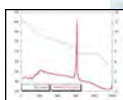
Three small molecule diffractometers



Two powder X-ray diffractometers (P-XRD)



Thermal gravimetric differential thermal analyzer (TG-DTA)



High brilliance macromolecular diffractometer



Combustion analysis (CHN Analysis)



Robots for protein crystallization



UV/Vis/NIR Spectrometer also available for use.



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The Core Research Facilities at The University of Toledo are comprised of multiple facilities located on both Main Campus and the Health Science Campus of The University of Toledo. Individual core facilities can be found on the website at:

<http://www.utoledo.edu/corelabs/>



THE UNIVERSITY OF  
**TOLEDO**  
1872