



## CU Anschutz Core Labs

Fitzsimons Innovation Community companies are able to utilize the services of the **university core labs** located in the Research Complex buildings on the adjacent CU Anschutz Medical Campus.

These facilities provide equipment and expertise that may be too expensive for many companies to efficiently develop in their own laboratories.

### CU ANSCHUTZ MEDICAL CAMPUS CORE FACILITIES INCLUDE:

- Biophysics
- Biostatistics and Bioinformatics
- Computational Biology
- Cytogenetics
- DNA Sequencing & Analysis
- Flow Cytometry
- Laboratory Animals
- PCR
- Mass Spectrometry
- Metabolic
- Micro Array
- Microscopy
- NMR
- Pathology
- Pharmacokinetics & Modeling
- Protein Expression, Monoclonal Antibody, Tissue Culture
- Pharmacology Core
- Proteomics Core
- Transgenic/Knockout
- X-Ray Crystallography

# CU Anschutz Core Labs

## Advanced Microscopy Core Lab

We have several microscopes in the R2 DOM-SOM Facility including: 1) a Laser-Scanning Confocal/Multiphoton-Excitation (MPE) and Second Harmonic Generation (SHG) fluorescence microscope with a Meta spectral detection system (Zeiss NLO 510 with META) and an environmental chamber; 2) a Total Internal Reflection Fluorescence (Zeiss TIRF) microscope with an environmental chamber; 3) a Fluorescence Correlation Spectroscopy (FCS) and Fluorescence Lifetime Imaging Microscope (FLIM) (ISS) equipped with an environmental chamber; and 4) a forthcoming Coherent Anti Stokes Raman Scattering (CARS) Microscope equipped with an environmental chamber. These microscopes allows for the high-resolution analysis of fixed samples as well as the time-resolved imaging of live cells. These microscopes are also set up to conduct biophysical studies in live cells such as fluorescence recovery after photobleaching (FRAP), fluorescence resonance energy transfer (FRET), fluorescence correlation spectroscopy (FCS) and fluorescence lifetime imaging (FLIM). These techniques are of considerable use in studying the dynamics of lipids and protein in live cells and the interactions of transcription factors and signaling molecules.

The Zeiss LSM 510 META microscope system (in conjunction with the Coherent Chameleon for both two-photon and confocal fluorescence imaging) is available for routine use, including demonstrations, hands-on training and research support. The other microscope systems are also available for specialized projects.

## Animal Models Core (IDDRC)

The objectives of the Animal Models core are three-fold: (1) to provide animal husbandry and genotyping services to IDDRC investigators; (2) to provide expertise, assistance and facilities for assessing the behavioral phenotype of genetically modified or other experimental rodents; (3) to provide access to equipment and expertise for small-animal radiologic imaging and for in-situ and in-vitro metabolomic analysis using NMR spectroscopy.

The core, in consultation with IDDRC investigators, breeds the mice, provides timed generation of pregnancies and newborn mice, administers special diets and collects blood and/or tail samples for genotyping. PCR and FISH-based genotyping are available. The core also provides training in the correct technique for making blood smears suitable for FISH analysis.

## Bio-Imaging Research Laboratory (BIRL)

The University of Colorado Bio-Imaging Research Laboratory (UC BIRL) provides image analysis and radiology review services for all clinical phases of drug development, ranging from small Phase I studies to large, international trials. Our services have been instrumental in the testing of new compounds, particularly in multiple sclerosis and the approval of Avonex™. The lab is composed of GCP and HIPAA trained professionals who have extensive training and experience in radiology, medical physics, computer science and clinical trials management. UC BIRL provides experienced project managers, interfacing with both sponsors and sites to ensure the timely receipt, review and reporting of quality data.

The UC BIRL facility supports both film and digital data, with the ability to convert between the two. Fully digital (filmless) studies can be accommodated. 21 CFR 11 compliant systems allow UC BIRL to electronically receive, QA, process, and archive medical image data in a secure manner.

Typical analyses include lesion counting and volumetrics, focal or whole-brain atrophy measures, serial registration, RECIST evaluation and lung histogram analysis. The laboratory also has the ability to process more complicated acquisitions, including diffusion tensor imaging (DTI), magnetization-transfer (MTR), and functional imaging (fMRI) using BOLD contrast. Custom data analysis for new or emerging biomarkers is available.

# CU Anschutz Core Labs

## Biomolecular NMR Core Facility

The NMR Core facilities provide access to state of the art instrumentation to researchers at UCHSC and its affiliated institutions for the study of the structure and function of biological macromolecules. NMR core staff and faculty provide assistance to other users through training or through the development of collaborations.

The facility has Varian INOVA spectrometers operating at 500 MHz and 600 MHz, and an 800 MHz NMR spectrometer, which is located at the UC Boulder campus. Recently a 900 MHz spectrometer was installed in the facility as part of the Rocky Mountain Regional NMR Resource. A variety of probes are available that are suitable for the solution NMR studies of biological macromolecules including proteins, nucleic acids and carbohydrates. There is a small wet lab that can be used for sample manipulations, and an office/computer room for visitors while using the facility.

## Biophysics Core Facility- The Program in Biomolecular Structure

We currently have resources to study biomolecular structure and thermodynamics with Biacore surface plasmon resonance phenomenon, CD/ORD, ITC, DSC, fluorescence spectroscopy, and analytical ultracentrifugation (AUC). Mass spectroscopy, LC/MS/MS, HPLC, amino acid analysis are also available.

## Biorepository Core Facility

The University of Colorado Denver Biorepository (UCDBCF) housed in the Department of Pathology functions as a campus-wide biorepository facility offering a wide range of services to the University of Colorado Denver (UCD) research community and beyond. UCDBCF manages a large number of organ-specific biorepositories in support of research projects at UCD and its affiliated hospitals. In addition, UCDBCF is active on a national level providing centralized biorepository and pathology services for multi-institutional SWOG, NIH, and NIDDK research networks.

UCDBCF has the flexibility to offer a full range of services ranging from protocol development and patient recruitment to simple specimen storage. Situated in a department that bridges basic and clinical sciences, the UCDBCF is in an ideal position to promote and support interdisciplinary research.

Services include: Full Service Pathology Lab, Automated Tissue Processing, Automated H&E Staining, Automated Immunostaining, Freezer Repository, Protocol & SOP Development, IRB Assistance, Collection Kit Design, Patient Consent, specimen Collection, Phlebotomy, Inventory Management, Histology, Tissue Processing, Routine H&E, Microtomy / Cryomicrotomy, Immunohistochemistry, Special Stains, Special Processing, Tissue Microarrays, Laser Capture Micro dissection, DNA/RNA/ Protein Isolation, Imaging, Whole Slide Imaging, Image Analysis, Epidemiology / Biostatistics, Molecular & Clinical Diagnostics

## Biostatistics and Bioinformatics Shared Core Service

The University of Colorado Cancer Center Biostatistics and Bioinformatics Core provides quantitative and information science support for the planning, design, analysis and presentation of basic science, clinical, and epidemiological investigations by Cancer Center members. Services include: Consultation on study design (clinical and basic science, including gene expression arrays and proteomics experiments), Consultation on sample size and power, Development of data collection, storage, and quality control procedures (basic science and clinical studies, protocol review and monitoring), Data analysis, including genomic and proteomic data, Collaboration on manuscript and oral presentation preparation, and grant proposal development.

## Cellular Systems and Analysis Core Unit (IDDRC)

The overall mission of this core is to stimulate and facilitate IDD-related research at the cellular and tissue levels. This core also performs lymphoblast immortalization for bio-banking and genomic analysis.

# CU Anschutz Core Labs

The Cell Systems and Analysis Core has two sections focused on cell culture and one on brain tissue, respectively. This core is designed not only to advance ongoing in-vitro studies but to assist investigators without experience in the area with the adoption of in-vitro approaches. In addition, this core provides the technology and assistance to analyze brain tissue with neuroanatomical and cell labeling techniques as well as with approaches of subcellular fractionation and biochemistry.

The Core also provides training and assistance with the preparation of primary neural cell cultures. For experimentation with very limited scope or pilot studies, the Core prepares cultures of rat or mouse cortical explants or dissociated cells. For larger studies the principal investigator's laboratory receives appropriate training and advice. Training also may include the establishment of other neuron populations (those from hippocampus, cerebellum, olfactory bulb, peripheral ganglia and others) or of glial cell types.

## ic42/CNRU Mass Spectrometry Core [Department of Anesthesiology Clinical Research and Development]

The Mass Spectrometry Core's mission is to provide a state-of-the-art laboratory facility, expertise in mass spectrometry technologies and assays as well as to provide education, training and consulting to investigators with projects relevant to the field of nutrition. As exemplified over the last years, the Core has continued to develop diagnostic tools to predict disease and monitor the progress and treatment of disease. In addition, we have provided comprehensive instruction for interested CNRU investigators in order to increase their proficiency in our highly complex technologies and instrumentation.

In addition to the quantification of small molecule drugs, the CNRU Mass Spectrometry Core offers a range of assays for targeted and non-targeted analysis of molecular markers and drug metabolism services. The available assays and strategies are listed in Appendices I (endogenous compounds and molecular markers) and II (drug metabolism).

The CNRU Mass Spectrometry Core has the track record, experience and infrastructure to assist basic science departments to bring drug candidates into clinical development and to serve as a resource for patient research in clinical departments, to serve as a resource for the pharmaceutical industry and to function as a interface between the University of Colorado Denver and Colorado biotech industry. The CNRU Mass Spectrometry Core has experience with all stages of drug development including direct FDA interactions. This core is a unique facility since it combines quantitative mass spectrometry (drugs, drug metabolites, other small molecules and large molecules, endogenous compounds), metabolic and protein profiling technologies under one roof and thus is capable of complex projects ranging from pharmacokinetics to the development and qualification of molecular markers and novel diagnostic tools.

## Colorado Advanced Photonics Technology Center (CAPT)

The 2000 square foot Colorado Advanced Photonics Technology (CAPT) Center is located in Longmont. The CAPT Center has several labs with equipment that give companies access to state of the art measurement and fabrication equipment. Companies are welcome to come to the center and use equipment, or contract service measurements are also available. There is also a dark room for photolithography, a general optics and development lab, office space, and conference room. The four major areas of concentration are:

- Optical Characterization and Metrology Lab
- Photonics and General Developmental Lab
- Prototype Packaging and Photolithography Lab
- Environmental Test and Evaluation Lab

As a non-profit organization, the CAPT Center provides cutting-edge technical services and human resources to its corporate and educational partners.

# CU Anschutz Core Labs

The CAPT Center is the only photonics resource in Colorado that can deliver: surface roughness measurements, optical testing, contract measurement services, prototyping, precision metrology, environmental testing, use of photonics equipment and facilities, training for current employees, and connections with future employees. The CAPT Center provides access to state-of-the-art facilities and equipment:

- \$5 million in equipment for material characterization, prototype packaging, measuring, inspection and environmental testing
- 2,000 sq. ft. of support laboratories
- Design, processing, characterization, packaging and quality labs
- CAPT Incubator Program

## Colorado Biostatistics Consortium (CBC)

The Colorado Biostatistics Consortium (CBC) is a unit in the Department of Biostatistics & Informatics, Colorado School of Public Health, University of Colorado Denver (UCD). The CBC is a shared resource for biomedical investigators at UCD, Colorado State University (CSU), University of Northern Colorado (UNC) and other institutions. It provides biostatistical expertise for centers, programs, departments, and individual investigators to facilitate the design of studies, data acquisition protocols, data analysis, and the preparation of grants and manuscripts.

## Colorado Clinical and Translational Sciences Institute (CCTSI)

The CBC administers the Biostatistics, Epidemiology, and Research Design (BERD) core function of the CCTSI. Biostatistical consultation is provided to CCTSI award/grant recipients at no charge. BERD hosts courses and seminars in study design, data collection and results analysis for medical researchers who desire to deepen their understanding of these topics.

## Research Consulting Laboratory (RCL)

Medical investigators needing a “quick question” answered and students working on theses, dissertations and research projects can obtain support from the CBC Research Consulting Lab. Staffed by graduate students in Biostatistics & Informatics, and supervised by Kim McFann, PhD, the RCL provides tutoring on the design of studies, sample size calculations, data analysis, and other biostatistical subjects. Located in Historic Building 500, Third Floor, West Wing, Room W3132, the RCL is open during normal business hours every weekday.

## Computational Biology Core

The Program is an interdepartmental graduate training program offered within the School of Medicine at the University of Colorado at Denver and Health Sciences Center Fitzsimons campus in Aurora, Colorado. Student training places a major emphasis on research experiences, both in lab rotations and thesis projects, and includes a range of coursework in biochemistry; drug design; pharmacology; cellular, molecular and structural biology.

The Program encourages students to engage in collaborative projects and provides shared mentoring that can include faculty from outside The Program. Such interactions are geared towards fostering interdisciplinary training.

Faculty research activities cover a range of structural and computational techniques including NMR Spectroscopy, X-Ray Crystallography, Mass Spectrometry and Proteomics, Biophysics, and Peptide/Protein Chemistry that are focused on a diversity of biological targets such as signaling molecules, transmembrane proteins, RNA, genome bioinformatics, lipids, and oligosaccharides.



# CU Anschutz Core Labs

## Cytogenetics Core

The UCCC Cytogenetics Core Laboratory provides classic and molecular cytogenetics services, including fluorescence in situ hybridization (FISH). We have experience with commercially available and researcher-provided probes, such as:

- chromosome enumeration probes
- painting probes
- translocation probes
- single copy or locus-specific probes
- nick-translated DNA fragments

We also provide consulting services and training for non-assisted lab use.

### SINGLE AND DUAL COLOR FLUORESCENCE IN SITU HYBRIDIZATION (FISH) ASSAYS

- Differentiation of mammalian chromosomes or DNA sequences translocated to rodent chromosomes and monitoring established cell lines using human genomic or Cot-1 DNA probes.
- Identification of specific aneuploidies in metaphase spreads and interphase nuclei, in preparations from diffuse or solid tissues using satellite and locus-specific DNA probes.
- Identification of particular human chromosomes or chromosome fragments in complex rearrangements and/or marker chromosomes using whole chromosome-specific painting probes (WCP) or a region-specific probe (Partial Chromosome Probes). WCPs are used also for identification of human chromosomes in hybrid cells.
- DNA clone mapping (phage, cosmid, P1, PAC, BAC, and YAC) on metaphase chromosomes of human, rat, mouse and hamster cells.
- Investigation of genomic deletion, duplication or amplification in metaphase and in interphase nuclei in fresh or preserved biological preparations using DNA clones.
- Detection of chromosome translocations in metaphase or interphase cells using probes encompassing or closely associated with the breakpoints.

### MULTICOLOR-FISH ASSAY

- Simultaneous hybridization of several probes to extended chromatin to determine the orientation and overlap of the tested sequences.
- Analysis of multiple probes in a given cell for more accurate definition of its genomic status.

### SPECTRAL KARYOTYPING

- Spectral karyotype of a cell representative of the small cell lung carcinoma cell line UMC19.

### COMPARATIVE GENOMIC HYBRIDIZATION (CGH) ASSAY

- Analysis of DNA sequence copy numbers of cultured or uncultured human, mouse and rat specimens.
- Multicolor Karyotyping using spectral karyotyping in human, mouse and rat specimens (SKY) and multiplex-FISH (M-FISH) in human specimens.

### UNBANDED CHROMOSOME ANALYSIS

- Breakage evaluation.
- Cell proliferation index (mitotic index).
- Ploidy evaluation

### GIEMSA-TRYPsin (GTG) BANDED CHROMOSOME ANALYSIS

- Karyotype characterization of human, mouse, rat, and hamster specimens or cell lines in metaphase or prometaphase cells.
- Determination of cell line homogeneity and evolution using metaphase analysis.
- Identification of parental species in hybrid cell lines.

### ADDITIONAL PROCEDURES

- Tissue culture
- Initiation, maintenance, harvest, and freezing of cell cultures for cytogenetic purposes.
- Establishment of immortal cell lines from lymphocytes DNA labeling by nick-translation for FISH assays

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Lab staff performs nick translation labeling. DNA fragments may be genomic DNA, cDNA or vector DNA. Due to sensitivity limitations of our current instrumentation, we need unique sequence probes larger than 2.5 kb for mapping studies. If the probe is known to be amplified, we can use probes >1.0 kb.

Core facilities at the BDC are BioResources (animal and islet), Autoantibody Measurement, Flow Cytometry, Histology and Molecular/Vector.

In addition, the BDC is the home of the Juvenile Diabetes Research Foundation (JDRF) Autoimmunity Prevention Center. Another of the facilities funded by the JDRF Center grant provides Lymphocyte Analysis core.

## The Diabetes and Endocrinology Research Center (DERC)

DERC brings together the collective experience of basic and clinical scientists from different faculty and research backgrounds to enhance the productivity and the quality of diabetes and endocrinology research within the University of Colorado Denver Health Sciences Center community.

### DERC MOLECULAR BIOLOGY SERVICES

#### AUTOMATED DNA SEQUENCING

- Dye-terminator sequencing on ABI 3130xl and ABI 3100-Avant capillaries
- Online sample submission and results retrieval
- 24-36 hour turnaround time

#### FRAGMENT ANALYSIS

- Microsatellite analysis
- SNP detection
- Determination of STR or VNTR number Real Time PCR
- Roche LC480 and AB 7000 SDS
- High Resolution Melt Capable
- Genotyping
- Gene Quantification and Expression analysis

#### IN-SITU HYBRIDIZATION PROBE SYNTHESIS

The Barbara Davis Center (BDC) is the home for the NIH Diabetes Endocrinology Research Center (DERC) that provides funding for seven distinct cores. These cores provide services to principal investigators within the BDC researching type 1 or childhood diabetes and other principal investigators throughout campus wide scientific projects.

## DNA Diagnostics Laboratory

The UCD DNA Diagnostic Laboratory at the University of Colorado Denver is a clinical molecular genetics laboratory offering full service nucleic acid-based testing. Established as a national and regional resource for the medical and genetics communities, the laboratory performs testing for a variety of genetic diseases utilizing state of the art techniques.

## DNA Sequencing

The primary function of the CU-Cancer Center DNA Sequencing Core is to sequence DNA samples brought to us as purified DNA. We can also purify DNA from bacterial colonies for sequencing. However, we highly recommend that the customer confirm that the E. coli transformant does in fact bear the correct plasmid before submitting it for DNA purification and sequencing.

We offer several levels of sequencing service - from our Premium Full-Service Single-Pass Sequencing to budget "Single-Shot" sequencing, where the customer performs the sequencing reaction themselves and submits the reaction products ready for electrophoresis on one of our automated sequencers. The Core's two capillary ABI fluorescent sequencing instruments can provide between 650 and 950 bp of reliable DNA sequence per AmpliTaq FS cycle sequencing reaction with dRhodamine and BigDye labelled dye-terminators.

Sequencing results will only be delivered electronically as follows: customers will receive an email informing them that their results are ready. In the message, there will be a link to our website from where the results can be downloaded, using the customer's name and password.

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The data will be available on the server for one month from date of posting; afterwards customers will need to contact the Core directly for the data. We will no longer print electropherograms of sequencing results.

- Full scale hybridization from gene of interest selection to imaging and analysis
- Preparative work underway to build probe library for islet related targets (insulin, glucagon, slc30a8, etc)
- In conjunction with the DERC Histology

## CORE BASIC MOLECULAR BIOLOGY SERVICES

- Nucleic acid purification
- Cloning and expression of genes of interest in bacterial systems
- Plasmid DNA preparation (small-large scale)
- Site directed mutagenesis
- Restriction digestion and analysis
- RT-PCR
- PCR and PCR product purification
- Recombinant protein expression and purification

## PREMIUM FULL-SERVICE STANDARD SINGLE-PASS DNA SEQUENCING

This is the highest level of sequencing service, which includes performance and processing of the sequencing reaction, loading the products on a sequencing instrument, and preparing and troubleshooting the results for the customer. The DNA samples should be quantified by the customer using agarose gel electrophoresis.

## FLOW CYTOMETRY CORE AND CELL SORTING FACILITY

The Flow Cytometry Core offers services to Cancer Center members, Charles C. Gates Regenerative Medicine and Stem Cell Biology Program members, academic non-members and private industry researchers. CC and RMSCB Members receive scheduling priority and a discounted rate for services. Our experienced staff can analyze your samples for you or train you to run the analysis equipment for all services except cell sorting. Core staff performs all cell sorting.

## FLOW CYTOMETRY ANALYSIS SERVICES

We have three main analyzers, each best for different types of analysis. You may use the machines yourself or ask us to analyze your samples for you.

### BECTON DICKINSON FACSCALIBUR

- 2 lasers: 488 and 635
- 4 color analysis
- Suggested fluors: FITC , PE , PECy7, APC

### BECKMAN COULTER FC500

- High through-put
- 2 lasers: 488 and 635
- 5 color analysis
- Suggested fluors: FITC , PE , PE-Texas Red, APC, PECy7, PI

### CYAN

- Analysis rate of 50,000 events/second
- 100 million event data files
- New 40mW red diode laser for enhanced APC and APC-Cy7 detection
- 9-color analysis

## CELL SORTING SERVICES

We have two cell sorting machines with different capabilities. Core staff performs all cell sorts.

### MOFLO

- 3 lasers: 488, 635 and tunable Krypton
- Many laser lines for optimizing fluorescent protein detection
- Plate sorting
- 7 color capability

### MOFLO XDP

- Optimized for rare events
- Plate sorting for any size plate
- 4 lasers: UV, 405, 488, 635
- 9 color capability
- Sort rate of 70,000 events per second
- 5 decade data resolution
- 4-way sorting



# CU Anschutz Core Labs

## LUMINEX MULTIPLEX BEAD ASSAYS

This analysis measures cytokines, chemokines, phosphoproteins and apoptosis markers.

## ALSO AVAILABLE

- ViCell Cell Counter
- Victor Multilabel Counter (self-service only in RC-1 South, Room 4215)
- Cytospin microscope slide centrifuge

## Gene Expression, Microarray & PCR Core

The Gene Expression Core is dedicated to providing state-of-the-art facilities and technical support and services for analysis of gene expression, which will allow UCCC members to be on the cutting edge of cancer research. The Gene Expression Core is comprised of:

- Microarray Core
- PCR Core

## CORE OBJECTIVES

- Analyze gene expression using both pre-made and custom designed oligonucleotide arrays
- Facilitate gene discovery
- Accurately quantitate gene expression using real time PCR and GenomeLab GeXP technology
- Provide support for data analysis and bioinformatics by our data mining tool and our data analysis capabilities
- Remain committed to using a variety of approaches for expression analysis
- Provide consultation and educational services to help those members with limited knowledge on microarray technology and to bring the Core customers up to date as technology advances

## GENE EXPRESSION CORE

The Gene Expression Core was established in response to the technological advances in gene array, as well as the demand for high throughput expression analysis and genomic investigation to investigate pathogenesis, therapeutics, genetic susceptibility and gene discovery in cancer research. The informatics aspect is of paramount importance, and five distinct analysis programs, as well as a network, are used to store, share and analyze the data.

To date, the Core is one of the highest volume Affymetrix microarray facilities in academia in the country, having performed more than 10,900 microarrays including test arrays over seven years for nearly 250 investigators. On average, 85% of the users are UCCC members.

## MICROARRAY CORE

The Microarray Core is an advanced, state-of-the-art Microarray Technology Center providing crucial research support for investigators interested in using Affymetrix GeneChips®, CombiMatrix CustomArray™ Chips or the Nanogen NanoChip®. We also host rtPCR with the Bio-Rad iCycler. Our team is dedicated to providing high-quality microarray laboratory instruction, service, and consultation to the research and clinical community affiliated with CU and other research institutions in the region.

## High-throughput Genome Sequencer

Protein sequence, structure, and functional evolution; Evolutionary genomics; Adaptive co evolution and ancestral reconstruction; Evolution of mitochondrial genomes; Evolutionary theory; Testing evolutionary predictions through mutagenesis and directed evolution. Rapid likelihood analysis on large phylogenies using partial sampling of substitution histories by A. P. Jason de Koning, Wanjun Gu and David D. Pollock, Molecular Biology and Evolution (available online September 2009). Complex models, way fast. We have developed a code package called PLEX (Phylogenetics, Likelihood, Evolution, and compleXity), written by Jason de Koning, Wanjun Gu, and David Pollock. The approach is described in the above paper.

# CU Anschutz Core Labs

## Histology Core

Routine histological services in tissue fixation, processing, sectioning, and staining with histochemical dyes and immunochemical reagents. Provision of slide and tissue banks of commonly used tissues or animal models e.g. developmental or NOD disease progression. Epifluorescence microscopy for acquisition of images and performance of morphometric analyses.

Confocal microscopy for use by investigators interested in high-resolution fluorescence microscopy and live cell imaging requiring the use of FRAP and FRET analyses.

In-situ hybridization analyses that include all elements from acquisition and amplification of the gene of interest, probe synthesis, optimization of hybridization conditions, and performance of multigene analyses on a moderate scale.

Higher-level microscopy including access to instrumentation and services in Laser Capture Microscopy, 2-photon confocal microscopy, spinning disk confocal microscopy, Total Internal Reflectance microscopy, conventional, and immunoelectron microscopy.

Training of fellows and students in morphological and morphometric techniques and consultation in specific areas including microdissection and single cell microinjection, low-level computer programming.

## Informatics Core

The University of Colorado Cancer Center Informatics Core, located on the 6th Floor of Building 500 on the Anschutz Medical Campus in Aurora, was established to work with researchers and clinicians to design, implement and maintain information technology applications that support the Cancer Center research enterprise.

- We build databases and integrate them with dynamic websites or client/server front ends
- We provide workstation support and network and server administration

We have developed applications in the areas of clinical trials registration, specimen tracking, clinical trials pathology and prevention and control. In addition, we have developed databases containing clinical data (prognostic clinical factors, therapies, toxicities, response to treatment and outcomes) for the Lung SPORE and for breast cancer.

## INFORMATICS CORE SERVICES

Researchers who have informatics projects have a choice of funding part of an FTE or purchasing services on an hourly basis. When the informatics project is substantial and planned, funding part of an FTE is the preferred approach, since projects funded under FTEs will be given higher priority. When the project is small or unanticipated, the hourly charge back is appropriate. We offer members discounted hourly rates.

### WE OFFER THE FOLLOWING SERVICES

- Network administration / workstation support: web-, database-, file- and print server administration, including backups, access, and security. Workstation configuration and maintenance.
- Website development: analysis and development of dynamic or static websites
- Database design and development: analysis and development of table structures for appropriate security and performance.
- Data quality assurance: loading and querying databases to ensure timely and proper data collection.
- Report development: analysis of static or parameterized reports.

## Institutional Animal Care and Use Committee (IACUC)

The Institutional Animal Care and Use Committee (IACUC), mandated by the Health Research Extension Act (HREA) of 1985 and the Animal Welfare Act (AWA), is responsible for the oversight and evaluation of the Institution's animal care and use program, procedures and facilities, ensuring that they are consistent with the recommendations in the Guide for the Care and Use of Laboratory Animals, Animal Welfare Regulations and PHS Policy.

The IACUC is an Institutional level committee, the direct representative of the Chancellor of the University of Colorado Denver and comprises veterinarian, scientist and non-scientist members, as well as at least one member who represents the general community interests in the proper care and treatment of animals, and, is not affiliated in any way with the Institution other than as a member of the Committee.

# CU Anschutz Core Labs

## Interdisciplinary Transcranial Magnetic Stimulation (TMS)

Review of proposals using TMS, assistance with preparation of IRB materials for TMS projects, training in the use of TMS and stereotactically guided TMS, performance of TMS on human subjects for research and therapeutic purposes.

## Laser Capture Shared Core Service

Laser capture microdissection (LCM) is a technique for obtaining pure cells from specific tissue sections. A machine uses a laser beam to activate a special transfer film. The film bonds to cells that have been identified and targeted by microscopy.

Laser capture microdissection (LCM) is a technique that allows pathologists to lift specifically targeted cells from a section of cell tissue, leaving behind unwanted cells that could contaminate the molecular purity of subsequent analysis. This technology, which was developed in the late 1990s at NIH in collaboration with bioengineering and cancer pathology groups, is precise, accurate and automated.

LCM uses a special laser and film, which absorbs the laser energy and leaves the macromolecules undamaged. Starting tissue can be fixed, embedded in paraffin or frozen.

## Light Microscopy

Researchers are trained to use the microscopes and image acquisition software themselves, with staff assistance when necessary to ensure collection of high quality images. Data can then be processed off-line for export into the required format.

## Machine Shop

The Neuroscience core machine shop is located in room NG003 on the ground floor of Building 500 (northwest corner) at the Fitzsimons campus of UCD/HSC. The shop's equipment and staff are there to meet the custom machining needs of the faculty, staff and students of the Neuroscience program and the university research community.

### THE SHOP MACHINERY INCLUDES:

- 2 manual milling machines with 9" x 42" tables (1 with digital readout)
- 1 CNC milling machine (full 3-axis automation)
- 2 precision lathes
- 1 surface grinder
- 1 wood/metal-cutting band saw
- 1 table saw
- 1 chop saw
- 2 grinding machines
- 1 drill press
- 1 6" belt sander
- 1 52" shear
- extensive tooling & precision measuring devices

The shop stocks a modest amount of material (acrylic and other plastics, aluminum, brass, hardware) so most projects can be completed using material on-hand.

Billing is based upon an hourly shop rate plus material cost and charges are levied against a university speed-type account. At present there is no mechanism for billing outside of the university system.

Shop services: custom design and production of equipment for scientific experimentation. The shop is equipped with machining equipment to produce equipment made from plastics, aluminum, steel or stainless steel.

## Metabolomics Core

Metabolomics, one of the "omic" sciences in systems biology, is the global assessment and validation of endogenous small-molecule biochemicals within a biologic system.

Metabolite detection and quantification is usually carried out by nuclear magnetic resonance (NMR) spectroscopy while mass spectrometry (MS) provides another highly sensitive metabolomics technology. The UCCC Metabolomics Core provides all NMR-related metabolomics services on human and animal cells, biopsies, and body fluids. Various metabolic biomarkers, related to glycolysis, mitochondrial citric cycle acid, choline, phospholipids and fatty acid metabolism, were recently reported to play important roles in cancer development and responsiveness to anti-cancer treatment using NMR-based metabolic profiling.

# CU Anschutz Core Labs

The Metabolomics Core consists of the high-resolution NMR facility, which is located at the Anschutz Medical Campus, Research Complex-2 (Suite P15-1109).

The facility is fully equipped for all aspects of nuclear magnetic resonance spectroscopy (1H-, 13C-, and 31P-NMR and two-dimensional NMR). We performed expanded quantitative metabolic analysis:

- on cells
- cell extracts
- human and animal tissues and biopsy extracts
- body fluids (including blood, plasma, urine, cerebral and prostatic fluids etc).

## SERVICES

- Project design and consultation: recommendations and advice on end points to be monitored, budget, suggestions for data analysis.
- Sample Handling and Extraction for Metabolic NMR: Facilities for tissue, body fluids, and cell extraction, sample lyophilization, and sample preparation for NMR. Sample storage is also available.
- NMR based metabolic protocols: Structure determination based on two-dimensional NMR is used for metabolite identification, specially designed 1D-NMR program is used for precise metabolite quantification, various statistical packages are available to perform principle component analysis (PCA), linear regression etc. analysis on metabolic data sets.
- Data set collection is available.
- Access to computational facilities.
- Data analysis and publication and grants preparation/ assistance.
- Training in MR safety (for all users).
- Training in MR operation (for advanced users only)
- Data handling and storage

## Molecular and Cellular Analytical Core Lab

The Molecular and Cellular Analytical (MCA) Core is part of the Colorado Nutrition Obesity Research Center (NORC). The main services of the MCA Core are bioenergetic analyses with an XFe96 Seahorse Analyzer and gene expression analysis using real-time quantitative PCR. The Core also provides selected assays for specific hormones, cytokines and metabolites over a broad range of species (rat, mouse, human, sheep) and tissue types (adipose, muscle, liver). Location: RC15 L18-7403G.

## MCA Core Services

### AGILENT SEAHORSE EXTRACELLULAR FLUX TECHNOLOGY

- The Seahorse XF technology simultaneously interrogates two major energy producing pathways of the cell – mitochondrial respiration and glycolysis - in a microplate, in real-time. The XFe96 Analyzer determines in vitro oxygen consumption rate (OCR) and extracellular acidification rate (ECAR) to assess cellular functions such as oxidative phosphorylation, glycolysis, and fatty acid oxidation. The XFe96 technology provides the tools to rapidly detect cellular responses to substrates, inhibitors and other compounds in a 96-well-plate.
- Initial training on the Seahorse machine is provided. Users are expected to determine their experiment design and interpret their own data. Users will supply their own FluxPaks (plates & cartridges), calibrant, reagents and medium.

### GENE EXPRESSION ANALYSIS FOR A MULTITUDE OF MOLECULAR TARGETS

- RNA isolation from various tissues (liver, muscle, adipose) and cell types (macrophages, cell cultures) from human, nonhuman primate and rodents
- cDNA synthesis
- We currently have over 600 primer sets for human, mouse and rat genes. For primer sets not available in-house, we provide primer design & ordering.
- Quantitative real-time PCR using SYBR Green technology on genes of interest and two or more reference genes

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- Consultation and services for a broad range of assays over a variety of tissue types, fluids and cells, including cytokine & hormone analyses, metabolite colorimetric assays, Western blot analysis & mitochondrial assays.

Please contact Rachel for the current prices:  
Rachel.Janssen@ucdenver.edu

## Molecular Discovery (IDDRC)

The objective of the Molecular Discovery Core Unit is to provide advice, training and service to Colorado IDDC investigators in molecular IDD research, from hypothesis generation to characterization of macromolecules. This includes: molecular bioinformatics focused on IDD; genome transcriptome and proteome analysis; characterization of protein structure, activity and interactions; and access to shared instrumentation, such as centrifuges and fluorescence imaging.

## Morphology and Phenotyping Core

Although the Morphology and Phenotyping Core specializes in processing and analyzing skin samples, it has expertise in the processing of all types of tissues. Although all tissue samples can be processed by the Core, the Core particularly specializes in skin samples.

The following services are available: Paraffin Histology; Frozen Section Histology

## Pathology Shared Core

The University of Colorado Cancer Center Pathology Core ensures that well-characterized human tumors and materials derived from human tumors to are provided to Cancer Center and other funded investigators for research in human cancer.

### THE PATHOLOGY CORE:

- Establishes priorities for tissue collection. With the support of the Core, members of the UCCC have obtained separate funding to support large organ-based repositories
- Serves as a central planning resource for these separate repositories

- Interacts with the Biostatistics/informatics and Clinical Investigation Cores to provide an optimal infrastructure for the conduct of translation research
- Provides supplemental and backup support for the repositories
- Offers diagnostic assistance and tissue processing services, including histological and immunohistochemical services, to Cancer Center investigators who are not supported by a separate tissue bank

The Core provides central infrastructure for separately funded banks that are increasing in number and sophistication. In 2007, the Southwest Oncology Group solid tumor banks moved entirely to Colorado.

### TISSUE PROCUREMENT SHARED CORE SERVICE

The Tissue Procurement Core provides University of Colorado Cancer Center members and other funded researchers with well-characterized human tumors and materials derived from human tumors for research in human cancer. Our organ-based pathology subspecialists contribute anatomic expertise to organizing collection protocols and verify histopathological classification of specimens we collect.

We provide investigators with IRB-approved protocols and pathology subspecialist collaborators with:

- frozen tissue fragments
- tissue sections
- DNA
- RNA
- cells purified by microdissection from tumors, preneoplastic lesions and matched normal control tissue

## The Peptide and Protein Chemistry Core

This core provides peptide synthesis, purification and peptide/protein composition analysis as well as mass spectrometry services for academic and industrial clients. The Peptide and Protein Chemistry core personnel help users choose and design experiments using appropriate chemistry/instrumentation, to obtain the necessary data, and interpret the results.



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The Core also provides instruction for graduate students and postdoctoral fellows for the use of HPLC and LC/MS approaches. The core is equipped with state of the art instrumentation and technical support suitable for diverse applications and samples.

## Pharmacology Core

The University of Colorado Cancer Center Pharmacology Core, located at Colorado State University in Fort Collins, was established to work with researchers and clinicians in a collaborative manner to design and implement studies to measure xenobiotics (drugs, toxicants, natural products, inc.) in biological systems and matrices.

- We are an analytical laboratory focused on drug measurement.
- We help investigators with study design, sample collection, sample analysis and data interpretation.

The mission of this core is to assist in the prospective design of studies to assess drug exposure in biological systems, to measure drug levels using validated analytical assays, and to analyze, model and interpret the results.

### SERVICES

- Analyte determination and quantitation in matrix (per sample)
- Assay setup and validation (hourly)
- Metabolite identification and analysis (hourly)
- Sample analysis and identification (hourly)
- Pharmacokinetic modeling (hourly)
- Animal treatment and sampling (hourly)

## Protein Production/ MoAB/Tissue Culture Shared Core

The Protein Production/MoAB/Tissue Culture Core, located on the Anschutz Medical Campus, offers services to UCCC members, other academic investigators and private companies. We have more than 10 years of experience with protein production in the baculovirus system cell fusion, as well as developing new monoclonal antibodies and small- to large-scale culture of a wide range of cell lines.

### CUSTOM HYBRIDOMA SERVICES

- Construction of new hybridomas
- In vitro production of monoclonal antibodies from existing hybridomas

### CUSTOM BACULOVIRUS SERVICES

- Construction of recombinant virus
- Amplification and titering of recombinant baculovirus stocks
- Protein production in insect cells

### CELL LINE REPOSITORY

- >150 cancer cell lines, including 51 different lung cancer cell lines and 11 breast cancer cell lines

### ON-SITE CULTURE MEDIA/SERUM SUPPLY CENTER

- Liquid cell culture medium from Invitrogen and HyClone
- Supplements
- Serum from HyClone

### OTHER SERVICES

- Tissue grossing
- Tissue processing
- Tissue embedding
- Cutting paraffin and frozen sections
- HE staining
- Cell line fixation, including cell pallet creation
- Tissue array block creation from donor blocks
- Tissue array cutting
- Special cutting and staining sections for microdissection
- Immunohistochemistry staining, including antibody standardizations
- Tunnel assay staining
- Histology special stains #88312 & 88313
- Ventana Benchmark XT for automated immunohistochemistry

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## Proteomics/Mass Spec Core Lab

The Proteomics Shared Core Service aims to provide the expertise, technical resources, training and collaborative interactions that enable Cancer Center members to undertake detailed proteomic studies. The goal of the Proteomics Facility is to provide investigators with the capabilities to identify, characterize and quantify the proteins present in tissues, cells and biological fluids. Through the development of advanced methods, the Facility aims to assist members with solving difficult or previously intractable problems in biomedical research. Methods for protein and peptide isolation, separations, quantification, identification and bioinformatics analysis, together with expert guidance in study design, are integrated into expertise offered by the Facility. The Facility has access to several analytical technologies thereby allowing investigators to adopt multiple strategies and to independently verify their findings. The Facility also provides training in proteomics analysis and experimental design.

## UCD Rodent In Vivo Neurophysiology Core

The core facility provides continuous rodent behavioral and neurophysiological/EEG monitoring (including cerebral electrical patterns during waking and sleep, heart rate, respiration, EMG). This type of monitoring will permit investigators at UCD to more thoroughly phenotype the rodents they are using in their research and specifically address issues of whether they have abnormalities of neurophysiological functioning such as interictal epileptiform discharges, sleep disturbances and seizures. This can be important for the characterization of translational models of nervous system disorders including stroke, epilepsy, head trauma, neurodegenerative, psychiatric, genetic and developmental disorders. Equipment available in the Rodent In Vivo Neurophysiology Monitoring Core facility includes an inhalational anesthesia system, Angle 2 stereotactic apparatus with rat and mouse atlases and video microscope for electrode placement and cerebral injections, microinfusion pump, and 48 cages (32 rat and 16 mouse) equipped for video EEG monitoring (Stellate and Pinnacle systems).

## Shared Analytical Service Laboratory (SASL)

Laboratory provides basic and analytical chemistry related resources, including advanced analytical instrumentation. With the increase in the interdisciplinary nature of research, the SASL supports the analytical chemistry needs across all scientific disciplines. Additionally, the continuing effort to more efficiently use University resources has created a demand for sharing resources.

The SASL allows researchers from a variety of disciplines to utilize analytical tools without having to invest time, money, or resources towards maintaining the effort in their own research groups. At the same time, the Laboratory allows faculty the freedom from duplicating instrumentation and other resources that are used only peripherally. Finally, the SASL works to support the efforts of the other colleges of the UCD, and to support the wider community.

The following instrumentation is available for use in the Shared Analytical Service Laboratory. While this equipment is fully functional, in some cases, like the gas and ion chromatographs and the Hitachi GFAA, instruments have been shut down to save on the cost of the consumables. Restarting the instrument may take several days before it would be ready for analytical use.

- Perkin Elmer Model 5000 Flame Atomic Absorption
- Hitachi Z-8270 Polarized Zeeman Graphite Furnace Atomic Absorbance Spectrophotometer
- Leeman Labs, Inc. PS 200 II Automated Mercury Analyzer
- HP 5890 Gas Chromatograph fitted with both a Perkin Elmer ATD 4000 Thermal Desorption Sampling System and a Dynatech DynaSoils Purge and Trap Sampling System.
- Applied Biosystems 4000 Q Trap Triple Quad Mass Spectrometer coupled with an Eksigent Temp nano MDLC (LC-MS)
- Dionex 4500i Ion Chromatograph
- Hewlett-Packard 5890 Gas Chromatograph coupled with a Hewlett Packard Model 5970B Mass Selective Detector.

# CU Anschutz Core Labs

- Tekmar Model 6000 Thermal Desorption System
- Technicon TRAACS 800 Continuous Flow Analytical System
- Thermo Separations Products P4000 Liquid Chromatograph and UV1000 Detector (LC) Cary 1E UV-Vis Spectrophotometer
- Nicolet Analytical Instruments MX-S Infrared Spectrophotometer (FTIR)

## Small Animal Imaging Core

The major goal of the small animal imaging program is establishment of novel imaging approaches to cancer and cancer experimental therapeutics using animal models and pharmacodynamic endpoints. State-of-the-art imaging facilities are extremely expensive and require advanced technical personnel. Modern non-invasive imaging technologies include:

- Magnetic Resonance Imaging (MRI for anatomic, physiologic, and molecular imaging)
- Computed Tomography (CT for anatomic imaging)
- Positron Emission Tomography (PET for metabolic and molecular imaging)
- Optical Imaging (Bioluminescence, Fluorescence)
- Ultrasound

## MRI/CT/PET Services

The University of Colorado Cancer Center Small Animal Imaging Core offers MRI, CT and PET services to members and non-members.

Our facility is fully equipped for magnetic resonance imaging and proton spectroscopy (MRI/ MRS) studies on small animals. All <sup>18</sup>F-DG-PET and bone- and soft-tissue (enhanced) CT protocols are available. All standard operating procedures (SOP) for animal imaging are in place. The facility is currently comprised of approximately 660 sq ft of laboratory space, in which are housed three imaging modalities (MRI, PET and CT), animal anesthesia equipment, one physiological monitoring system, animal warming equipment, and computers and data processing systems.

The facility is fully equipped for all aspects of MRI, PET and CT evaluations on small animals, ex vivo specimens and vivo cell models:

- 4.7 Tesla Bruker Pharmascan MRI/MRS scanner with 1H resonance frequency of 200 MHz, RT bore without shims 160 mm. The system is equipped with an actively shielded gradient system I (90 mm inner diameter: x,y,z with 3 mT/m/A); maximum gradient strength 300 mT/m.
- Three volume transmitter/ receiver coils of different diameters (from 22 to 68 mm diameters).
- Siemens Inveon microPET (field of view 12 cm allowing for one-bed position for the whole-body mouse scan).
- Siemens Inveon microCT (to be installed in February 2008).
- Bruker computer platform is equipped with a high-performance MR-workstation X2000 for use with Bruker MR softwares (NMR SUITE and PARAVISION™ 3.0). The PC is configured with Intel Pentium 1.5 Hz, 1 Gbyte RAM, SCSI Controller Adaptec 29160, 73 GByte Disk, Red Hat LINUX, 20" TFT LCD monitor with graphics 1024, HP printer, Ethernet card etc. x-resolution of 1280
- Anesthesia machines, physiological monitoring system, warming pads and fans, as well as other additional accessories are available in the animal preparation room.

## The Radiation Sciences Core

The Radiation Sciences Core supports radiation biology studies of cell cultures and small animals receiving moderate-dose radiation. We also enable investigators to study low dose-rate irradiation in cell culture. And we provide irradiation services for investigators who need this tool in support of other efforts, such as using total body irradiation for immunosuppression of animals before stem cell transplantation. We offer the following services:

- Project design and consultation, including advice on radiation delivery to in vitro experiments and animal models
- Design assistance for single or fractionated radiation protocols and study duration

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- Radiation safety training (all users) and radiation operation training (advanced users)
- Animal tumor and partial-body irradiation at doses comparable to external beam radiotherapy
- Cell suspension irradiation
- High-dose irradiation to sterilize implant material
- Dosimetry calculation
- Calibration in support of stem cell research
- Blocking cellular division in in vitro cell cultures
- Immune function assays
- Radiation-induced DNA damage repair studies
- Data analysis and publication preparation assistance

## EQUIPMENT

- Cesium Irradiator, which allows for deep tissue irradiations with notable accuracy
- Electronic Monitoring System for tracking and recording system use

## In Vivo Optical Gene Service

The In Vivo Optical Gene Imaging Facility offers UCCC members and other investigators the tools to image biological processes in live experimental animals based on powerful, non-invasive bioluminescence and fluorescence imaging. We use a state-of-the-art Xenogen IVIS200 imaging device that is specifically designed to visualize genetically labeled cells, such as tumor cells, and proteins, such as those that stimulate cancer growth in live animals. It does so by recording light emitted from the genetic labels, such as firefly luciferase, located within the animals.

## Transgenic and Gene Targeting Core

A new "Transgenic and Gene Targeting Core" has been established in the Charles C. Gates Regenerative Medicine and Stem Cell Biology Program at UCD. Our core facility replaces the Transgenic/Knockout Core that was part of the UCD Cancer Center. We are committed to provide the UCD research community with state-of-the-art services. Our goal is to assist PIs in designing and generating genetically engineered mouse lines to further biomedical research. Our services include pronuclear injections (conventional and BAC transgenic mice), ES cell injections (e.g. knockout and knockin mice), cryo-preservation of embryos and embryo re-derivation.

## Translational Neuroscience Nexus Core (IDDRC)

The Translational Nexus (Nexus) is a database, patient registry and biological sample bank focused on pediatric neurological, cognitive and behavioral disorders (IDD). Its major goal is to advance research on neurodevelopmental disabilities (i) by linking human neurological, cognitive, behavioral phenotypes to biological samples, especially DNA, and (ii) by facilitating access to appropriate patient cohorts for clinical trials.

## UCH CTRC Core Lab

Currently available CTRC Core Laboratory assays have priority over newly developed assays. Occasionally, the laboratory director will negotiate with the investigator to reduce the number of requests for expensive or time-consuming assays. Assays which are not available in the routine hospital lab or the CTRC Core Laboratory are generally expected to be paid for by the investigator's individual research funds; although the CTRC Core Laboratory can often help with sample processing. Any shipment of specimens to an off-site laboratory is the sole responsibility of the investigator.

# CU Anschutz Core Labs

## Office of Laboratory Animal Resources (OLAR)

OLAR is obligated to recover the costs associated with the procurement and care of and use of animals. These costs are billed to investigators monthly. Per diem rates for animal care or direct charges for personnel costs and supplies are based on a cost analysis and recovery program outlined by NIH Cost Analysis and Rate Setting Manual for Animal Resource Facilities.

## X-Ray Core Facility

The X-ray core facility was set up in 1999. The facility is fully equipped for biomolecular crystallization, crystal screening, data collection, data processing, structure-determination and model building. It currently has a Rigaku/MSR Ru-H3R X-ray generator, two Raxis IV++ area detectors, and two X-stream cryo-cooling apparatus. The facility is located in RC1 South Building Rm 1301.

### SERVICES CURRENTLY PROVIDED

- Project design and consultation: Assistance with starting projects includes advice on protein expression and purification, and crystallization. Until now these services have been provided in direct collaboration with the primary users. Since the manager has just become available, these services will be more broadly available to all members of the cancer center.
- Crystallization screening: Facilities for setting up crystal growth trays is available.
- Screening crystals: Crystal (diffraction) screening is available.
- Data collection: Data collection service is available.

## Zebrafish Transgenic Core

The NINDS P30 Center Zebrafish Core has three Specific Aims:

- Create transgenic lines of zebrafish that express different fluorescent proteins in specific populations of pre- and postsynaptic neurons
- Create transgenic zebrafish strains that express genetically-encoded calcium indicator dyes in specific neuronal populations
- Maintain transgenic and wild type zebrafish strains for the UCD neuroscience community

During the first year of the grant, the fish facility at the Fitzsimons campus is being optimized and we are focusing on Aim 3. In subsequent years, Aims 1 and 2 will be a priority. The Core can cover the expenses associated with breeding wild type fish for pilot experiments.