Research Facilities: Graduate student education and research training at Brown University benefits from a wide range of cutting edge facilities, instrumentation, and other resources to support these endeavors. Brown University’s Shared Technology Resource (Core) Facilities function at the level of service, research, and teaching. Serving as centers of intellectual exchange and collaboration, each technology-focused core provides a broad spectrum of investigators access to cutting edge instrumentation, current technologies, and expert consultation. The facilities are financed by a mixed funding model that includes grant awards, user fees, and institutional support. Additional cost effectiveness and efficiency are achieved by decreased equipment duplication, economy of scale savings, improved quality control, and rapid turnaround times. Advanced technology platforms of similar scale and productivity would not be financially feasible for any individual lab to purchase, upgrade, and maintain. Each facility is staffed by highly trained personnel that provide exceptional customer service and resource management. Faculty oversight and facility user committees advise the core directors. A PhD, MBA-level Director of Research Operations provides assistance with facility operations and fiscal management and serves as a liaison between the core directors and research administration. The timely acquisition of new instrumentation in the core facilities and the frequent implementation of new technologies facilitate faculty recruitment, education, and training of students, and support research funding.

Bioimaging Facility: The Leduc Bioimaging facility has two locations: the Laboratories for Molecular Medicine, 70 Ship St and Sidney Frank Hall of Life Sciences, 185 Meeting St. The facility has a PhD-level director and MS-level Microscopist Manager. These facilities provide equipment and instruction dedicated to high-resolution imaging for life science research. Facility instrumentation includes a Philips 410 transmission electron microscope, with goniometer stage, low-dose imaging equipment, an ATM digital imaging system, and a Hitachi 2700 scanning electron microscope equipped with a backscatter detector, lanthanum hexaboride gun, and a Quartz PCI digital imaging system. The facility also houses a Zeiss LSM710 confocal laser scanning microscope, Zeiss LSM510 confocal laser scanning microscope, Zeiss LSM410 Meta confocal laser microscope, Leica TCS SP2 AOLS confocal laser scanning microscope, two Zeiss Axiovert 200M fluorescence microscopes with DIC, phase contrast, and a stage heater for live imaging, and a Zeiss Lumar fluorescence stereomicroscope. MetaMorph software is available for image analysis. Training in microscopy, image analysis, and ultrathin sectioning is provided at both sites. This facility receives partial support from the Division of Biology and Medicine, Brown University.

Bioinformatics: An MD, MS-level Bioinformatics Analyst supports the data intensive core facilities at Brown University. The Analyst collects and assembles data for genomic analysis and for gene expression profiling (deep sequencing, microarray, and quantitative sequencing). He is a general source of advice on existing tools for genome analysis, gene expression analysis, gene annotation, and epigenetic analysis and a resource for structural bioinformatics, proteome analysis, and general data-mining strategies. He is responsible for developing data workflows and pipelines and coordinating with computational facilities for data processing and storage/archiving. The Analyst provides access to online educational tools and customized software. He is readily available to provide individual training to investigators. This service is supported in part by National Science Foundation (EPSCoR Grant No. 0554548) and the Division of Biology and Medicine, Brown University.

Flow Cytometry: Biomedical Center, 171 Meeting St. The facility is directed by a PhD-level investigator and managed by a research technician who performs the flow cytometry based analysis and cell sorting. The primary facility instrument is a Becton Dickinson FACSARia with a fixed-alignment cuvette flow cell providing superior fluorescence sensitivity. There are three air-
cooled lasers at 488nm, 633nm and 407nm allowing for multicolor analysis of up to 15 parameters and sorting of 2 to 4 populations simultaneously. A dedicated computer workstation with FlowJo data analysis software is provided for the facility users. This facility has received partial support from the Division of Biology and Medicine, Brown University.

**Genomics:** Laboratories for Molecular Medicine, 70 Ship Street. The genomics facility is directed by a PhD level director and is staffed by a junior and a senior research technician. This facility provides investigators ready access to a wide variety of advanced instrumentation, genomic technologies, data analytical services, and training. The most popular services provided by this facility are next generation sequencing using the Illumina HiSeq 2000 or GAIIx platforms and microarray analysis using the Affymetrix Gene Chip Workstation. Other facility instrumentation includes two ABI 7900 Real Time PCR machines, an Agilent 2100 Bioanalyzer, a Typhoon 9410 Variable Mode Imager, a Spectra Max M5 Scanner, a Li-COR Odyssey Infrared Imaging System, an AXON GenePix 4000B Scanner, a Beckman Optima Max Ultracentrifuge, a Nanodrop ND 1000, and a Becton Dickinson FACSCalibur Flow Cytometer. This facility has received partial support from the National Institutes of Health (NCRR Grant No P20RR015578, NCRR Grant No P20 RR018728, NCRR Grant No 1S10RR027634), National Science Foundation (EPSCoR grant No 0554548), Lifespan-Rhode Island Hospital, and the Division of Biology and Medicine, Brown University.

**Magnetic Resonance Imaging:** Sidney Frank Hall of Life Sciences, 185 Meeting St. This facility is directed by a PhD-level investigator, managed by two PhD-level Associate Directors, and staffed by a registered radiography technologist specialized in magnetic resonance imaging. The centerpiece of the Facility is a state-of-the-art research dedicated Siemens 3 Tesla TIM Trio. The scanner is equipped with 32 receiver channels for significant gains in signal-to-noise ratio and acquisition speed and a high performance gradient insert for small animal imaging and small animal coils are available. Experiments involving visual or auditory stimulus presentation, physiological monitoring, participant monitoring, and eye tracking can be conducted. An MRI simulator and MRI-compatible EEG are available and data is collected on a high performance computer cluster. The MRI Research Facility provides infrastructure and support to facilitate research and educational activities using magnetic resonance imaging technology. Ongoing research includes studies of brain structure and function in normal and clinical populations as well as studies of other body systems, non-invasive animal imaging and materials science. This facility has received partial support from the Institute for Brain Science, Brown University.

**Media Prep Kitchen:** Biomedical Center, 171 Meeting St. This facility is directed by a Ph-D level investigator and staffed by a media prep assistant. The Media Kitchen is dedicated to providing investigators with high quality media for Drosophila research and genetic stock maintenance. To provide large and small quantities of media, this centralized kitchen is equipped with a food-service quality steam kettle fitted with a stirring unit and an induction cooktop. Media is pumped into trays of vials or plastic bottles using Filamatic and Masterfex/Digistalic dispenser pumps. Used vials are returned to the facility where they are sterilized in a Steris autoclave and washed in a Lancer washer fitted with custom racks for glass vials.

**Molecular Pathology Core Research Laboratory:** Laboratories for Molecular Medicine, 70 Ship St. This facility is directed by a PhD-level research investigator and managed by a histotechnologist. The research laboratory, which is open to graduate students, faculty, and staff, provides histopathological, immunohistochemical and immunocytochemical technologies. Processing, embedding, sectioning, and staining of specimens is provided along with
educational and hands on training. The facility instruments include a ScanScope CS digital slide scanning system from Aperio Technologies for image analysis, a Fujix Bas 1000 phosphor imager, a Nikon Eclipse TS100 inverted fluorescence microscope, a Nikon E800 microscope with a digital camera, a Vibratome for soft tissue sectioning, and an Arcturus PixCell II laser capture microdissection system. This facility has received partial support from the National Institutes of Health (NIEHS Grant No. P42ES013660).

**Mouse Transgenics and Gene Targeting:** Laboratories for Molecular Medicine, 70 Ship St. This facility is directed by a PhD-level research investigator and employs a full time facility manager to perform the technical work. Services provided include pronuclear injection of DNA into fertilized eggs and injection of gene targeted embryonic stem cells into blastocysts. The individual investigators are responsible for genotyping, husbandry, and breeding of generated mouse strains. Facility instrumentation includes a Nikon SMZ1500 dissection microscope, a Nikon Eclipse TE200 inverted microscope, an Eppendorf FemtoJet microinjection, a Zeiss Axiovert 25 inverted microscope, a Nikon SMZ800 surgical microscope and a Thermo Forma CryoPlus 1 liquid nitrogen storage system. This facility has received partial support from the National Institutes of Health (NCRR Grant No P20RR015578) and the Division of Biology and Medicine, Brown University.

**Proteomics:** Laboratories for Molecular Medicine, 70 Ship Street. The proteomics facility is directed and staffed by a PhD level scientist with technical know-how of numerous instrumentation platforms and bioinformatics analytical tools. Mass spectrometry and protein analysis using the Thermo LTQ Orbitrap Velos instrument is the central focus of this facility. Other facility instrumentation includes a Jasco J-815 Circular Dichroism Spectropolarimeter, MicroCal VP Differential Scanning Calorimeter, a MicroCal Isothermal Titration Calorimetry (ITC) 200, HORIBA Jobin Yvon FluoroMax-4 Spectrofluorometer, a GE Healthcare AktaPrime Plus Protein Purifier, an Agilent 1200 HPLC, a Minifors Fermentor, and a QiAcube Robotic workstation for automated DNA, RNA, or protein purification. This facility has received partial support from the National Science Foundation (EPSCoR Grants Nos. 0554548 and 1004057), the National Institutes of Health (NCRR Grant No. 1S10RR020923), a Rhode Island Science and Technology Advisory Council grant, and the Division of Biology and Medicine, Brown University.