The Department of Biology

Programs of Study

The Biology Department offers students a top-tier education. Our degree programs place a strong emphasis on preparing students to excel in various career fields.

B.S. degree in Biology
with concentrations in:
- Integrative Biology
- Cell and Molecular Biology
- Neurobiology
- Plant Biology

B.S. degree in Microbiology and Immunology

MS degree in Biology
Thesis option with emphasis in:
- Cell and Molecular Biology
- Microbiology and Immunology
- Neurobiology

Non-Thesis option with emphasis in:
- Science Education
- Open Emphasis

MS degree in Biotechnology

Ph.D. degree in Biology
with concentrations in:
- Neurobiology
- Cell and Molecular Biology
In the pages of this publication, we have highlighted the areas of specialization, and impressive achievements in research, including numerous new grants and original research publications of faculty of the Department of Biology at The University of Texas at San Antonio.

I am extremely proud to have been selected to lead a Department that provides a friendly and supportive environment for students, faculty, fellows, and staff with a strong international reputation for excellence in teaching and research. This is an exciting time for the department as we are enjoying the fruits of a vigorous expansion phase over the past 10 years, with the addition of exceptional faculty members during this time.

Within the Biology Department we have faculty with national and internationally recognized research programs that are at the forefront in the areas of Infectious Disease, Neuroscience and Cell/Molecular Biology. Our faculty study fundamentally important biological processes that include behavior, bioinformatics/computational biology, developmental biology, epigenetics, gene regulation, learning and memory, macromolecular structure/function, neurodegeneration, plant biology, proteomics/genomics and stem cell biology.

The Department is home to the Center of Excellence in Infection Genomics (CEIG), San Antonio Cellular Therapeutics Institute (SACTI), South Texas Center for Emerging Infectious Diseases (STCEID), and the UTSA Neurosciences Institute. Part of the success of our research programs is due to the involvement of UTSA students. Each year, undergraduate, graduate and postdoctoral scholars work directly with faculty and are engaged in state-of-the-art research projects. Biology is home to several National Institutes of Health funded student-training programs, including the Maximizing Access to Research Careers - Undergraduate Student Training in Academic Research (MARC-U*STAR), and the Research Initiative for Scientific Enhancement (RISE).

The faculty in the Department of Biology are known for teaching excellence, with Drs. Cassill, Gdovin and Sponsel receiving distinguished teaching awards within the past several years. The Department of Biology is one of the largest departments at UTSA, with 76 full-time faculty, 20 staff, 127 doctoral and master’s students, and more than 2,152 undergraduate majors. The Department offers B.S. degrees in Biology and a B.S. in Microbiology and Immunology. Within these degrees we offer a broad curriculum with concentrations available in Cell and Molecular Biology, Integrative Biology, Neurobiology and Plant Biology. At the graduate level we offer the MS in Biology, the MS in Biotechnology, and the Ph.D. in Biology with a concentration in Cell and Molecular Biology or Neurobiology. These programs offer core graduate courses in molecular biology, biochemistry and neuroscience, as well as advanced courses in a wide range of specialty areas reflecting the research interests of our faculty.

The Department offers numerous events, including journal clubs and research seminars, to develop the skills necessary for students to have successful careers in a wide variety of disciplines, such as secondary school teaching, microbiology, molecular biology, biotechnology, genetics, and neuroscience, and careers in the Health Sciences including medicine, dentistry, veterinary science and related allied health disciplines.

In summary, the faculty and staff of the Department of Biology are very excited about our future and we welcome you to work with us as we develop educational and research opportunities for students in the Biological Sciences. I encourage you to explore the pages of individual Biology Faculty, to come to our numerous seminars offered during the week and to stop by and visit with me during our quarterly coffee times.

Garry Sunter, Ph.D.
Professor and Chair
The Department of Biology
Faculty and Specializations

Cell & Molecular Biology

J. Aaron Cassill, Ph.D.
Professor

Matthew J. Gdovin, Ph.D.
Associate Professor

Luis S. Haro, Ph.D.
Professor

Brian P. Hermann, Ph.D.
Assistant Professor

Richard LeBaron, Ph.D.
Professor

Chin-Hsing Annie Lin, Ph.D.
Assistant Professor

Martha J. Lundell, Ph.D.
Professor

John R. McCarrey, Ph.D.
Professor and Kleberg Distinguished University Chair in Cellular & Molecular Biology

Cell & Molecular Biology and Microbiology & Immunology

Bernard Arulanandam, Ph.D., MBA
Jane and Roland Blumberg Professor and Interim Vice President for Research

Astrid E. Cardona, Ph.D.
Associate Professor

James P. Chambers, Ph.D.
Professor

Mark Eppinger, Ph.D.
Assistant Professor

Thomas G. Forsthuber, M.D., Ph.D.
Professor and Jesse H. & Mary Gibbs Jones Endowed Chair in Biotechnology

M. Neal Guentzel, Ph.D.
Professor

Kirsten K. Hanson, Ph.D.
Assistant Professor

Hans W. Heidner, Ph.D.
Professor

Karl E. Klose, Ph.D.
Professor

Soo Chan Lee, Ph.D.
Assistant Professor

Jose L. Lopez-Ribot, Pharm.D., Ph.D.
Professor and Margaret Batts Tobin Distinguished Chair

Robert D. Renthal, Ph.D.
Professor

Stephen P. Saville, Ph.D.
Associate Professor

Janakiram Seshu, Ph.D.
Associate Professor & Associate Dean of the Graduate School

Garry Sunter, Ph.D.
Professor and Department Chair

Yufeng Wang, Ph.D.
Professor

Floyd L. Wormley Jr., Ph.D.
Professor and Associate Dean of Research & Graduate Studies
Faculty and Specializations

**Plant Molecular Biology & Biochemistry**

Jurgen Engelberth, Ph.D.
Associate Professor

Valerie Sponsel, Ph.D., D.Sc.
Professor and Ricardo Romo Endowed Professor in Honors College

**Neurobiology**

Alfonso Apicella, Ph.D.
Assistant Professor

Deborah L. Armstrong, Ph.D.
Professor

Edwin J. Barea-Rodriguez, Ph.D.
Professor and Associate Dean for Student Success and Instructional Innovation

Brian E. Derrick, Ph.D.
Professor

Gary Gaufo, Ph.D.
Associate Professor

David B. Jaffe, Ph.D.
Professor

Hyoung-gon Lee, Ph.D.
Associate Professor

Asif M. Maroof, Ph.D.
Assistant Professor

Isabel A. Muzzio, Ph.D.
Associate Professor

Carlos A. Paladini, Ph.D.
Associate Professor

George Perry, Ph.D.
Professor and Dean of College of Sciences; Semmes Foundation Distinguished University Chair in Neurobiology

Clyde F. Phelix, Ph.D.
Professor

Fidel Santamaria, Ph.D.
Associate Professor

David M. Senseman, Ph.D.
Associate Professor

Kelly J. Suter, Ph.D.
Associate Professor

Todd W. Troyer, Ph.D.
Associate Professor

Matthew Wanat, Ph.D.
Assistant Professor

Nicole Y. Wicha, Ph.D.
Associate Professor

Charles J. Wilson, Ph.D.
Professor and Ewing Halsell Chair in Biology
Research Focus
I am interested in issues that prevent students from successfully completing their education. I am especially interested in problems encountered by students transferring from community college to four-year institutions and increasing the number of underrepresented students entering research careers.

Selected Publications and Funding
• Piloting a Pre-Research Program “Bootcamp” to Educate and Pre-Screen Undergraduate Students. Gail Taylor, Danielle Gordon, J. Aaron Cassill & Edwin Barea-Rodriguez 5th Annual Conference on Understanding Intervention that Broaden Participation in Research Careers, Baltimore, MD 5/10-12/12
• GEEMS Program to Prepare Highly Qualified Math and Science Teachers. Christine Moseley and Aaron Cassill, Science and Math Teacher Imperative, Association of Public and Land-Grant Institutions, Alexandria, VA 6/6-8/12
• NSF Noyce Scholarships- “Scholarship Support for Community College Transfer Students” PI Cassill, $1,392,192 9/1/13-8/31/18
• NSF S-STEM Scholarships- “Retaining Emerging Alamo College Talent in STEM (REACT-STEM)” PI Cassill, $637,188 8/1/15-7/31/20

Research Focus
Gdovin's laboratory recently combined the use of fluorescent pH indicator dyes to optically record pHi with the photoactivation of caged compounds to develop a novel photodynamic cancer therapeutic. He exposed MCF-7 breast cancer cells to the H+ carrier nitrobenzaldehyde (NBA) and, following flash photolysis, was able to release this H+ from NBA and decrease pHi from 7.34 to 6.42 in an effort to cause pH-induced apoptosis. The reduction in pHi with this technique was focal, as only the cancer cells exposed to both NBA and the photoactivated wavelength were acidified. More importantly, they were able to demonstrate that this novel treatment killed 98% of cancer cells within 3 hours, with no changes to untreated control cells.

The technique was also effective in causing significant reductions in the growth of Triple Negative Breast Cancer (TNBC) tumors and nearly doubling survival time in mice. To date, the technique has been successful in killing two types of breast cancer and one type of prostate cancer, supporting their hypothesis that reducing pHi to cause apoptosis may be a mechanism to kill cancer which no cancer cells can evade.

In 2015, Gdovin submitted a patent to the U.S. Patent and Trademark Office regarding this breakthrough cancer therapy, and plans to continue the development of this novel treatment, testing the efficacy of killing multiple types of cancers and multi-drug resistant cancer. He has also demonstrated the ability to kill breast cancer cells using a photo-upconversion nanoparticle as a potentially non-invasive treatment targeted to specific cancer receptors.

Training Opportunities
Fluorescence microscopy, cell culture, in vitro photodynamic therapy, in vivo animal models of cancer & cancer treatments.

Selected Publications and Funding


Active Projects
• Intracellular apoptotic pathways
• Animal models for cancer therapeutics
• Toxicology
• Efficacy of photodynamic therapy to kill pancreatic, prostate, and renal cancer

Current Graduate Students
Steve Holliday (M.S.)
Robert Lindberg (M.S.)
Research Focus
The Herman laboratory studies the basic biology of spermatogonial stem cells (SCCs), which are adult tissue stem cells responsible for sperm production in the mammalian testis and which are essential for male fertility. Ongoing studies in the lab are focused on 1) determining how these cells are regulated and behave like stem cells, 2) how we can prevent SCC loss due to chemotherapy, 3) how SCCs can be used to treat male infertility, and 4) how the pool of SCCs forms during development. Thus, our work has potential implications for basic stem cell biology, reproduction, as well as translational significance for treatment and prevention of male infertility.

Training Opportunities
We employ mice (including genetic models, Cre/lox, etc.) and nonhuman primate animal models and work with human testicular tissues. Our approaches are multidisciplinary, including in vitro SSC culture, an in vivo SSC transplantation assay for SSCs, immunofluorescence, as well as conventional and high-throughput molecular biology and genomic approaches. We also examine gene expression at the level of individual cells (e.g., single-cell RNA-seq) which allows us to investigate heterogeneity among cells within a population employ bioinformatics strategies to explore these data.

Selected Publications and Funding


Active Projects
• Helen Freeborn Kerr Charitable Foundation, Devise new treatments for male infertility that result from chemotherapy and radiation treatments for childhood cancer
• Southwest National Research Center Pilot Research Program VS980, Culture and transplantation of baboon spermatogonial stem cells.
• NIH R21 HD078916, G-CSF prevents male infertility after chemotherapy.
• NIH F32 HD079235, Regulation of Spermatogonial Stem Cell Proliferation and Differentiation by UTF1.
• UTHSCSA IIMS/CTSA IMMS-TTR Supplement, Single-Cell gene expression studies to identify the human spermatogonial stem cell.

Current Graduate Students
Navid Leelani (M.S.)
Max Mayo (M.S.)
Behnam Doraji-Naseri (M.S.)
Anukriti Singh (M.S.)
Research Focus
My research is focused on human cell interactions with molecules of the extracellular matrix (ECM), through cell surface receptors called integrins. I focus on two ECM molecules. One is called BIGH3, a proapoptotic protein playing roles in cancer progression, and promoting diabetes complications in the renal and ocular systems. We are dissecting the molecular signaling pathway that induces apoptosis. The other is called lubricin, a protein that is crucial for articular joint lubrication. Human temporomandibular joint (TMJ) can develop a disorder (TMD) that can be exceedingly painful and occurs more frequently in females of birth-giving years, indicating a hormonal response. My lab discovered that estrogen blocks lubricin gene expression. We are presently documenting discovery in female and male TMJ cells and how that leads to TMD.

Training Opportunities
We study molecular mechanisms that we believe underlie development of three human diseases; lubricin roles in TMD (see above), and BIGH3 roles in diabetic complications in the ocular and renal system, and in cancer progression. Our methodology and techniques include eukaryotic cell isolation, immortalization and long-term cultures, introducing mechanical stimuli to select cells, characterization of new cell lines, cell harvesting from necropsies, light and fluorescence microscopy and imaging, cell attachment and migration assays, expressing and isolating recombinant protein, column chromatography, use of expression vectors in selected cells, siRNA, standard and real-time RT-PCR, DNA and protein gels and blots, and general lab procedures.

Selected Publications and Funding
BIGH3 Diabetic Nephropathy

BIGH3 Diabetic Retinopathy
• Betts-Obregon, B.S. et.al. (2016) TGFß induces BIGH3 expression and human retinal pericytes apoptosis: a novel pathway of diabetic retinopathy, Eye online publication, 26 August 2016; doi:10.1038/eye.2016.179

Lubricin (Prg4) TMJ / TMD

BIGH3 Tumor Progression

Link to Publications:
https://www.ncbi.nlm.nih.gov/pubmed/?term=richard+leBaron

Active Projects
• NIH. LeBaron, Richard (PI) Estrogen Negatively Modulates Proteoglycan-4 Expression in TMJ
• San Antonio Area Foundation. LeBaron, Richard (PI) Development of a Monoclonal Antibody Product to Diminish Apoptosis in Diabetic Renal, Ocular and Vascular Complications.

Projects active, funding is pending
• BIGH3 roles in diabetic retinopathy
• BIGH3 roles in diabetic nephrology
• Molecular and cellular mechanisms of BIGH3 effects on tumor progression

Current Graduate Students
Robert Moritz (Ph.D.)
Veena Karthikeyan (M.S.)
Komal Ramzanali (M.S.)
Research Focus
Our research is focused on the stem cell and cancer biology. Ongoing studies in the lab related to stem cell biology include 1) understanding how stem cells in adult brain migrate and homing to their final destination to generate functional neurons, 2) how we can apply stem cells to the regenerative medicine for treating stroke, trauma, spinal cord injury, and neurological disorders. Thus, our work has potential implications for basic stem cell biology as well as translational significance for treatment and prevention of diseases.

Training Opportunities
The approaches we use in the lab including animal models genome editing, live and large-scale imaging, and high-throughput genome-wide analyses. To analyze discrete populations of cells in the brain regions with spatial complexity, we purify in vivo neural stem progenitor cells (NSPCs) for cutting-edge genome-wide assays (i.e. ChIP-Seq; RNA-Seq; quantitative proteome) to glean epigenetic landscape as well as differential expression of proteins and transcripts at different stages of cell fate as they exist in vivo. We have mapped out the epigenetic landscape and delineated gene expression between normal and disease conditions. Using conditional rodent models, we are assessing in vivo phenotypes.

Selected Publications and Funding
• Christopher T. Rhodes a, Richard S. Sandstrom b, Shu-Wei Angela Huang a, Yufeng Wang a, Gunnar Schotta c, Mitchel S. Berger d, *, and Chin-Hsing Annie Lin a, e, *. Cross-species Analyses Unravel the Complexity of H3K27me3 and H4K20me3 in the Context of Neural Stem Progenitor Cells. Neuroepigenetics 6, 10-25 (2016).
• NIH/NIGMS (1 SC3 GM112543-01). 2/1/2015 to 12/31/2018
• SCORE Grant - Lin, C-H Annie, PI “Aberrant Epigenetic Repression in Esophageal Malignancy”

The major goal of this project is to identify targets under aberrant epigenetic repression as potential biomarkers for early diagnosis of esophageal malignancy.

Selected Publications

Active Projects
• Epigenetic Regulation in Neuronal Plasticity
• Aberrant Epigenome in Cancer Heterogeneity
• Reprogramming Cell Fate by Protein-based Delivery for Therapeutic Intervention

Current Graduate Students
Christopher Rhodes (Ph.D.)
Kevin Tang (M.S.)
Research Focus

Research in the Lundell laboratory is primarily focused on how neurons in the central nervous system of Drosophila acquire unique cell fates during development. In particular we are examining the genetic pathway that leads to the specification of neurons that synthesize serotonin. Serotonin is a neurotransmitter conserved throughout the animal kingdom and has been associated with locomotion, learning, memory and several human neural disorders.

The Drosophila serotonin cell lineage includes six cells: two serotonin producing neurons, a neuron that produces the neuropeptide corazonin, a motor neuron and two cells that undergo apoptosis. We have characterized a number of genes that are essential in specifying these different cell fates, and are investigating the genetic interactions between these genes.

Training Opportunities

The Lundell lab uses a combination of genetics, molecular biology, immunohistochemistry, confocal microscopy and behavior paradigms to study the genes that regulate neurogenesis in Drosophila.

Selected Publications and Funding


Link to Publications: [http://www.ncbi.nlm.nih.gov/sites/myncbi/1m5TOb0QzuA2/bibliographay/47799631/public/?sort=date&direction=ascending](http://www.ncbi.nlm.nih.gov/sites/myncbi/1m5TOb0QzuA2/bibliographay/47799631/public/?sort=date&direction=ascending)

Active Projects

- ZFH-2 promotes Notch-induced apoptosis in the CNS and appendages of Drosophila Melanogaster
- Hunchback prevents Notch-induced apoptosis in the serotonin lineage of Drosophila Melanogaster
- ZFH-2 and the Springer retrotransposon define a new gene insulation system in Drosophila
Research Focus
Research in my laboratory is centered on the development, differentiation, and epigenetic regulation of mammalian germ cells and stem cells. We are interested in 1) the occurrence and correction of epimutations in the germ line, 2) the effects of assisted reproductive technologies on the induction of epimutations in the offspring produced, 3) the development of spermatogonial stem cells, 4) the maintenance of enhanced genetic integrity in germ line and pluripotent cells, 5) the regulation of gene expression in germ cells, 6) X-chromosome activity or inactivity in germ cells, 7) germ line epigenetic programming, and 8) developing the baboon as a preclinical model for studies of stem cell-based therapies.

Training Opportunities
Opportunities exist for training in association with any of the research foci listed above. Technical approaches include – analysis of gene expression patterns by RNA-seq, molecular regulation of gene expression including analysis of protein-DNA interactions by ChIP, DNA methylation by methyl-seq, histone modifications by ChIP-seq, chromatin structure by ATAC-seq; derivation and culture of pluripotent stem cells & germ cells – particularly spermatogonial stem cells; analysis of mutation frequencies; stem-cell based therapeutic approaches via derivation and directed differentiation of iPS cells & transplantation into mice or nonhuman primates.

Selected Publications and Funding
• NIH RO1 Grant - “Epimutations in offspring produced by assisted reproductive technologies”
• Kleberg Foundation Research Grant - “PriStem - a primate resource for developing stem cell therapies”
• Templeton Foundation - “Molecular etiology of epigenetic transgenerational inheritance of disease”
• Kyoto Univ, Japan, - “Analysis of mutations in spermatogenic stem cells”
• Kleberg Distinguished Chair endowment.

Active Projects
• Analysis of epimutations in mice produced by assisted reproductive technologies
• Analysis of genetic integrity in germ cells – especially spermatogonial stem cells
• Analysis of genetic integrity in pluripotent stem cells including embryonic stem cells and induced pluripotent stem cells
• Analysis of epimutations induced by exposure in utero to endocrine disruptors
• Development of the baboon as a preclinical model for testing the efficacy and safety of stem-cell based therapeutic approaches
• Use of iPS cells to facilitate ‘disease-in-a-dish’ studies of neurodegenerative diseases

Current Graduate Students
Megan Mahlke (Ph.D.)
Jacqueline Shay (Ph.D.)
Christine Duginski (M.S.)
Jake Lehle (M.S.)
Bo Li (M.S.)

Link to Publications:
Bernard Arulanandam, Ph.D., MBA
Jane and Roland Blumberg Professor and
Interim Vice President for Research

Research Focus
The Arulanandam Laboratory studies the basic mechanisms of immune defenses at mucosal sites. Mucosal surfaces form the major interface between the host and the environment, and constitute the first line of defense against bacterial pathogens. (A) Using ‘omics’ based approaches, we are investigating host immunity and pathogenesis associated with pulmonary and genital Chlamydia trachomatis in murine and guinea pig models of infection (B). Francisella tularensis is the causative agent of tularemia.

We are currently examining the mechanism(s) by which mast cells modulate innate immune defenses against this pathogen. We also characterized the use of defined F. tularensis mutants as live attenuated vaccine candidates against pneumonic tularemia. (C) Acinetobacter baumannii has emerged as an important nosocomial pathogen. We have developed an oral-gastrointestinal (GI) challenge model with A. baumannii to examine the contribution of mucosal immune defenses against GI colonization by this pathogen and the subsequent systemic manifestation of this infection.

Training Opportunities
We utilize animal models including mice, rats, and Guinea pigs to study pathogenesis and host immune responses following Gram-negative bacterial infection. We employ various immunological techniques/tools, such as confocal microscopy, flow cytometry and ELISpot, to study immune cell activation and migration in response to bacterial infection. We also generate primary cells to establish cell coculture systems to delineate underlying immune protective mechanisms. Additionally, we track bacterial dissemination using a small animal whole body imaging system and evaluate infection induced respiratory dysfunction with the FlexiVent, a small animal ventilator. We also apply molecular and biochemical tools to generate cellular and subunit vaccine candidates against bacterial pathogens. My lab provide training opportunities to students who are interested in studying mucosal immunity against bacterial infection.

Selected Publications and Funding
• DHS 2014-ST-062-000058: Analysis and Training in Defense of Biological & Digital Threats
• DoD W911NF-11-1-0136: Center of Excellence in Infection Genomics
• NIH 1R03AI117714-01A1: The Contribution of MicroRNA-182 in Genital Chlamydia trachomatis Infection
• NIH 1R21AI124021-01: Thioredoxin Mediated Acinetobacter baumannii Colonization in the GI Tract
• Texas State VDCSA grant: Vaccine Development Against Systemic Acinetobacter baumannii Infection

Link to Publications:

Active Projects
• Host microRNA mediated anti-chlamydial immunity at mucosal surfaces
• Development of prophylactic and therapeutic treatments against multidrug-resistant Acinetobacter infection
• Investigation of mast cell mediated innate immune responses against Gram-negative bacterial infection through intercellular communication

Current Graduate Students
Jonathon Keck (Ph.D.)
Holly May (Ph.D.)
Aravind Kancharla (M.S.)
**Research Focus**

The overall goal of my research program is to understand the role of fractalkine and its receptor CX3CR1 in neuronal-microglia interactions and in the regulation of CNS pathology during Multiple Sclerosis (MS), neurocysticercosis and diabetes. I first delineated the role of CX3CR1 in vivo in 2006 and have continued providing evidence that CX3CR1 is an important modulator of microglial-mediated neurotoxicity. Notably, mice lacking CX3CR1 exhibited worse EAE, enhanced inflammation and profound myelin loss. In MS direct T-cell and microglial interaction with oligodendrocytes supports the detrimental effects of inflammation to oligodendrocyte survival. However, the role of CX3CR1 in innate and adaptive immunity during MS is unknown. Our central goal is to determine the role of CX3CR1 in 1) microglia and DCs in the establishment of pathogenic T-cell responses, and in neuronal pathology and demyelination CNS inflammation and 2) in microglia and peripheral monocytes/macrophages in the establishment of inflammation, neuronal and vascular pathology in the CNS.

**Training Opportunities**

My lab focuses on the functional interactions between immune cells, microglia, neurons and blood vessels, utilizing experimental mouse models of disease, immunological assays, flow cytometry, fluorescent activated cell sorting, microscopy and molecular biology approaches.

Motivated trainees with a clear interest for a career in biomedical science have opportunities to participate in my research via independent study, thesis/dissertations and work-study. Training is provided to acquire experience in how to choose, design and expedite new experiments. An important goal is also to develop excellent communication skills, written and oral. This involves becoming an engaged lab member who can present his/her own work, and actively participates in the execution of research, lab meetings, seminars, journal clubs, scientific conferences, and in generation of written reports and scholarly products.

**Selected Publications and Funding**


**Active Projects**

- NIH/NIGMS SC1GM095426 Role: PI Role of CX3CR1 in adaptive immunity during autoimmune encephalomyelitis.
- NIH/NINDS R01NS078501 Role: PI Role of C-type lectin receptors in myeloid plasticity in neurocysticercosis.
- UT-Brain Seed Funding Role: Collaborator PI: Spencer. Neural invasion by Francisella tularensis causes lethal neuroinflammation.

**Current Graduate Students**

- Andrew Mendiola (Ph.D.)
- Victoria Diaz (M.S.)

James P. Chambers, Ph.D.
Professor

Research Focus
Dr. Chambers is an established Biochemist of long-standing with national/international recognized expertise in many aspects of the enzymology of inherited lysosomal storage diseases, i.e., Gaucher and Pompe’s Disease, glyconjugate characterization, receptor mediated channel function, i.e., Ca2+/Mg2+ Dependent ATPase, and biosensor sensing element development (antibody, RNA aptamer, DNA-branched chain nucleic acid, and dendrimer based formats) for detection/diagnosis of Influenza and bacterial pathogens.

Training Opportunities
Dr. Chambers has trained over the years many Undergraduate, Masters, and Doctoral level students in his laboratory. In 1992, Dr. Chambers implemented the first free-standing Ph.D. program here at UTSA, and trained its first two students. He is recipient of numerous research and teaching awards.

Selected Publications and Funding

Link to Publications:

Active Projects
- “Characterization and purification of an acid phosphatase from Acinetobacter baumannii”.
- “Carboxyphosphotransferase and abiotic synthesis of ATP via pyrophosphate hydrolysis”.

Current Graduate Students
Elizabeth Moreno-Smiley (M.S.)
Research Focus
The focus of Dr. Eppinger’s research is on the application of microbial genomics to address fundamental questions in emerging infectious diseases. His current interests are directed towards large-scale sequencing and phylogenomic studies investigating major public health threats, such as the causative agent of foodborne disease in North America, Escherichia coli O157:H7. Experimental approaches include:
1. Microbial Genome Sequencing – the gathering of additional sequence data as prerequisite to capture the genome architecture and genomic diversity in environmental or clinical settings
2. Phylogenomics – the development of bioinformatics tools to survey the genomic plasticity within pathogen populations and elucidate the ancestry of microbial species
3. Microbial Diversity – the discovery of subtle yet important genetic variations in gene content and activity
4. Pathogenicity – the study of virulence determinants and dynamic host-pathogen interactions

Data from this research provides crucial insights into the make-up of bacterial pathogens and how genomic variants relate to differences in evolutionary and ecological niches that underlie human transmissibility, infectivity and disease outcome. Most importantly, this research can help to initiate countermeasures in an attempt to decrease human morbidity rates.

Selected Publications and Funding
- National Institutes of Health (NIH-NIAID) SC2AI12094. Phylogenomic framework for virulence studies of Escherichia coli O157:H7

Link to Publications:

Active Projects
- Phylogenomic framework for virulence studies of Escherichia coli O157:H7
- Analysis and Training in Defense of Biological and Digital Threats

Training Opportunities
Dr. Eppinger’s research program offers an opportunity for students to be trained in a high-throughput microbial genomics and infectious disease laboratory. The research program, which is focused on microbial genomics, incorporates several fields of science, and has exposed students to aspects of microbiology, ecology, (patho-) genomics, epidemiology, molecular biology and bioinformatics and has provided individual projects for students, which have been completed within the scope of a Work Study, Research Volunteer, MS thesis or Ph.D dissertation project.
Research Focus
Erroneous activation of the immune system can lead to autoimmune diseases such as multiple sclerosis (MS). Dr. Forsthuber’s lab pursues several lines of investigation to understand how the immune system, in particular T cells, contribute to autoimmune diseases and how to modulate T cell immunity for therapeutic purposes in humans. Specifically, he studies immune mechanisms in the central nervous system in experimental autoimmune encephalomyelitis (EAE), the animal model for MS. Moreover, he studies human autoimmune heart disease in a model called experimental autoimmune myocarditis. His research is aimed towards direct applicability to human diseases, for example by developing novel drugs for autoimmune diseases and biomarkers to monitor the efficacy of treatments for autoimmune diseases.

Training Opportunities
Work in the laboratory focuses on better understanding the pathologic immune mechanisms that drive autoimmune diseases such as MS, T1D, and autoimmune myocarditis. Specifically, we study immune mechanisms in the central nervous system during experimental autoimmune encephalomyelitis (EAE), the animal model for MS. The lab has generated transgenic and knockout mouse models to investigate the role of important autoimmune disease-related genes such as HLA-DR. We use immunologic, cell biology, and molecular biology methods such as cytokine detection assays, flow cytometry, RT-PCR and many other assays in our studies.

Selected Publications and Funding
- Itay Raphael; Swetha Mahesula; Anjali Purkar; David Black; Alexis Catala; Jonathon AL Gelfond; Thomas G Forsthuber*; William E. Haskins*. Microwave & Magnetic (M2) Proteomics Reveals CNS-Specific Protein Expression Waves that Precede Clinical Symptoms of Experimental Autoimmune Encephalomyelitis. *shared senior authors. Nature Scientific Reports 4:6210 (2014) PMCID 4152753


Active Projects
- M2 proteomics of the EAE model of multiple sclerosis
- NETs and lipid peroxidation in EAE
- MIF inhibition as a novel treatment for autoimmune myocarditis.

Current Graduate Students
Carol Chase (Ph.D.)
Saisha Nalawade (Ph.D.)
Rachel Robinson (Ph.D.)
Elizabeth Fritz (M.S.)
Francisco Gomez-Rivera (M.S.)
Research Focus
Dr. Guentzel’s research expertise is in microbial pathogenesis and immunology. Initially, he worked with cholera (Vibrio cholerae) and was the first to show motility as a virulence factor for any bacterial pathogen and extensively characterized an animal model for studies of cholera pathogenesis and putative vaccines for cholera. He also studied pathogenesis of the major fungal pathogen Candida albicans and developed a new animal model for candidiasis.

His current research interests are on the STD agent Chlamydia trachomatis, the select agent Francisella tularensis, and the multi-drug resistant wound and nosocomial (hospital acquired) pathogen Acinetobacter baumannii.

Training Opportunities
Current studies have focused on pathogenesis and putative vaccines for Chlamydia trachomatis, the world’s leading cause of bacterial STD, which is often asymptomatic but if left untreated can induce ascending infection in the uterus and fallopian tubes, causing pelvic inflammatory disease (PID) and complications such as ectopic pregnancy and infertility in women, and infant pneumonia in children with serious respiratory sequelae later in life.

The lab’s studies on the select (bio-threat) agent Francisella tularensis have helped to define the virulence determinants of this pathogen and characterized the immune response and protection afforded by putative attenuated vaccine strains. Acinetobacter baumannii is a multi-drug resistant, important wound, nosocomial (hospital acquired), and pulmonary pathogen with a high mortality, which is being studied for mechanisms of colonization, pathogenesis and control by targeting virulence factors.

Selected Publications and Funding

Link to Publications

Active Projects
- Acinetobacter baumannii
- Chlamydia trachomatis
- Francisella tularensis
- Microbial pathogenesis
- Vaccines

Current Graduate Students
Jonathon Keck (Ph.D.)
Holly May (Ph.D.)
Research Focus
Despite great strides in malaria control during the past decade, Plasmodium parasites still caused over 200 million clinical cases of malaria during 2015, leading to over 400,000 deaths.

The parasite forms responsible for malaria exclusively infect red blood cells, but all mammalian Plasmodium infections must initiate in the liver. This liver stage of parasite development has emerged as a key target for antimalarial chemoprophylaxis, as it precedes both disease and transmission back to the mosquito vector. Successful interventions against liver stages can thus protect both individuals and populations, a key challenge for the malaria elimination agenda. Our research program is dedicated to identification of the most desirable compounds for liver stage-directed chemoprotection.

In addition to our compound screening program, we focus on novel assay development and chemical biology approaches to interrogating the unique cell biology that supports syncytial growth during the Plasmodium liver stage, and the rapid cellularization process that ends the liver stage, generating thousands of individual parasites that invade red blood cells, and cause disease.

Training Opportunities
We work with the rodent malaria models, P. berghei and P. yoelii using both in vitro and in vivo approaches, and a variety of experimental techniques. We have developed a robust method linking confocal microscopy to online image processing to automate parasite identification, and subsequent high resolution imaging, in both live and fixed infected hepatoma cells.

Our research thus relies heavily on the quantitative analysis of such parasite images to both elucidate fundamental questions of Plasmodium liver stage biology and host–parasite interactions, and identify desirable small molecules for antimalarial drug development.

Selected Publications and Funding
- Grand Challenges Explorations, Phase II – Bill and Melinda Gates Foundation
- Pilot Project – Military Health Institute of UTHSCSA

Link to Publications:

Active Projects
- Phenotypic profiling of antimalarial compounds
- Antimalarial drug discovery: assay development and small molecule screening to identify compounds with novel or desirable killing mechanisms
- Cell biology of the syncytium to single cell transition during liver stage development.
- Host-parasite interactions

Current Graduate Students
Rabiu Ibraheem (M.S.)
Research Focus
The primary focus of my research laboratory is the design and development of alphavirus-based vectors and vaccines. Alphaviruses are small RNA viruses that are spread to humans and other vertebrates through the bites of infected mosquitoes. Alphaviruses possess a number of properties that support their use as vectors for expressing foreign genes of interest. Therefore, these viruses have been researched extensively for use as recombinant vaccines.

We are using Sindbis virus, the prototype alphavirus, to develop and evaluate new strategies for targeting alphavirus vectors, or alphavirus-expressed antigens to immunologically relevant cell types such as dendritic cells. An additional project focuses on the development of an alphavirus-based influenza vaccine.

Selected Publications and Funding


Active Projects
An influenza A virus vaccine based on a M2e-modified alphavirus.
Research Focus
Dr. Klose’s lab is interested in bacterial pathogenesis -- how bacteria cause disease. Dr. Klose has worked most extensively with Vibrio cholerae, the bacterium that causes cholera, and is also researching Francisella tularensis, the bacterium that causes tularemia, or rabbit fever.

Cholera is found only where there are widespread problems with sanitation, so improving water and food supplies would eliminate the disease. Since that is unlikely to occur, a safe, cheap, effective vaccine is needed that would protect people. To design such a vaccine, the lab is addressing questions such as: How does V. cholerae know that it is in a human body and that is the place to express genes necessary for its survival and disease potential? What are the genetic factors responsible for V. cholerae to cause disease? How does this organism persist in aquatic environments, which lead to human infection?

Very little is known about F. tularensis or about tularemia. It is a highly virulent organism and can easily be aerosolized, so it is classified by the Centers for Disease Control (CDC) as a Category A select agent with the highest potential to be used as a biological weapon. The lab is working to identify genetic factors responsible for F. tularensis to cause disease and to develop suitable vaccine candidates to protect against tularemia infection.

Training Opportunities
We utilize a variety of techniques to allow students to address the scientific questions associated with bacterial pathogenesis, including genetics, molecular biology, biochemistry, immunology, vaccinology, genomics, and a variety of imaging techniques.

Selected Publications and Funding


Active Projects
- The genetic basis of virulence of Vibrio cholera
- Development of an effective vaccine against tularemia

Current Graduate Students
Mylea Echezarreta (M.S.)
Shweta Mogare (M.S.)
Research Focus
My laboratory studies a broad range of fungi that pose serious threats to public health. In particular, one of the goals of my research is to elucidate the interactions between hosts and human pathogenic fungi, which will subsequently contribute to the development of therapeutic options.

My research takes advantage of the Mucor dimorphism as a tool to elucidate fungal pathogenesis and host responses against life-threatening fungal infections. Another goal is to define the roles of the enteric mycobiota (fungi in the GI tract) in eating disorders. This could provide information for better understanding of the etiology and novel factors associated with eating disorders, which would facilitate the development of innovation and improved treatment options.

Training Opportunities
Mucormycosis caused by zygomycetes (in the order Mucorales) is an opportunistic fungal infection recently recognized as an emerging infectious disease. My research involves studying the host-pathogen interface. Mucor is a dimorphic fungus and the different morphogenic stages (spores/hyphae vs. yeast) result in different host-pathogen interactions. The key question is: what difference(s) between spores and yeast makes hosts respond differently? Our goal is to identify key virulence factors conserved in mucormycosis fungi, which enable the fungi to escape innate immunity.

Another research goal is to define the roles of the enteric mycobiota in eating disorders. My research will elucidate the dynamics of the fungal population in the gut of patients with eating disorders.

Selected Publications and Funding
- Improvement of genetic analysis in the pathogenic zygomycete Mucor circinelloides (R03-A119617, PI)


Active Projects
There are two ongoing projects to elucidate host-fungal pathogen interactions focusing on the Mucor dimorphism as a tool and the dynamics of the mycobiome in patients with eating disorders.
- Define pathogenesis in mucormycosis, an understudied fungal disease and investigate host responses against filamentous fungal pathogens.
- Investigate the dynamics of fungi in the gut (“mycobiome”) of the patients with eating disorders.
Research Focus
Research in the laboratory has provided important insights into the pathogenesis of candidiasis, the main fungal infection affecting an increasing number of immune- and medically-compromised patients. This work encompasses from the basic biology of the cell wall, biofilm formation, adhesion and morphogenetic conversions, to the use of animal models to better understand virulence and host responses, to the more clinical aspects such as antifungal drug development, drug resistance and vaccines, with the ultimate goal of devising new strategies for the diagnosis, prevention and treatment of candidiasis.

Training Opportunities
For students at all levels (from undergrads to postdoctoral fellows) to be trained in a variety of contemporary and state of the art techniques related to fungal pathogenesis and antifungal drug development.

Selected Publications and Funding


Active Projects
• National Institute of Allergy and Infectious Diseases (NIAID), National Institutes of Health (NIH). R01AI119554. “Development of novel chemical series of Candida albicans biofilm inhibitors”. Dates: 06/22/2015 to 05/31/2020. Role: PI.

Current Graduate Students
Daniel Montelongo Jauregui (Ph.D.)
Jesus Romo (Ph.D.)
Nelson Torres (Ph.D.)
Gina Wall (Ph.D.)
Lucero Martinez Delgado (M.S.)
Selected Publications and Funding


Active Projects

• U.S. Department of Agriculture Agricultural Research Service. Research Support Agreement. Measurement of metabolomic and proteomic profiles of ticks and horn flies. (PI)
• NIH RCMI Protein biomarkers core facility. Operation of a high-resolution mass spectrometry facility. (collaborator)

Current Graduate Students

Trisha Das (M.S.)
Research Focus
The Saville lab conducts research on the fungal pathogen Candida albicans and specifically how it is able to cause disease in humans. The fungus forms part of the normal microbiome of humans, existing as a commensal on the mucosal surfaces of the mouth, vagina or GI tract of 30-50% of the population. It is, however, capable of causing a wide range of diseases from superficial, generally treatable conditions such as oropharyngeal candidiasis (OPC; oral thrush) and vulvovaginal candidiasis (VVC; “yeast” infection) to a serious, life-threatening disease should the fungus disseminate to the deep organs.

The major cellular attribute linked to C. albicans capacity to cause disease is its ability to alter its growth form from single celled “yeast” to an elongated form called a hypha. Our research is focused on unraveling the cellular machinery controlling hypha formation and developing new antifungal drugs that will inhibit this process.

Training Opportunities
In our ongoing studies to provide additional details of the cellular machinery regulating C. albicans hypha formation, we recently discovered that the gene encoding the key transcriptional repressor Nrg1p is itself subject to negative regulation via the induction of an antisense transcript.

We are attempting to ascertain whether additional anti-sense transcripts play a role in controlling hypha formation and which C. albicans proteins are involved in their production and turnover; to that end, we employ a combination of molecular biology techniques such as RNA-Seq, ChIP-Seq and quantitative PCR with more traditional methodologies such as novel strain construction and microscopy. Our other major research endeavor involves characterizing the mechanism of action of several compounds we have identified which inhibit hypha formation.

Selected Publications and Funding

Link to Publications:
http://www.ncbi.nlm.nih.gov/pubmed/?term=Saville+SP

Active Projects
- Genetic Regulation of Candida albicans filamentation.
- Role of hypha formation in Candida albicans pathogenesis.
- Characterization and development of novel small molecule inhibitors of Candida albicans hypha formation as potential new anti-fungal drugs.

Current Graduate Students
Jesus Romo. (Ph.D.)
Research Focus
Our research focus is to study how pathogenic bacteria interact with their hosts leading to infectious diseases such as Lyme disease and Q fever. We determine the role of key players in regulatory pathways that facilitate bacterial pathogens to adapt to different environmental conditions and devise strategies to interfere with the lifestyles of bacteria to prevent their infectious capabilities. We also focus on developing a variety of products such as vaccines, inhibitors of critical metabolic pathways and modulators of host response to prevent bacterial infections using a number of experimental models of infection in conjunction with state-of-the-art methods in genomics, proteomics and metabolomics of host-pathogen interactions.

Training Opportunities
We train students at all levels in various stages of a vector-borne disease using Lyme disease as a model. These includes training modules in 1) recombinant DNA/RNA methods; 2) protein purification and analysis of interactions; 3) genetic manipulation of infectious bacterial agents and 4) analysis of infectivity using rodent and tick models of infection. Studies on the stages of infection of an intracellular pathogen, using Coxiella burnetii Phase II (avirulent strain) as model, involve use of microscopy/labeling methods, quantitative transcriptomics, proteomics and metabolomics. An intense “boot-camp” with hands-on training on many basic techniques in molecular microbiology is provided to all students and when the students gain sufficient competence in performing these methods, they will transition to independent projects.

Selected Publications and Funding

Link to Publications:

Active Projects
- Regulation of gene expression in Borrelia burgdorferi
- Cell wall biogenesis in Borrelia burgdorferi
- Metabolic control of virulence potential of the agent of Lyme disease
- Diagnostic tools for detection of ZIKV
- Inhibitors of antibiotic resistant strains of ESKAPE pathogens

Current Graduate Students
Sarah Helm (M.S.)
Jorge Gonzales (M.S.)
Research Focus
The Sunter laboratory explores various aspects of host-pathogen interactions using geminiviruses, an emergent group of plant single-stranded DNA viruses that cause devastating disease in food crops worldwide.

Ongoing studies in the lab focus on 1) Analysis of the viral chromatin state to understand how chromatin structure and epigenetics plays a role in regulating viral gene expression; 2) The study of host transcription factors that mediate expression of viral genes; 3) determining how geminiviruses manipulate the cellular environment to overcome host defense responses; 4) Network discovery to increase our understanding of plant immunity, and to identify key regulatory points that determine infection outcome.

Current control measures include limiting vector populations using pesticides, which is a significant health concern, as pesticides work by disrupting nervous system function. Thus, our work has potential implications for alternative ways of controlling geminivirus infections is warranted to reduce the incidence of geminivirus disease.

Training Opportunities
The lab utilizes model plants as well as agriculturally relevant crop plants as genetic models to study host-pathogen interactions, such as transcriptional regulation, transcriptional and post-transcriptional gene silencing (RNAi) and host immunity.

We use multidisciplinary approaches that include cell and molecular biology, genomics, bioinformatics and computational analysis. Skills developed in the lab involve cell culture, DNA/RNA and protein purification, fluorescence and confocal microscopy, gene expression studies and mutational analysis. Trainees are introduced to the design and conduct of experiments and statistical approaches for data analysis.

Selected Publications and Funding


Active Projects
- Developing tools and databases for network-based plant systems biology with applications to understanding plant-virus interactions.
- Analyzing the role of the plant DNA repair system in geminivirus infection
- Determining the role of a host transcription factor (TCP) in regulating geminivirus promoter activity
- Characterizing the impact of a viral RNA silencing suppressor on autophagy

Current Graduate Students
Mary Berger (Ph.D.)
Jennifer Guerrero (Ph.D.)
Maria Lockwood (Ph.D.)
Anthony Escalante (M.S.)
Research Focus
Research in Dr. Wang’s lab focuses on the comparative genomics, molecular evolution, and systems biology of gene families. The lab uses genomic and related data, coupled with other biochemical and microbiological information, to identify new therapeutic targets and to further study the underlying evolutionary mechanisms in diseases such as malaria. Their research has a particular emphasis on the functional divergence of duplicated genes, which are believed to provide the raw material for functional novelty. They are also interested in the association between sequence evolution and gene network regulation.

Training Opportunities
Students in the Wang lab will be trained to the use of cutting edge bioinformatic and genomic tools to statistical modeling and analysis of the omic data. Students will gain hands-on experience in bioinformatics and computational biology. Topics to be covered in student training include:

- Information and resources: PubMed, bioinformatics databases, molecular biology databases
- Next-generation sequencing: technology and data analysis
- Gene expression profiling
- Phylogenetic analysis and molecular evolution
- Gene regulatory networks and systems biology
- Population and statistical genetics
- Pathway analysis

Selected Publications and Funding


Active Projects

- Systems biology of infectious diseases
- Host-pathogen interactions
- Molecular evolution of protein families in vertebrates and infectious agents
Research Focus
Our research involves employing both molecular and immunological techniques to study host-pathogen interactions; specifically those interactions involving the host and fungal pathogens such as Candida albicans and Cryptococcus neoformans. The goals of our studies are to develop new anti-microbial drugs and novel immune prophylactic therapies and/or vaccines that augment host defenses against infections.

We have years of experience investigating various vaccine strategies and aspects of the host cellular mediated and antibody mediated immune responses. Our research is supported by grants from the National Institute of Allergy and Infectious Diseases (NIAID) of the National Institutes of Health (NIH) and the Department of Defense (DoD).

Training Opportunities
Our research laboratory utilizes the human fungal pathogens Candida albicans and Cryptococcus neoformans as model organisms to study host-fungal interactions for the purpose of developing novel immune therapies and/or vaccines to treat and/or prevent invasive fungal infections.

We have the expertise, instrumentation, and facilities to conduct training and research in the areas of host/pathogen interactions, vaccine development, and microbial pathogenesis. Specifically, we utilize various assays (i.e., flow cytometry, real-time PCR, ELISA, Western Blot, 1D and 2D polyacrylamide gel electrophoresis, Luminex-based assays, etc.) to define mechanisms that contribute to the pathogenesis of disease.

Selected Publications and Funding
• Funding – NIH and DoD

Selected Publications and Funding

Active Projects
• Protective Host Immunity Against Pulmonary Cryptococcosis. The long term goal of this project is to determine mechanisms that induce protective immunity against C. neoformans infections.
• Coordinated Regulation of Virulence Genes in C. neoformans. The major goal of this project is to identify microbial factors involved in the pathogenesis of the opportunistic fungus Cryptococcus neoformans.

Current Graduate Students
Marley Caballero (Ph.D.)
Althea Campuzano (Ph.D.)
Natalia Castro-Lopez (Ph.D.)
Research Focus
Our research focuses on the role of so-called ‘green leaf volatiles’ (GLV), the common “green” smell of plants, as mediators of plant stress responses. GLV are well known as compounds that prime stress responses, thereby effectively protecting plants without investing valuable metabolic resources. However, even after almost 20 years of research little is known about how GLV regulate these processes. We are therefore investigating the molecular mechanisms of GLV-induced priming and how these affect the physiology of the plant during stress responses.

Training Opportunities
We study the effects of GLV on plants under abiotic and biotic stress conditions. We use physiological, analytical, and molecular techniques to analyze these responses and to assess the effectiveness of GLV-induced signaling. Students on all levels are welcomed to work in the lab on these topics.

Selected Publications and Funding


Active Projects
• The role of GLV in priming plant stress responses.
• Free fatty acids and how they effect defense signaling.
• Herbivore-derived effectors of plant defense responses.

Current Graduate Students
Ting Li (M.S.)
Loan Doan (M.S.)
**Research Focus**

Dr. Sponsel’s research focuses on the gibberellin class of plant hormones that regulates plant growth and development. Many different gibberellins have been identified in plants and in the fungus Gibberella fujikuroi. It was the original identification of these compounds in Gibberella that led to their unusual name. In plants one class of hormone can control many different processes, for example, gibberellins regulate seed germination, stem growth, transition to flowering, and fruit development. In most instances this regulation involves interaction of gibberellins with other hormones.

Currently, the lab is interested in cross-talk between gibberellins and two other types of plant hormones, auxin and jasmonic acid in the model plant Arabidopsis thaliana. Defining processes and mechanisms of how growth and development are regulated in Arabidopsis can provide information that can be useful to improve growth and productivity of crop plants.

**Selected Publications and Funding**


**Active Projects**

- Investigating the effect of jasmonic acid on gibberellin biosynthesis and signaling in wildtype plants and auxin mutants
- Effect of gibberellins on jasmonic acid biosynthesis and signaling

**Training Opportunities**

Students in the lab use a variety of Arabidopsis mutants in which the biosynthesis, transport, signaling or response of one hormone is perturbed to examine the effects of other hormones on the transcription of genes involved in hormone action. Plants are grown under sterile conditions and/or in environmental growth chambers prior to nucleic acid extraction and PCR. Expression of reporter genes is monitored histochemically, and by confocal microscopy.

**Link to Publications:**

[https://scholar.google.com/citations?user=Cu17BlcAAAAJ&hl=en&oi=ao](https://scholar.google.com/citations?user=Cu17BlcAAAAJ&hl=en&oi=ao)
Research Focus
The goal of Dr. Apicella’s lab is to reveal the neural basis of perception. More specifically, he wants to understand exactly how cortical microcircuits process sensory information to drive behavior. To assess how populations of neurons concur to encode information, generate perceptions, and execute behavioral decisions requires working at both the cellular and system level. Towards this goal, by turning neurons “ON” and “OFF” using optogenetic and pharmacogenetic approaches, the lab can monitor and then manipulate specific subsets of neurons in awake behaving mice.

This approach will allow the lab to quantitatively determine how specific subsets of neurons contribute to sensory processing and behavior. By complementing in vivo work with synaptic connectivity and network dynamics analysis in vitro, they are going to achieve a more complete understanding for how neural circuits in our brain support sensation, action, and cognition.

Training Opportunities
Optogenetics and whole-cell patch-clamp recordings to examine synaptic mechanisms in vitro, as well as in vivo. Optogenetics and Designer Receptors Exclusively Activated by Designer Drugs (DREADDs) manipulation of relevant neural circuits in-vivo to modify behavior.

Selected Publications and Funding

http://saci.uthscsa.edu/

Active Projects
Cortical microcircuits process sensory information to drive behavior. Deciphering how populations of neurons encode information, generate perceptions, and execute behavioral decisions requires working at both the cellular and system levels.

Current Graduate Students
Crystal Rock-Frederickson (Ph.D.)
Research Focus
Dr. Armstrong's major research interest is the synaptic plasticity of limbic system neuronal pathways that underlie memory trace formation and how psychoactive drugs alter these synaptic events. Dr. Armstrong's funded research projects examined the effects of alcohol, sedative-hypnotics and brain peptides on long-term potentiation in the hippocampus. She also received funding for utilizing the hippocampal slice preparation to detect subtle changes in neuronal activity after low dose exposure to environmental toxins.

Dr. Armstrong no longer maintains a wet lab and her efforts focus on teaching an undergraduate psychopharmacology class and a graduate pharmacology-toxicology class.

Selected Publications and Funding

Active Projects
Dr. Armstrong is pursuing funding to support improvements in drug education.
Research Focus
My research interest focuses on investigating and applying the best teaching practices in STEM education. Pedagogy is defined as the method and practice of teaching. Unfortunately, many graduate programs in STEM (Science, Technology, Engineering, and Math) disciplines do not incorporate pedagogy in their training programs. This results in faculty using teaching methods that do not facilitate student learning.

Scientific Teaching is a pedagogical method used in undergraduate science courses. The main idea of Scientific Teaching is to help scientists bring to teaching the critical thinking, rigor, creativity, and spirit of experimentation that defines research (Handelsman et. al, 2007). Scientific Teaching involves three major components, Active learning, Assessment, and Inclusiveness.

Training Opportunities
I welcome students who are interested in learning or studying best teaching practices in STEM disciplines.

Selected Publications and Funding
All my funding is focused on student-training programs. The goal is to increase underrepresented minorities in STEM.

Link to Publications:

Active Projects
- Scientific Teaching as a teaching method to improve retention in STEM
Research Focus
Dr. Derrick’s lab studies information processing in the hippocampal formation, a limbic structure crucial for encoding and the retrieval of episodic and semantic memory. They are interested in hippocampal function from a dynamical and cognitive/systems approach and are exploring the predictions of current computational theories of brain function using molecular, neurophysiological, neuropharmacological, and behavioral techniques. The lab is specifically interested in the interactions among cortical inputs to the CA3 and CA1 hippocampal regions, and their dynamics during encoding and retrieval in behaving animals.

Training Opportunities
Dr. Derrick’s lab studies both unit activity and local field potentials within the hippocampal formation to study both neuronal and synaptic processes within the hippocampus in awake, behaving animals. In addition, we employ current pharmacological, behavioral and imaging techniques in conjunction with electrophysiological techniques to elucidate the relationship between brain activity and specific behaviors.

Selected Publications and Funding

Active Projects
• The role of 5-HT2a receptors in modulating cortical-hippocampal input
• Default circuits in the hippocampal formation mediating retrieval and novelty detection

Link to Publications:
**Research Focus**
My laboratory is interested in understanding how evolutionarily conserved patterning programs along the anteroposterior (AP) and dorsoventral (DV) axes are integrated to generate functional and cellular complexity in vertebrates. By tinkering with these axial patterning programs, we hope to learn about converging mechanisms that control progenitor or stem cell fate, and ultimately how this information may provide insight into altering the course of diseased cells.

**Training Opportunities**
We use a multi-pronged approach to investigate the mechanisms that generate functional and cellular complexity in the vertebrate head. Our primary research tool is the genetically-engineered mouse. We use various mouse lines harboring conditional and mutant alleles for a myriad of transcription factors and signaling molecules, Cre and inducible-Cre recombinases, and GFP reporters.

To analyze the phenotypes associated with genetically-manipulated mice, we use confocal microscopy, micro-computed tomography, basic histology, the neurosphere assay, and basic biochemical and genomic assays, to name just a few. To complement our in vivo approach, we use the CRISPR/Cas9 system to manipulate gene expression in induced pluripotent stem cells to understand the molecular mechanisms controlling differentiation of neural progenitor and osteoprogenitor cells.

**Selected Publications and Funding**


**Active Projects**
- Craniofacial development
- Placode-neural crest interaction
- Dorsoventral patterning along the anteroposterior axis of the neural tube
- Differentiation of induced pluripotent stem cells into neural crest cells

**Current Graduate Students**
Ashley Rawls (M.S.)
Research Focus
The lab's major area of interest is the CA3 region of the hippocampus. This sub region is where information from two regions outside the hippocampus, the dentate gyrus and the entorhinal cortex, converge. In addition, this area is also characterized by strong recurrent feedback between CA3 pyramidal neurons forming what is thought to be an auto-associative network. Artificial neural networks composed of such circuits perform pattern completion. Under pathological conditions, this circuitry is what makes area CA3 highly susceptible to epilepsy.

Training Opportunities
- The effects of stress on hippocampal function using a combination of in vitro and in vivo electrophysiological (whole cell recording and extracellular field recording, respectively), along with chemogenetic and imaging approaches.
- How BK channels affect the excitability of dentate gyrus granule neurons are studied using biophysical computer modeling.

Selected Publications and Funding

Active Projects
- Effect of stress on sharp wave ripples in ventral hippocampus
- Role of BK channels in determining dentate gyrus granule cell excitability

Current Graduate Students
Robert Graham (M.S.)
Chad Milam (M.S.)
Jacques Onu (M.S.)
Research Focus
Dr. Lee’s research is focused mainly on the understanding of the pathological mechanism(s) underlying the selective neurodegeneration in Alzheimer disease (AD) and other neurodegenerative diseases. Multiple molecular mechanisms identified from previous research in the lab which would lead to the development of the effective therapy. Among these identified mechanisms, ongoing research in the lab is focused on following topics.

Cell cycle re-entry in neurodegeneration
Aberrant cell cycle activation in neurons is now emerging as a key pathogenic mechanism in many neurodegenerative diseases including AD. The lab has recently developed the transgenic mouse models to study the role of aberrant cell cycle re-entry in neurodegeneration and, with theses animal models, the lab focuses on elucidating molecular and cellular mechanism how cell cycle re-entry causes neurodegeneration.

Insulin signaling in AD
Defects in glucose metabolism and insulin signaling in AD brain have also been suggested as an underlying cause of neurodegeneration in AD although its causal mechanism is elusive. Dr. Lee’s lab has been studied potential mechanisms causing dysregulation of neuronal insulin signaling and its pathological effect on AD. Several molecular targets have been identified in the lab and the lab is actively pursuing to reveal the molecular/cellular mechanism and its pathological role in AD.

Training Opportunities
1. Cell cycle re-entry in neurodegeneration. Aberrant cell cycle activation in neurons is now emerging as a key pathogenic mechanism in many neurodegenerative diseases including AD. We have recently developed the transgenic mice models to study the role of aberrant cell cycle re-entry in neurodegeneration and current research focus on how cell cycle re-entry causes neurodegeneration in these animal models.

2. Insulin signaling in AD. Defects in glucose metabolism and insulin signaling in AD brain tissues have been suggested as an underlying cause of neurodegeneration in AD although its causal mechanism is elusive. My lab has been studied potential mechanisms causing dysregulation of insulin signaling in neurons and its pathological effect on AD.

Selected Publications and Funding


Active Projects
• Pathological role of cell cycle re-entry in neurodegeneration
• Insulin signaling in neurons and its pathological significance in neurodegeneration.
Neurobiology

Asif M. Maroof, Ph.D.
Assistant Professor

Research Focus
My lab is interested in understanding the molecular and physiological aspects of cellular dysfunction that occur in the brain with aging, injury, or disease. Using pluripotent stem cells induced from human patients (hIPS) with Alzheimer’s disease (AD), Frontotemporal Lobar Degeneration associated with Dementia (FTLD), or Amyotrophic Lateral Sclerosis (ALS), we apply several differentiation paradigms to generate and isolate distinct subgroups of fate-committed neurons and glia of the cortex.

These cells are then co-cultured with cells derived from transgenic mouse models to produce physiologically functional circuits, which are useful in determining the molecular interactions that render specific neural cell types susceptible or resistant to neurotoxicity at distinct, progressive stages of disease.

Training Opportunities
To study cellular dysfunction with neurodegeneration, the Maroof lab implements several novel and published models for AD, FTLD, or ALS. Through in vitro assays that use co-cultures of both primary neural cells isolated from transgenic mice and hIPS cells differentiated into forebrain-committed neurons and glia, several defined pathological stages of disease progression can be examined using biological and physiological techniques.

Upon discovery of the molecular determinants that lead to toxicity or resistance in distinct human neuronal subgroups, these in vitro assays would be applicable in high throughput screening (HTS) platforms enabling the identification of novel therapeutic targets at pre- and post-symptomatic stages.

Furthermore, several fundamental aspects of human cortical circuit maturation, from the formation of synaptic connections to the modulation of neuronal network behavior, will be studied using live cell fluorescence microscopy, multi-electrode array recordings, single cell characterization, and genome modification techniques.

Selected Publications and Funding

Link to Publication:

Active Projects
• The Role of Cortical Projection Neurons Susceptible to Progressive Degeneration with Age (K99/R00)
Research Focus
Dr. Muzzio’s research interests focus on the variables that affect spatial navigation and episodic memory - events occurring in specific contexts at particular times. Specifically, her lab investigates how neurons in the hippocampus, an area involved in spatial processing and memory, respond when animals are lost and disoriented, or under conditions of stress and fear. Additionally, her lab studies the relationship between sleep and memory in young and old animals. Dr. Muzzio’s lab addresses these questions conducting long-term single cell recordings in freely moving mice in combination with pharmacological, genetic, behavioral, and computational tools.

Training Opportunities
Trainees in Dr. Muzzio lab learn sophisticated in vivo electrophysiological tools in combination with various pharmacological, and genetic approaches. Additionally, trainees learn to design and conduct complex behavioral experiments and use several computational and statistical approaches for data analysis.

Selected Publications and Funding
• Julian JB, Keinath AT, Muzzio IA, Epstein RA. Place recognition and heading retrieval are mediated by dissociable cognitive systems in mice. Proc Natl Acad Sci U S A. 2015;112:6503-6508.
• Keinath AT, Wang ME, Wann EG, Yuan RK, Dudman JT, Muzzio IA. Precise spatial coding is preserved along the longitudinal hippocampal axis. Hippocampus. 2014;24:1533-1548.

Active Projects
• Neural substrates of spatial reorientation: Oriented navigators use internal and external cues to keep track of their bearings. However, during disorientation, internal cues are disrupted, and navigators must rely on external cues to reorient. We study how these cues are used and represented in the brain combining in vivo recordings and computational tools.
• Role of the ventral hippocampus: While the role of the dorsal hippocampus in spatial processing is well established, the function of the ventral region remains unclear. We investigate the role of this area by combining single unit recordings, optogenetic, and pharmacological tools.
• Sleep patterns and aging. In aged animals sleep patterns become more fragmented. We investigate if sleep fragmentation contributes to the cognitive decline observed in aging conducting in vivo recordings and biochemical assays.

Current Graduate Students
Kiran Lakhani (Ph.D.)
Robin Yuan (Ph.D.)
Research Focus
Activity patterns in the brain establish the manner in which sensory information is perceived, salience is assigned, and motor output is performed. Transient, impulse-dependent release of dopamine is critical for natural processing in the brain. Disruptions of dopamine function result in many of the symptoms of a wide range of psychiatric diseases, drug addiction, and in the extreme case of the degeneration of these cells, to Parkinson’s Disease.

In vitro studies have determined that ion channel proteins drive the activity patterns of dopamine neurons. The multitude of physiological consequences of their opening and closing makes ion channels and their associated receptors highly compelling as important therapeutic targets for treating many of the symptoms of mental illnesses.

Training Opportunities
We investigate the cellular, synaptic, and circuit mechanisms by which inputs to dopamine neurons influence their activity, and how they are changed in various disease states. These inputs include not only other neurons in the brain, but also astrocytes. To achieve this, we use selective in vitro and in vivo manipulation of identified inputs following prior viral infection with light-sensitive opsins. This strategy gives us a unique opportunity to dissect and individually examine all the components necessary for dopamine cell activity.

Our lab has developed methods to individually manipulate identified neuronal inputs and astrocytes. We also have developed methods to record the electrical activity of dopamine neurons in vivo. Training is provided not only in these technical advances but also in experimental design, publication and funding strategies, and scientific advancement.

Selected Publications and Funding


Active Projects
- “Ion Channels of Reward Related Behavior.” This study is an investigation of the specific cellular channels and receptors that drive dopamine neuron firing pattern during reward related behavior.
- “Cellular Mechanisms of Dopamine Neuron Bursting.” This study is an investigation of the cellular mechanisms that enable dopamine neurons to fire at high frequencies.
- “Mechanisms of cocaine hypersensitivity following chronic DBH inhibition.” This study will address the effects of chronic reduction of the norepinephrine precursor enzyme, dopamine beta hydroxylase, on the responses of striatal spiny projections neurons to exposure to dopamine.
- “The Synaptic Origin of Reward Prediction Error Signal in Dopamine Neurons.” This study is an investigation of the neuronal and astrocytic components that are capable of driving dopamine neurons to burst or pause, and how drugs of abuse change the influence of each input.

Current Graduate Students
Jorge Gomez (Ph.D.)
Alyssa Petko (Ph.D.)
Dr. Perry's studies are focused on the mechanism of formation and physiological consequences of the cytopathology of Alzheimer disease. The lab has shown that oxidative damage is the initial cytopathology in Alzheimer disease. They are working to determine the sequence of events leading to neuronal oxidative damage and the source of the increased oxygen radicals. Current studies focus on the:

1. mechanism for RNA-based redox metal binding
2. consequences of RNA oxidation on protein synthesis rate and fidelity
3. role of redox active metals in mediating prooxidant and antioxidant properties
4. signal transduction pathways altered in Alzheimer disease that allow neurons to evade apoptosis
5. mechanism of phosphorylation control of oxidative damage to neurofilament proteins

Selected Publications and Funding


Active Projects

- Mass spectrometry of disease related studies
- Metal catalyzed redox chemistry
- Mitochondria dynamics
- Stem cell models of disease
Research Focus
I am a computational neuroscientist with two main lines of work. The first one is to understand how the cerebellum processes and stores information. In particular I study a really beautiful neuron called the Purkinje cell. My second line of research is very theoretical. Here my interest is to understand how the engram, the physical foundation of memory, is implemented by the interaction of processes spanning multiple scales of biological organization, from molecules to neuronal networks. For this I use fractional order differential equations, a branch of mathematics that is the natural language to describe complex systems.

My long term objective is to combine theory, modeling, and experiments to understand how the cerebellum computes information; develop closed-loop systems for neuronal control, particularly those associated with deep brain stimulation; and neuromorphic devices for the solution of real-time complex signal analysis for brain machine interfaces.

Training Opportunities
In my laboratory people can be trained in modeling, electrophysiology, and imaging. Our modeling uses all available resources, from ready to use software to our own algorithms. We run our simulations in local servers, computer clusters, super-computers, and even the cloud.

The experimental work that my lab performs requires performing intracellular recordings in live neurons in vitro. These recordings can be done also using fluorescent markers to then be visualized in a two-photon microscope. With this approach we can control and monitor the electrical activity of the neuron while also visualizing biochemical signals in its complex dendrites. Ideally, all students in the lab should combine modeling and experimentation for their work.

Selected Publications and Funding

Link to Publications:
http://www.utsa.edu/SantamariaLab/
https://scholar.google.com/citations?user=7zf6DMEAAAAJ&hl=da
https://www.researchgate.net/profile/Fidel_Santamaria

Active Projects
- NSF-DBI: BRAIN EAGER: Analyzing and modeling power-law behaviors in neuroscience

Current Graduate Students
Chenling Fang (Ph.D.)
David Stockton (Ph.D.)
Zhen Yang (Ph.D.)
Research Focus
I am interested in the hypothalamic oscillator which controls the release of gonadotropin releasing-hormone (GnRH). The secretory pattern of this hormone is the focal point in the control of sexual reproduction. We focus on the control of the intermittent mode of secretion composed of small, almost hourly “pulses” of GnRH. We are specifically interested in how GnRH neurons integrate the variety of internal and external cues that regulate reproduction.

We are also interested in the shift of GnRH secretion which occurs at the time of puberty. We are interested in the dynamics of GnRH release and in the mechanisms that modulate the transition to adult fertility.

Training Opportunities
We use a variety of experimental approaches including whole animal physiology, single neuron anatomy and brain slice electrophysiology (whole-cell and cell attached) coupled with optogenetic, photolysis, and use of simulated circuits via dynamic clamping. We also use computational approaches to model single GnRH neurons.

Selected Publications and Funding
• Hemond PJ, O'Boyle MP, Roberts CB and Suter KJ 2012 γ-aminobutyric acid (GABA) synaptic input and L-type calcium channels form functional microdomains in hypothalamic gonadotropin releasing-hormone (GnRH) neurons. Journal of Neurosci. 32:8756-8766. Featured article

Active Projects
• Hemond P and Suter KJ 2010 Dual somatic recordings from gonadotropin releasing-hormone (GnRH) neurons identified by green fluorescent protein (GFP) in hypothalamic slices. J of Vis Experiments. Feb 23:36. (16,463 views)

Link to Publications: https://www.ncbi.nlm.nih.gov/pubmed/?term=kelly+suter
Research Focus
Research in the Troyer lab focuses on the question of how neural activity is coordinated within neural circuits to produce behavior. One set of research questions centers on studies of vocal communication in songbirds and mice. Songbirds are an excellent model system for understanding how the brain orchestrates activity on multiple timescales to produce a complex sequence of actions.

Studying ultra-sonic vocal communication in mice provides opportunities to investigate related issues in a mammalian system amenable to the latest molecular and optogenetic techniques. A second line of research employs theoretical and modeling techniques to gain fundamental insights into how noise and variability influence computations in neural circuits. Particular questions include neural resonance and synchronization within cells and circuits, and the emergence of power law behavior.

Training Opportunities
Research in the Troyer lab combines theoretical and computer modeling techniques with detailed analysis of vocal behavior. Students receive training in a broad range of techniques in computational neuroscience. More theoretical research is based on a solid grounding in mathematical approaches to studying and modeling nonlinear dynamical system, including the use of phase response curves and stochastic differential equations.

Students investigating vocal behavioral will learn a range of modern signal processing techniques. All students receive extensive training in computer programming and gain familiarity with modern statistical and machine learning approaches to data analysis.

Selected Publications and Funding
- NSF BRAIN EAGER: “Analyzing and modeling power-law behaviors in neuroscience.”
- SALSIRESEARCHCLUSTERSINNEUROSCIENCE: “Elucidating social communication deficits in autism.”


Active Projects
- Behavioral investigations of sequence representations in Bengalese Finches
- Power law behavior and fractional differential equation modeling of cortical circuits
- Analysis of ultrasound vocalizations in mouse models of autism spectrum disorders
- Modeling of neural oscillators in the Basal Ganglia

Current Graduate Students
Anand Kulkarni (Ph.D.)
Research Focus
Dr. Wanat’s research studies the neurobiological systems that mediate motivated behavior. Motivation, or rather the decision of ‘to do’ or ‘not to do’, is modulated by both one’s internal state as well as by external factors. For example, the decision to get a cup of coffee is influenced by thirst (internal state) and by coffee-related cues like an empty mug or a coffee shop logo (external factors).

Psychiatric disorders, such as drug addiction and depression, can be characterized by alterations in motivational processes resulting from changes both in one’s internal state, along with how external factors influence one’s behavioral actions.

Training Opportunities
My research focuses on elucidating the role of the mesolimbic dopamine system on motivated behavior. Current projects in the lab examine how dopamine is involved with learning, stress-related behaviors, and drug addiction.

We are also interested in how prior experience with abused substances or stressful events can alter dopamine-dependent learning processes. We use a number of techniques including fast-scan cyclic voltammetry, chemogenetics, and optogenetics in conjunction with a diverse array of behavioral assays.

Selected Publications and Funding
• NIH DA033386


Active Projects
• Dopamine and cue-dependent learning
• Dopamine and the motivation to work for natural and drug rewards
• Dopamine control of subjective preference
• Negative reinforcement, stress, and dopamine release
Research Focus
Dr. Wicha’s research focuses on understanding how the brain processes language in real time using both behavioral and brain imaging techniques, in particular event-related brain potentials (ERPs). Dr. Wicha has used this non-invasive direct measure of electrical brain activity to study the brain processes underlying language comprehension. Her findings indicate that the brain processes responsible for different linguistic operations interact over time.

Moreover, the brain uses predictive processes to rapidly anticipate upcoming information and facilitate comprehension. Currently, a primary focus in her lab is in understanding the unique processing capabilities of the bilingual brain, and how being bilingual affects other aspects of cognition, such as math cognition. Funding from the National Institute of Child Health and Human Development supports her research into how bilinguals access arithmetic facts in each of their languages.

Training Opportunities
Training opportunities: Undergraduate, graduate and post-doctoral positions are available for training in the cognitive neuroscience of language.

Technologies & Methods: electroencephalogram; event related brain potentials; behavioral paradigms in reading and math cognition; fMRI.

Selected Publications and Funding
- NSF DBI1451032 (Santamaria, Fidel, PI) 09/14 – 08/16. National Science Foundation. BRAIN EAGER: Analyzing and modeling power-law behaviors in neuroscience. Role: Co-PI
- PI, R21 HD079884 04/15 – 03/17 National Institute of Child Health and Human Development “Brain and behavior of multiplication fact retrieval in bilingual children”. Role: PI

Link to Publication:
Dr. Wilson’s lab studies the circuitry and neurons of the basal ganglia, with the goal of understanding the computational function of these structures at the cellular level, and their dysfunction in diseases, especially Parkinson’s Disease.

Our experiments are focused on the ionic mechanisms that endow each cell type with its characteristic responses to synaptic input, the patterns of connectivity that deliver specific inputs to each cell, and the dynamics that arise from the combination of these.

Training Opportunities
We use intracellular recording, fluorescence microscopy and computer simulations to study the intrinsic properties of basal ganglia neurons, their connectivity and their network dynamics.

Selected Publications and Funding


Active Projects
- Therapeutic mechanism of deep brain stimulation
- Oscillations and resonance in striatal neurons
- Network interactions in the basal ganglia

Current Graduate Students
Juan Morales (Ph.D.)
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