IDO derives a GCN2 dependent autophagy flux in glomerular epithelial cells
(Kapil Chaudhary)
Welcome! The Molecular Medicine program combines the resources of basic science and clinical medicine for an interdisciplinary approach to understanding disease processes. Based in an interdisciplinary research institute rather than an academic department, the program includes approximately 40 faculty members drawn from clinical and basic science departments. Students are encouraged to design their own program of study according to their interests and in consultation with their faculty mentor and advisory committee. Focused on discovering the molecular basis of human disease, research opportunities include neurobiology, immunology, molecular chaperones, radiobiology and cancer biology, regenerative medicine and reproductive medicine.

This handbook is designed to guide you through the current course requirements, exam policies, and forms in concordance with The Graduate School’s PhD Guidebook:


Please know that my door is open to current, future, and past students. Contact information for the program’s administrators is listed on the next page. I look forward to assisting you in your journey towards a Ph.D. and beyond.

Finally, I’m grateful to Molecular Medicine graduate student Jill Bradley for providing a student’s perspective and helpful comments on a draft of this handbook. Thanks to students (acknowledged on each figure) who provided the beautiful images as well.

Sincerely,

Lynnette McCluskey, Ph.D.
Program Director
Program Contact Information

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Georgia Research Alliance Scholar in Neuroscience
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Email: lalayman@gru.edu

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Email: yhe@gru.edu

Anatolij Horuzsko, MD/PhD
Chaperone Biology Program
Office: CN-3154
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Institute of Molecular Medicine and Genetics
Office: CA-2008
Phone: 706-721-1097
Email: xshi@gru.edu
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<td><strong>Molecular Medicine Program Faculty 2013</strong></td>
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<td><strong>Erhard Bieberich, PhD</strong> (<em>Department of Neuroscience &amp; Regenerative Medicine</em>)</td>
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<td>The greatest challenge in molecular cell biology is to understand the translation of a molecular interaction into a biological phenotype. During embryonic development, this molecular interaction regulates stem cell migration and germ layer formation, two processes essential for shaping the human embryo and ultimately, us. In cancer, specific molecular interactions determine the formation of tumors and tumor-supporting tissue, including new blood vessels differentiated from stem cells. In our group, we study how the molecular interaction of a particular lipid (ceramide) with a cell signaling protein (protein kinase C (PKC)) regulates embryonic development and stem cell differentiation. We apply multidisciplinary approaches ranging from molecular modeling and organic chemistry to molecular and developmental biology. Our work has shown that there is a close relationship between tumor and stem cell biology. Eventually, this knowledge will help us to better understand the coordinated development of the embryo, to improve stem cell therapy, and to fight cancer.</td>
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<td><strong>Darrell Brann, PhD</strong> (<em>Department of Neuroscience &amp; Regenerative Medicine</em>)</td>
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<td>The endocrine system exerts profound and significant regulatory effects upon the nervous system in humans and other species. The Brann Lab focuses on understanding the actions and mechanisms of a key endocrine regulatory molecule, 17-beta-estradiol (E2), in the central nervous system. A significant difference in male and female physiology is the ability of females to secrete large amounts of E2 into the bloodstream in a cyclic pattern. Intriguingly, at menopause in females, there is a precipitous drop in E2 secretion, which coincides with an increase of neurological diseases (e.g., stroke, Alzheimer's disease and Parkinson's disease). These observations have led to the suggestion that E2 may exert neuroprotection and/or neural repair, which could delay onset and/or lessen the severity of neurological diseases. E2 also maintains a normal functioning reproductive system and has been reported to enhance working memory.</td>
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Richard Cameron, PhD (Department of Neuroscience & Regenerative Medicine)

Our research is focused on understanding the cellular and molecular mechanisms that regulate the neuronal cell cycle during the development of the mammalian cerebral cortex. Specifically, we are interested in the role of the S-phase nuclear myosin, MYO16.

Ahmed Chadli, PhD (Chaperone Biology)


Bo-Shiun Chen, PhD (Department of Neuroscience & Regenerative Medicine)

Glutamate receptors play essential roles in the regulation of synaptic activity and dysfunction of these receptors contributes too many neurological and psychiatric disorders, including Alzheimer's disease, Parkinson's disease and schizophrenia. Adequate excitatory neurotransmission is required to maintain normal physiological brain function, with the strength of postsynaptic responses to glutamate controlled by the precise regulation of the number and type of glutamate receptors expressed on postsynaptic neurons. Most excitatory synapses in the mammalian brain contain two major classes of postsynaptic glutamate receptors, NMDA receptors and AMPA receptors. My laboratory focuses on studying the molecular mechanisms by which NMDA receptors are regulated to modulate the strength of synaptic transmission. NMDA receptors are critical in mediating the excitotoxicity produced during cerebral ischemia. We are interested in understanding the molecular basis for the role of NMDA receptors in controlling neuronal survival and damage. We use a combination of molecular biology, biochemistry and cell biology to characterize NMDA receptor trafficking and regulation.
Quansheng Du, PhD (Department of Neuroscience & Regenerative Medicine)

One of the most critical steps during cell cycle is the correct segregation of sister chromatids into daughter cells. During mitosis, microtubules reorganize into a highly dynamic bipolar array known as mitotic spindle. Proper spindle organization and orientation are crucial for the asymmetric cell division of neuronal progenitor cells, where cell fate determinants are segregated to only one of the two daughter cells. Spindle orientation is also important during morphogenesis, for instance, in the maintenance of epithelial sheets. My lab is interested in the molecular and cellular mechanisms underlying mitotic spindle organization and spindle orientation. Our studies will help to identify therapeutic targets for cancer and birth defects.

Ali Erogul, PhD, DVM (Department of Neuroscience & Regenerative Medicine)

My research interests include cell and tissue preservation; understanding molecular mechanisms of nuclear reprogramming; genomic imprinting and related disorders such as cancer; and gene targeting using embryonic stem cells.

Yukai He, MD/PhD (Cancer Immunology, Inflammation and Tolerance Program)

The research in my lab is focused on elucidating the basic mechanism of T cell activation following recombinant viral vector immunization and the potential applications of these viral vectors mediated genetic immunization in tumor immunology and chronic microbial infections. It has increasingly been recognized that T cell mediated cellular immunity, including CD8+ cytotoxic T lymphocyte (CTL), play an important role in immunotherapy of malignancies and in control of chronic infections such as HBV, HCV, and HIV. Thus, recent efforts in vaccine research are beginning to include strategies to induce cellular immunity, giving rise to a new generation of “T-cell” vaccines. However, the development of “T cell vaccines” has been problematic mainly because of lack of understanding of the basic mechanisms of how the T cell responses are primed and maintained.
Anatolij Horuzsko, MD/PhD (Chaperone Biology)

1) Understanding the molecular, biochemical and immunological functions of HLA-G and its potential use in organ transplantation (human and mouse models). 2) Biology of immune receptors on dendritic and T cells that promote immunological tolerance. 3) Molecular links between inflammation and cancer development, role of TREM-1 in tumorigenesis (human and mouse models).

Carlos Isales, MD (Department of Neuroscience & Regenerative Medicine)

My main area of interest involves defining the role of nutrition and the "incretin" hormones in normal bone turnover. We have identified glucose-dependent insulinotropic peptide (GIP) as a hormone with major anabolic effects on bone and bone derived cells. We currently use both an in vitro model involving primary rat osteoblasts and an in vivo model involving transgenic mice overexpressing GIP. By combining these cellular and molecular approaches, we plan to define the role for GIP signaling in normal bone turnover.

Theodore Johnson, MD/PhD (Cancer Immunology, Inflammation and Tolerance Program)

Neoplastic processes actively create immunosuppressive environments that drive systemic tolerance to cancer cells. Tumors develop exquisitely complex stromal networks that promote growth despite the presence of antigen-presenting cells (APCs) and tumor infiltrating lymphocytes. Although tumor-associated macrophages (TAMs) appear to be fully competent APCs, they process immense volumes of dead and dying tumor cells without inciting adaptive immune responses. Our laboratory uses a variety of solid tumor models to study the role of TAMs in regulating anti-tumor immune responses.

Jimok Kim, PhD (Department of Neuroscience & Regenerative Medicine)

My research interests are synaptic plasticity and neural network in the mammalian central nervous system. We investigate synaptic and neuronal activity in brain slices using electrophysiological, optical and biochemical techniques. Our current focus is on how synapses change their strengths during alterations in activity, and how the synaptic modulation influences integrated network activity. In this effort, we are particularly interested in the role of cannabinoid
Pandelakis Koni, PhD (Cancer Immunology, Inflammation and Tolerance Program)

Immune regulation by dendritic cells and regulatory T cells in mouse models of cancer and autoimmunity.

David Kozlowski, PhD (Department of Neuroscience & Regenerative Medicine)

The inner ear is responsible for hearing (vestibular) and hearing (auditory) function in all vertebrates. We are interested in the development and function of sensory hair cells in the zebrafish vestibular system. Unlike mammals, fish are able to regenerate hair cells and a goal of this lab is to identify the molecular mechanisms of hair cell regeneration in fish. Ultimately, we will determine why these same genes/mechanisms do not function to regenerate hair cells in mice or humans.

Lawrence Layman, MD (Department of Neuroscience & Regenerative Medicine)

Our laboratory is interested in genes important in human puberty, reproduction, and development. Humans with delayed puberty due to idiopathic hypogonadotropic hypogonadism (IHH)/Kallmann syndrome (KS) and women with congenital absence of the uterus and vagina are being characterized clinically and genes are being identified using innovative methods. Gene mutations are characterized and then studied in vitro to determine their functional effects; and further genotype/phenotype correlations are made. Mutations have been identified and characterized in genes including GNRHR, FSHB, CHD7, WDR11, and NELF, among others. Human, mouse, and zebrafish models are being utilized to further understand normal hypothalamic-pituitary gonadal axis development and function with regard to normal puberty and fertility.
Santhakumar Manicassamy, MD *(Cancer Immunology, Inflammation and Tolerance Program)*

Dr. Manicassamy is examining critical mechanisms that regulate adoptive immune responses at the mucosal surfaces of the gastro-intestinal track. New insights from Dr. Manicassamy's research will shed light on interactions between commensal micro-organisms and how these interactions can become dysfunctional to cause increased risk of inflammatory bowel disease and colon cancers.

Tracy McGaha, PhD *(Cancer Immunology, Inflammation and Tolerance Program)*

The research interests of my laboratory are primarily focused on systemic autoimmune disease development and mechanisms of inflammatory pathology manifestation/progression to end stage target organ failure. In particular our interests are in signal integration and how the immune system responds to diverse stimuli from the extracellular milieu to develop a coherent and appropriate response to micro-environmental cues. Currently we have four active projects.

Lynnette McCluskey, PhD *(Director - Graduate Program in Molecular Medicine - Department of Neuroscience & Regenerative Medicine)*

My lab is interested in the role of the immune system in the normal and de/regenerating taste system. Following axotomy, taste neurons and their associated receptor cells are able to regenerate and make functional connections. This process appears to depend on a normal immune response to injury. We believe that studying the influence of leukocytes, cytokines, and adhesion molecules in the taste system will provide insight into novel ways to promote regeneration in the CNS.
<table>
<thead>
<tr>
<th><strong>Lin Mei, PhD</strong> (Georgia Research Scholar/Eminent Scholar in Neuroscience &amp; Director, Department of Neuroscience &amp; Regenerative Medicine)</th>
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<tr>
<td>We are interested in molecular mechanisms underlying the formation and maintenance of synapses. Our goal is to identify targets to develop therapeutic strategies for treating neurological disorders including spinal cord injury, neuromuscular disorders, epilepsy, and psychiatric disorders such as schizophrenia.</td>
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<tr>
<th><strong>Steffen Meiler, MD</strong> (Chair, Department of Anesthesiology &amp; Perioperative Medicine)</th>
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<tr>
<td>Mechanisms of Vascular Inflammation and Inflammatory and Immune Responses to Anesthesia</td>
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<th><strong>Andrew Mellor, PhD</strong> (Eminent Scholar Chair in Immunogenetics &amp; Director, Cancer Immunology, Inflammation and Tolerance Program)</th>
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<tr>
<td>Fundamental cellular and molecular mechanisms underlying immunological phenomena. Infectious and autoimmune disease, inflammation, transplantation biology, pregnancy and cancer.</td>
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<tr>
<th><strong>Nahid F. Mivechi, PhD</strong> (Director – Chaperone Biology Program)</th>
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<tr>
<td>1) Role of heat shock transcription factors and molecular chaperones in pathways involved in tumorigenesis &amp; metastasis (breast cancer research; hepatocellular carcinoma; and other solid tumor malignancies using both human and mouse models). 2) Role of molecular chaperones in stem cell function. 3) Role of heat shock transcription factors and molecular chaperones in neurodegenerative disease.</td>
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<tr>
<td>Demetrius Moskophidis, MD <em>(Chaperone Biology)</em></td>
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<tr>
<th>David Munn, MD <em>(Cancer Immunology, Inflammation and Tolerance Program)</em></th>
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<tr>
<td>Macrophage and dendritic cell differentiation; regulation of T cell activation by antigen-presenting cells; regulation of immune function by indoleamine 2,3-dioxygenase (IDO) and tryptophan metabolism; clinical trials of IDO inhibitors in cancer and HIV.</td>
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<th>Albert Pan, PhD <em>(Department of Neuroscience &amp; Regenerative Medicine)</em></th>
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<td>Neural circuits are information highways that connect diverse neuronal types and allow them to perform complex functions. The goal of my laboratory is to uncover the molecular and cellular mechanisms that regulate neural circuit formation, which are important for neurological disorders such as Down syndrome and autism. Zebrafish is a uniquely advantageous system for this endeavor. It is transparent, which allows continuous visualization of circuit development at high resolution. The small number of cells and compact size also make it a more tractable system to investigate how complex brain structures emerge in a vertebrate organism (Pan et al. <em>Development</em> 2012). We are also developing tools that would allow detailed mapping of neural circuits, e.g. Brainbow multi-color imaging (Pan et al. <em>Development</em> 2013) and viral trans-synaptic tracing.</td>
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Nilkantha Sen, PhD (Department of Neuroscience & Regenerative Medicine)

Alzheimer’s disease (AD) is the most prevalent form of dementia and it generally occurs in patients over the age of 60, but there are genetic predispositions and an early-onset phenotype. On an average 5.3 million Americans have AD and 13% of those ages 65 and older have AD. The Neurophysiological changes associated with AD are massive cell loss and atrophy, especially prevalent in cortex and hippocampus. AD is characterized by a loss of neurons and buildup of neurofibrillary tangle formation (NFT) and aggregation amyloid beta (Aβ) peptide in brain. My lab is interested to elucidate the role of neuro-gasotransmitters like Nitric Oxide (NO), Hydrogen Sulfide (H2S) or Carbon monoxide (CO) on APP processing and hyperphosphorylation of tau protein in brain. Our study may provide a new direction for the treatment of AD.

Xingming Shi, PhD (Department of Neuroscience & Regenerative Medicine)

Osteoporosis is a major public health problem affecting 44 million Americans. The estimated direct health care costs for osteoporosis were $17 billion in 2001 and is rising. The research interest of my laboratory is to study the cellular and molecular mechanisms of glucocorticoid (GC)-induced osteoporosis and to search for new therapies for the treatment of this devastating disease.

Wei-Hua Wu, PhD (Department of Neuroscience & Regenerative Medicine)

Chromatin is a highly condensed and complex organization of eukaryotic DNA and histone proteins. The structure of chromatin is essential to control DNA metabolism and gene expression. ATP-dependent chromatin remodeling enzyme, a class of evolutionarily conserved enzymes, plays a key role in tuning the ‘on’ and ‘off’ states of chromatin. It changes chromatin structure to establish a dynamic molecular interface, thereby facilitating the accessibility of large DNA enzymes, histone modification enzymes or regulatory factors. Misregulation of this process may cause a cascade of pathologic events including disordered gene expression, failed DNA damage response, and genome instability, all of which may lead to neurological disorders and cancer. Using a combination of molecular biology, biochemistry and functional genomics, my laboratory studies how ATP-dependent chromatin remodeling enzyme alters chromatin structure to regulate gene expression.
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<th>Wen-cheng Xiong, PhD (∙ Weiss Research Professor - ∙ Department of Neuroscience &amp; Regenerative Medicine)</th>
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<td>We are interested in the molecular mechanisms underlying axon pathfinding and bone remodeling. Axon pathfinding is an essential process for normal brain wiring during development. Bone remodeling, an important process for skeleton development and for a healthy bone, involves the balance of functions of both osteoblasts and osteoclasts. Specifically, we are interested in questions how neuronal axon growth cones are guided by netrin-1/DCC signaling, how chondrocytes/osteoblast differentiation is regulated by RGM-neogenin signaling, and how osteoclast differentiation and activation are modulated by RAGE signaling. We are addressing these questions by using a combination of biochemical (in vitro), cell biological (in culture), and genetic mutant animal (in vivo, including rodents, chicken, and zebrafish animals) techniques.</td>
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<th>Nathan Yanasak, PhD (∙ Chaperone Biology)</th>
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<td>Refinement of diffusion-weighted imaging for improved performance in the clinic, through the development of noise-reduction and benchmarking techniques. Application of diffusion-weighted techniques for the imaging of neurological disorders in both animal models and humans, especially stroke and multiple sclerosis. Use of functional MRI (fMRI) to study the impact of sickle-cell anemia on cognition.</td>
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<tr>
<th>Jianhua Xu, PhD (∙ Department of Neuroscience &amp; Regenerative Medicine)</th>
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<td>Synaptic transmission between neurons relies on neurotransmitter release during the precisely regulated exocytosis of synaptic vesicles. Vesicles after exocytosis are recovered via endocytosis, and mobilized to the releasable pool for future exocytosis. Such a vesicle recycling process plays an essential role in maintaining the synaptic transmission and the function of neuronal network. My lab is interested in the mechanisms of vesicle recycling in both health and disease conditions. Taking advantage of a large synapse in the brainstem - the calyx of Held, which is accessible to patch-clamp recording, optical imaging and molecular manipulation, we analyze individual steps of vesicle recycling with a temporal resolution of milliseconds.</td>
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</table>
Robert Yu, PhD, Med.Sc.D. (Georgia Research Alliance Eminent Scholar in Molecular and Cellular Neurobiology-Department of Neuroscience & Regenerative Medicine)

My research concerns the chemistry, metabolism and biological function of complex glycoconjugates, particularly glycosphingolipids. These compounds play crucial roles in determining cellular properties such as intercellular interactions, recognition, and adhesion. In particular, we are developing an understanding of the role of glycoconjugates in cell proliferation and differentiation, as well as the metabolic basis and regulatory mechanisms for changes of their expression in the developing nervous system. A major thrust of our more recent effort is on the glycobiology of neural stem cells. We are developing an understanding of the role of stage-specific glycoconjugates in governing events in cell differentiation and cell-fate determination via several signaling pathways. In addition, we are elucidating the basic mechanisms underlying a variety of neurodegenerative disorders, including autoimmune demyelinating neuropathies, multiple sclerosis, mucopolysaccharidoses, and sensorineural hearing loss, with a goal of developing novel strategies in disease diagnosis and therapy.

Gang Zhou, PhD (Cancer Immunology, Inflammation and Tolerance Program)

The current research in my lab focus on the role of tumor-specific CD4+ T cells in the context of chemotherapy and immunotherapy. Certain chemotherapeutic agents can reprogram the tumor microenvironment from tolerogenic to immunogenic, thereby promoting the effector differentiation and clonally expansion of tumor-specific CD4+ T cells. These CD4+ effector cells in turn act as the “gatekeeper” of the host antitumor immunity, and their functional status critically determines the outcome between eradication and regrowth of the residual tumors. The major efforts in my lab include identifying and characterizing novel CD4+ T cell-potentiating chemotherapeutic agents, elucidating the mechanisms by which CD4+ effector cells activate other tumor-reactive immune cells, determining the molecules/pathways involved in sustaining or attenuating the function and survival of CD4+ effector cells. Findings from these studies will provide mechanistic basis for the design of more effective chemo-immunotherapy strategies for cancer.
Current Molecular Medicine Students

**Student** | **Affiliation**
---|---
Jill Bradley | Cancer Immunology, Inflammation and Tolerance Program
Connie Chung | Dept. Neuroscience and Regenerative Medicine
Joanna Erion | Dept. Neuroscience and Regenerative Medicine
Ji Na Kong | Dept. Neuroscience and Regenerative Medicine
Rahul Shinde | Cancer Immunology, Inflammation and Tolerance Program
Yan Wang | Chaperone Biology Program
Eun Kyung Ko | Dept. Neuroscience and Regenerative Medicine
Tsadik Habtetsion | Cancer Immunology, Inflammation and Tolerance Program
Eslam Mohamed | Cancer Immunology, Inflammation and Tolerance Program
Daniel Swafford | Cancer Immunology, Inflammation and Tolerance Program
Sridhar Kandala | Cancer Immunology, Inflammation and Tolerance Program

Molecular Medicine Program Graduates
(Listed chronologically with most recent first)

Qian He | Stanford University (Postdoctoral Fellow)
Haiyun Liu | Johns Hopkins University (Postdoctoral Fellow)
Mona El Rafaey | Georgia Regents University (Postdoctoral Fellow)
Kapil Chaudhary | Georgia Regents University (preparing for USMLE)
Buvana Ravishankar | Genentech, Inc. (Postdoctoral Fellow)
Lingqian Li | University of Washington (Postdoctoral Fellow)
Chaitanya Patwardhan | University of Pennsylvania (Clinical Fellow)
Davies Agyekum, PhD | Tufts University Medical School (Medical student)
Samuel Quaynor, PhD | Georgia Regents University Medical School (Completing MD/PhD)
Anthony Florschutz | Georgia Regents Medical Center (Surgeon, Dept. of Orthopedics)
Juhi Ojha, PhD | Mayo Clinic, Arizona (Postdoctoral Fellow)
Wonyoung Cho, PhD | Georgia Regents University (Postdoctoral Fellow)
Lakiea Bailey, PhD | Georgia Regents University (Postdoctoral Fellow)
Haixia Qin, MD/PhD | Georgia Regents University (Postdoctoral Fellow)
Kyungsoo Ha, PhD | Georgia Regents University (Postdoctoral Fellow)
Tiffany Floyd, PhD | Georgia Regents University (Research Staff)
Pam Wall-Steen, PhD | Aiken Technical College (Faculty)
Daniel Eisenman, PhD | Medical University of South Carolina (Biosafety Officer)
Durga Udayakumar, PhD | UT Southwestern Medical Center (Instructor; Radiation Oncology)
Henrique Lemos, PhD | Georgia Regents University (Postdoctoral Fellow; ITC)
Rusty Johnson, MD/PhD | Johns Hopkins University (Clinical Fellow in Hematology/Oncology)
Ceba Humphrey, MD/PhD | Knoxville, TN (Surgeon)
Awards

Molecular Medicine students are eligible for several awards associated with Graduate Research Day, including the Molecular Medicine Program Award. Awards are based on poster scores given by faculty judges. All Molecular Medicine students that present posters at Graduate Research Day are considered for this award; no additional application is necessary.

Molecular Medicine students are also eligible for the Rasmussen Award, presented annually to recognize research accomplishments. This award honors the late Dr. Howard Rasmussen, founder of the Institute of Molecular Medicine and Genetics. Dr. Rasmussen was a staunch supporter of graduate student research. His own work resulted in hundreds of publications, and was recognized by numerous awards. The winner of the Rasmussen Award will receive $500. Two runners-up will receive $250 each. Mentors provide letters of nomination documenting the nominee’s research record and scientific potential. The program director will call for nominations each fall, and winners are chosen by majority vote of the Molecular Medicine Graduate Education Committee (MMGEC).

Travel Award funds are available through the Graduate School for students presenting their work at national / international meetings as first author. Please complete the form found in the Appendix, have your mentor sign it, and submit to Deenie Cerasuolo. Deenie will also assist you in completing a Travel Request and the forms for travel reimbursement when you return.

Leave Policy

Students may receive permission to be off campus for up to 30 days (including weekends and holidays) while enrolled. Please get approval from your mentor and Dr. Lynnette
McCluskey, and give the form to Deenie for submission to the Graduate School. The form for permission to be off-campus can be found in the Appendix.

For maternity/parental leave and medical leave which may require more than the 30 days, up to 6 weeks maximum may be considered. Leave must be negotiated between the student, her/his advisor and Dr. Patricia Cameron in the Graduate School.

Epitopes on NC1 domain of α3 chain of type IV collagen are exposed during glomerular inflammation. (courtesy of Kapil Chaudhary; appeared on the August 2013 cover of Kidney International)
Registration

You should register for courses online with PULSE when you receive an email notification from the Registrar’s Office. Please register as early as possible. If you miss the deadline, you must wait until the first day of class to register and will be assessed a $50 late fee. Also, if there is a “hold” on your account you will not be able to register until it the hold is cleared. Most holds are due to immunization issues, and may take several days to clear.

Molecular Medicine Curriculum

Students entering the Graduate Program in Molecular Medicine will have already taken the required courses from the Fall and Spring semesters, plus 4 credit hours of selective courses of the first year.

First Year Biomedical Sciences PhD Core Curriculum

Semester One (Fall)

- COGS 8012 - Scientific Communications (1 credit hour)
- COGS 8021 - Biochemistry & Gene Regulation (5 credit hours)
- COGS 8022 - Molecular Cell Biology (5 credit hours)
- SGS 8011 – Responsible Conduct of Research (1 credit hour)
- SGS 8040/SGS 8050 – Introduction to Faculty Research (2 credit hours)

Semester Two (Spring)

- COGS 8033 - Integrated Systems Biology (6 credit hours)
- COGS 8060 - Intro to Research II (4 credit hours)

AND TAKE FOUR CREDIT HOURS FROM THE FOLLOWING SELECTIVES:

- COGS 8215 - Fundamentals of Oncology I (2 credit hrs)
- COGS 8080 - Neuroscience I (4 credit hrs)
- COGS 8090 - Fundamentals of Genomic Med (2 credit hrs)
- COGS 8230 - Biology of Proteins in Disease (2 credit hrs)
- COGS 8240 - Intro to Immunology and Infectious Disease (2 credits hrs)
- COGS 8030 - Experimental Therapeutics (2 credit hrs)

Semester Three (Summer)  *Students choose a lab and program at the beginning of the summer semester

- STAT 7070 Biomedical Statistics
Upper-level coursework.

Trainees in the Graduate Program in Molecular Medicine must complete 6 credit hours of advanced electives. Upper-level courses may be chosen from those offered by the Molecular Medicine graduate program, listed below. Students may also choose 1st year selectives previously not taken or graduate courses offered by other biomedical graduate programs. This flexibility allows students across diverse research areas to individually tailor their program of study. A course proposal is developed by the primary advisor in consultation with the thesis committee, and must be approved by Dr. McCluskey. Trainees must enroll in MOL9030 and MOL9040 each semester until graduation (not including the summer semesters). These requirements ensure attendance at research seminars and Molecular Medicine Journal Club, respectively. Research hours complete the coursework each semester.

- **MOL8110 – Advanced Topics in Neurobiology (3 credit hours)**
  This course will cover current topics in neurobiology including developmental neurobiology, intracellular and intercellular communication, neurodegeneration and other diseases of the nervous system. The course will emphasize an understanding of the neurochemical and molecular mechanisms under normal conditions and leading to dysfunction. The course will focus on developing a critical understanding of the current scientific literature in neurobiology and preparing the students for careers in neurobiological research.

- **MOL8130 - Advanced Topics in Molecular and Cellular Immunology (3 credit hours)**
  This course will cover current topics in immunology including tolerance, thymocyte development, lymphocyte activation, immunological memory, cell adhesion and cell cycle control. The course will emphasize an understanding of the molecular mechanisms of immune responses and will focus on gaining a critical understanding of the current scientific literature in immunology.

- **MOL9010 – Advanced Seminar in Molecular Medicine (1 credit hour)**
  Seminar-style course covers a single, current topic in Molecular Medicine on a rotating basis each fall and spring semester. Topics include Cancer Biology & Gene Regulation, Nanomedicine, Translational Reproductive Medicine, Regenerative Medicine, Molecular Immunology, Developmental Neurobiology, and Molecular Chaperone Biology and Radiobiology.

- **MOL9020/MOL9030 – Seminar in Molecular Medicine (1 credit hour)**
  This course will provide training in critical evaluation of basic biomedical research. Students will be expected to attend seminars given by both internal and external speakers to provide written summaries of some of the topics presented. This course is offered in the fall semester. Prerequisites: Entry into the Molecular Medicine graduate program. Required course for all Molecular Medicine students each fall (MOL9020) and spring (MOL9030) semester until completion of the dissertation defense.
Course requirements: Students may attend seminars sponsored by any academic or research unit on campus. Please keep track of the seminar title, speaker, and date. This information must be submitted to Deenie by the end of the spring semester to receive course credit. You must attend 20 seminars and provide 5 synopses (see Appendix I) by the end of the Spring seminar. This represents seminar attendance during both the Fall and Spring semesters.

- MOL9040 – Molecular Medicine Journal Club (1 credit hour)
  This course will provide 1) In-depth discussion of current topics in Molecular Medicine; 2) The opportunity to critically evaluate and present current papers; 3) Discussion of current techniques in the field; and 4) Faculty mentoring of students in career skills (e.g. searching for postdoc positions, job interviews, balancing family and science). Each week the discussion will focus on a current scientific paper, classic techniques paper, or opinion paper, depending on the goal described above. Each senior student (third year plus) will select and present a paper to the class. Presentations will be followed by a class discussion. Feedback on student performance will be provided by the faculty mentor assigned to the topic. Discussions of current techniques and career skills will be led by faculty experts. This course will enhance students’ ability to analyze and present scientific literature. Required course for all Molecular Medicine students each fall and spring semester until completion of the dissertation defense.

Research Hours

- MOLM 9210 – Investigation of a Problem (variable credit hours).
  Investigation of a Problem must be taken every semester until admission to candidacy requirements are complete (i.e. the research proposal is approved by the thesis committee). Adjust the number of credit hours for this course so that you are enrolled for a total full-time load of 12 credit hours/semester.

- MOLM 9300 – Research in Molecular Medicine (variable credit hours).
  Research must be taken every semester after admission to candidacy (i.e. after you have submitted your approved proposal) until dissertation requirements are met. Adjust the number of credit hours for this course so that you are enrolled for a total full-time load of 12 credit hours/semester.

**Forms Required by the Graduate School**
It is the student’s responsibility to submit required forms to the Graduate School in a timely manner. Forms can be found on the Graduate School website and in the Appendix. Please bring completed forms to the Program Director (Dr. Lynnette McCluskey) or Program Chair (Dr. Lin Mei) for signatures as specified. Deenie can also assist in getting signatures and then submitting forms to the Graduate School. **It is strongly suggested that you keep a copy of forms for your records.**
Advisory Committee and Meetings

- An advisory committee is formed soon after the student joins the mentor’s lab. The committee is composed of four faculty members in addition to the mentor. The purpose of the committee is to guide the student’s research and training. At least four of five committee members must hold graduate school appointments. Molecular Medicine faculty and those from other graduate programs are eligible to serve on the advisory committee, though the student’s primary mentor must have an appointment with Molecular Medicine. Students must form a committee by the end of the fifth semester. Failure to form a committee and hold a meeting by the end of the fifth semester/second Spring will result in a grade of “Unsatisfactory” in MOLM 9210 Investigation of a problem, in accordance with the policy of the Graduate School.

http://www.gru.edu/gradstudies/current_students/documents/phdadvisorycommitteeform.pdf

- The advisory committee must approve the student’s proposed course of study during the initial meeting (or soon after). The coursework proposal form can be found at:

http://www.gru.edu/gradstudies/current_students/documents/phdcourseworkproposal.pdf

- Students must hold a committee meeting at least every three semesters (though more frequent meetings are encouraged). For example, if you have a committee meeting in October, your next meeting must occur before the end of the fall semester in the subsequent calendar year. Failure to hold a yearly committee meeting will result in a grade of “Unsatisfactory” in MOLM 9210 / MOLM 9300. Exceptions are granted only in special circumstances and must be approved by the Dean of the Graduate School. Please submit the advisory committee meeting form found at the following link:

http://www.gru.edu/gradstudies/current_students/documents/reportofresearchprogressandadvisorycommitteemtgspdf

- Please submit the research progress report as instructed on the form above during any semesters in which committee meetings were not held.

Comprehensive Exam

- The comprehensive exam in Molecular Medicine conforms to the format required by the Graduate School. The Graduate School requires that the exam is completed by the end of the seventh semester for students entering during/after Fall 2009.
Failure to complete the exam by the end of the second year will result in a “U” (i.e. Unsatisfactory) grade in MOLM 9210 Investigation of a Problem.

- The purpose of the exam is to test the student’s understanding of their subdiscipline of Molecular Medicine. As part of the requirement, students should demonstrate an adequate grasp of the primary literature in the area most relevant to the student’s work. The student should also be familiar with basic concepts, paradigms, and methodology in the most relevant subdiscipline, which is expected to be broader than the student’s specific area of specialization. The Advisory Committee will evaluate whether the student exhibits these skills at a level appropriate for a student in their second year of graduate study.

- The exam will consist of the following format:
  Written exam consisting of up to 5 essay questions administered over 4 hrs
  AND
  A two-hour oral exam held within 2 weeks of the written portion

- The exam questions will be written and graded by the Advisory Committee. The Advisory Committee will appoint an Exam Chair to administer the written exam and compile grades prior to the oral exam. The student’s major Advisor is not eligible to serve as Exam Chair. The Exam Chair will also serve as a liaison to the Dean’s Office (duties formerly performed by the Dean’s Representative). Please contact Deenie Cerasuolo (dcerasuo@gru.edu) to arrange assistance in proctoring the exam if needed. You will need to report your cumulative grades on the written and oral portions to the Graduate School (see form at the end of this section), so please ask your Exam Chair for this information if necessary.

- The GRU Honor Code is in effect for the qualifying exam. Plagiarism and access of unauthorized materials during the exam will result in notification of the Dean and referral to the Honor Court for possible expulsion.

- Grading will follow the following scale:
  
  +1 = Very good to outstanding
  0 = Minimally acceptable to average
  -1 = Unacceptable

  A cumulative score +1 is required to pass the written exam and advance to the oral exam.

  The oral exam will be scored with the same scale:
  +1 = Very good to outstanding
  0 = Minimally acceptable to average
  -1 = Unacceptable

  A cumulative score of +1 is required to pass the oral exam.
• A student failing either the written or the oral part of the comprehensive exam will be granted one opportunity to retake that portion after additional study. The exam is typically retaken within 3 months, but must be completed within 6 months. Note that the student remains enrolled in research hours and is not excused from lab work. A second failure of the Comprehensive Exam will be grounds for dismissal from the Graduate School.

• Please complete and submit the following form upon completion of the comprehensive exam:

http://www.gru.edu/gradstudies/current_students/documents/comprehensiveexam.pdf

Thesis Proposal

A 5-10 page written research proposal is a separate requirement of CGS, and is independent of the comprehensive exam. This proposal should be the student’s effort developed in consultation with the Advisor and Advisory Committee. After the proposal is completed, please instruct advisory committee members to complete and submit (1) the proposal form (Appendix II) and (2) the research proposal rubric (Appendix III) to the Graduate School. Note that you must be admitted to candidacy (i.e. submit forms indicating completion of comprehensive exam and research proposal; Appendix) at least two semesters prior to the dissertation defense. Formatting requirements for the Proposal format are included in the PhD handbook:

http://www.gru.edu/gradstudies/current_students/documents/writingaresearchproposal.pdf

Dissertation and Defense

Please refer to the following Graduate School guide to prepare for your dissertation and defense:

New Policies: As of Fall 2013, a Dean’s Representative is not required to attend the defense. Molecular Medicine students should get approval from their committee to ask their primary advisor or another advisory committee member to administer the defense. Please arrange for at least one reader to participate in the defense as well.
I. Seminar synopsis sheet

Your name:______________________

**Mol Med seminar course (Fall MOLM9020/Spring 9030) requirements**

*You must register for this course during each academic year (fall + spring semester)*
For Fall & Spring semesters combined you need to attend:
- 20 seminars by end of Spring semester (Provide Deenie Cerasuolo with the name of speaker, title of talk, date)
- 5 synopses by end of Spring semester

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<th>IMMAG SEMINAR STUDENT SYNOPSIS SHEET</th>
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<tbody>
<tr>
<td>Date:</td>
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<tr>
<td>Speaker:</td>
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<tr>
<td>Topic:</td>
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<td>What were the major question, approach, and conclusion?</td>
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