

HHMI Summer Scholars Program 2009: Faculty Research Projects

Dr. Suzanne Barbour, Associate Professor, Biochemistry and Molecular Biology
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<http://www.vcu.edu/biochem/faculty/barbour.shtml>
Phospholipases A2/lipid biochemistry

Dr. Danail Bonchev, Professor
Center for the Study of Biological Complexity and Department of Mathematics
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Trani Center for Life Sciences, Room 300
Network analysis of biological systems
Title: "Characteristic Motifs in Networks of Metabolic Pathways of Archaea, Bacteria, and Eukaryota." Efficient computational tools will be applied to the large-scale search for structural patterns characterizing the evolution of metabolic networks, and discerning the species from the three domains of life.

Dr. Paul Brooks, Assistant Professor, Statistical Sciences & Operations Research
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Project co-advisors: **Dr. Seth Roberts** and **Dr. Steve Fong**. Flux Balance Analysis (FBA) is the use of computer models and lab experimentation to analyze metabolism. FBA has been applied to various single-celled bacterial organisms. A fundamental assumption of an FBA model is that the organism makes optimal use of scarce resources. Uses of FBA include predicting a cell's response to changing environmental conditions, determining which reactions should be targeted for metabolic engineering, and determining which genes are necessary for maintaining a given level of activity. The summer project will involve the development of a new FBA model for a bacterial organism. Tasks will include querying biological databases, writing code to manipulate text files, and implementing the model using optimization software. In constructing the model, the investigators will decide how/if each metabolic reaction is included.

Dr. Francine Marciano-Cabral, Professor, Microbiology & Immunology
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Naegleria fowleri is a free-living amoeba that can cause CNS infections in humans. Although there are over 40 species of *Naegleria* identified, only one, *N. fowleri* has been associated with human disease. We have constructed a cDNA library from *Naegleria* and we are sequencing the DNA from this organism. The cDNA library is an expression library so that we can also induce proteins to be made. Our laboratory will sequence the cDNA and induce proteins to determine why one species causes disease and other species do not cause disease. Although a student would have an opportunity to study the amoeba, most of the work would be performed on a cDNA library.

A second project that we will be working on is the identification by PCR of ameba in recreational water sources and in distribution systems. Water will be collected and cultured in the laboratory. The water will be tested by PCR to determine whether *Naegleria amebae* are present in the water. We will develop a real time PCR assay to quantitate the number of amebae in water. This is an environmental microbiology project.

Dr. John Wes Cain, Assistant Professor, Mathematics

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<http://www.math.vcu.edu/faculty/cain.html>

<http://www.people.vcu.edu/~jwcain/>

Ordinary and partial differential equations, difference equations, numerical analysis, asymptotic and perturbation methods, and control theory with applications to problems in cardiac electrophysiology.

Dr. David Chan, Assistant Professor, Mathematics

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Room 2078, Oliver Hall

<http://www.math.vcu.edu/faculty/chan.html>

This ongoing project examines the role of a ring of cardiac tissue as a factor in the development of heart arrhythmias. In collaboration with faculty from the VCU Medical School, and the Computer Science and Mathematics Departments, a mathematical model has been developed to help understand the role of reentrant rings in cardiac tissue. These rings form when heart tissue is damaged due to heart attacks or other forms of heart disease and can cause further serious complications. Our goal is to see how arrhythmias, typically in the form of tachycardia, can spontaneously initiate and terminate. We have formed a complex mathematical model to mimic this behavior, and are in the process of studying it in greater detail. We are also in the process of comparing output from the model with real data from patients.

Dr. "Annie" Kai I. Cheang, Assistant Professor, Pharmacy

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Smith Bldg, Room 440

<http://www.vcu.edu/pcos/research.html>

and <http://www.pharmacy.vcu.edu/sub/faculty/facdetail.aspx?id=67>

Obesity and metabolic milieu as determinants of metabolic adverse effects from oral contraceptives: The birth control pill is known to worsen glucose tolerance and sensitivity to insulin. However, whether baseline metabolic milieu (e.g. obesity) affect an individual's response to the birth control pill is unknown. In addition, the birth control pill also worsens cardiovascular inflammatory markers, and the role of obesity plays in the mediation of this effect is also unknown. Furthermore there is some suggestion that prior use of birth control pill confers a protective effect towards future cardiovascular events. This research will investigate mechanisms by which estrogen and progestins mediate glucose disposal, diabetes risk, and future cardiovascular risk.

Dr. Ching-Kang Jason Chen, Associate Professor, Biochemistry and Molecular Biology

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Rm 2-032 Sanger Hall

<http://www.vcu.edu/biochem/faculty/chen.shtml>

Mechanisms of phototransduction and photoreceptor degeneration. The student will participate in characterizing novel photoreceptor specific genes by RT-PCR and in situ hybridization.

Dr. Wan-Ling Chiu, Assistant Professor, Biology

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Room 334, Trani Center for Life Sciences

Study how Gunnera plants initiate intracellular nitrogen-fixing symbiosis with cyanobacteria. We would like to start by making a cDNA library from plant tissue capable of hosting cyanobacteria in order to find genes that facilitate the establishment of intracellular symbiosis.

Dr. Daniel Conrad,

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419 Medical Sciences Building

<http://www.vcu.edu/micro/conrad.htm>

Laboratory focuses on new strategies to control allergic disease. Summer student be involved with projects looking at IgE production in both human in vitro and mouse in vivo models.

Dr. Cynthia Nau Cornelissen, Associate Professor, Microbiology and Immunology

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Sanger Hall 6-052

<http://www.vcu.edu/micro/cornelissen.htm>

Projects in my lab involve molecular characterization of iron transport systems employed by the pathogenic Neisseriae. HHMI summer institute projects could include bioinformatic analysis of neisserial genomes, identification of putative iron acquisition genes, and their subsequent cloning and expression in a heterologous host.

Dr. Sumitra Deb, Professor, Biochemistry & Molecular Biology, Massey Cancer Center

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Goodwin Research Laboratory, Room 384, 401 College Street

<http://www.people.vcu.edu/~sdeb/>

To study genes involved in mutant p53-mediated oncogenesis by microarray analysis

Dr. Umesh Desai, Associate Professor, Medicinal Chemistry

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Smith Building Room 542

<http://www.phc.vcu.edu/Faculty/Desai.html>

Rational design of mechanism-based anticoagulants as agents for prevention of cardiovascular diseases

Dr. Rodney Dyer, Assistant Professor, Biology

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Room 349 Trani Center for Life Sciences

http://dyerlab.bio.vcu.edu/wiki/index.php/Main_Page

Jeff Elhai, Associate Professor, Biology

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Room 335 Trani Center for Life Sciences

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http://www.vcu.edu/csbc/bbsi/people/faculty/jeff_elhai.html

1. Search for novel small RNAs that govern the process of cellular differentiation (via both molecular and computational techniques).
2. Understand what enables plants and N₂-fixing bacteria to enter into associations that enable the plant to grow without nitrogenous fertilizer (from both the analysis of global gene expression and directed mutation).
3. Develop an on-line knowledge environment that will engage the community of those studying viruses in the compilation and extension of all we know about viruses on earth (purely computational).
4. Computational discovery of origin and functions of repeated sequences in bacterial genomes (mostly computational, some molecular manipulation possible).

Dr. Sarah Elsea, Associate Professor, Pediatrics and Human & Molecular Genetics

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Sanger Hall 12-018A

<http://www.gen.vcu.edu/faculty/faculty/elsea.html>

1. Mutation analysis of RAI1 gene for diagnosis of Smith-Magenis syndrome
2. Bioinformatics analysis of gene isoforms and promoter analysis
3. Identification of new genetic loci for pervasive developmental delay and behavior disorder
4. Assessing the role of RAI1 in growth, obesity, and circadian rhythm
5. Model human disease in zebrafish in a collaborative project with Dr. Lister.

Dr. Paul Fawcett, Assistant Professor, Internal Medicine

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Sanger Hall

<http://www.vcu.edu/mbg/faculty/fawcett.html>

Use mouse whole-genome DNA microarrays to investigate the effect on cellular transcription following treatment of mouse macrophages with a variety of drugs known as "histone deacetylase inhibitors" (HDACi) that are thought to inhibit pathways involved with endotoxic shock, and to determine if HDACi can confer a protective benefit in terms of cell survival following bacterial infection.

Dr. Ivo Torres Filho, Associate Professor, Physiology and Biophysics

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Our laboratory utilizes a variety of techniques to study blood flow as well as systemic and local oxygenation. Measurements in microscopic tissue areas will be made using intravital video microscopy. The aim of these studies is to discover the physiological basis for better treatments for conditions where tissue oxygenation is compromised such as during hemorrhagic shock and anemia. Studies will also involve the use of novel oxygen therapeutics – perfluorocarbons. The student will participate in tasks related to husbandry, anesthesia, and surgery in experimental

animals (rats and mice). The student will help perform in vitro experiments and in vivo studies designed to measure microvessel diameter and blood flow, heart rate and other physiological variables. Experimental procedures will include ischemia, hypoxia, transfusion and embolism. This is a unique opportunity to participate in a research project involving diverse and complementary leading edge techniques such as in vitro models, microsurgery, in vivo videomicroscopy, spectroscopy and computerized biological data acquisition and analysis. The lab environment is stimulating and includes students of undergraduate, graduate and post-doctoral levels.

Dr. Michael Fine, Professor, Biology

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Trani Center for Life Sciences, Room 26

<http://www.has.vcu.edu/bio/people/bios/fine.html>

Examining the structure, material properties, and acoustics of swimbladders used in hearing and sound production in sciaenid fishes.

Stephen S. Fong, Assistant Professor, Chemical and Life Science Engineering

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Room 422, 601 West Main Street

<http://www.engineering.vcu.edu/fong-lab>

Research Project: Our group utilizes experimental and computational systems biology and synthetic biology approaches to create biological processes for the production of biofuels. Ongoing research covers all aspects of the biofuel production process including treatment of raw materials, engineering of microorganisms for biofuel production, and computationally modeling these processes.

Dr. Rima Franklin, Assistant Professor, Biology

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Dr. Yuan Gao, Assistant Professor, Computer Science

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601 West Main Street, Room 216

<http://www.egr.vcu.edu/cs/faculty/cs-faculty-gao.html>

<http://www.engineering.vcu.edu/fac/gao/>

Dr. David A. Gewirtz, Professor, Pharmacology and Toxicology and Massey Cancer Center

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Sanger Hall

1. Studies related to the mechanism of action in breast cancer of a new class of substituted pyrroles derivatives that appear to function as microtubule poisons.
2. A project in collaboration with Dr. Zhang to determine whether chemokine antagonists will interfere with breast tumor growth and angiogenesis.

3. Possibly working on a new project to determine whether cannabinoid agonists or antagonists interfere with breast tumor growth.

Dr. Gregorio Gil, Professor, Biochemistry and Molecular Biology

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Nuclear receptors in bile acid biosynthesis

Dr. Steven Grant, Professor of Medicine, Biochemistry, and Pharmacology, Massey Cancer Center

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Goodwin Research Lab

Projects typically involve investigating the effects of novel signal transduction modulators on the survival of malignant hematopoietic cells (leukemia, myeloma, lymphoma) and elucidating the molecular basis for drug interactions.

Dr. Scott Gronert, Professor, Chemistry

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1001 West Main St

The Gronert group uses mass spectrometry to study changes in protein structure related to aging and diabetes. Present projects focus on the formation of protein carbonyl modifications caused by oxidative stress. These modifications are a biomarker for aging and their concentration rises dramatically in the last third of normal life span. Mass spectrometry is being used to identify the specific sites of these modifications in model proteins treated with chemical oxidants *in vitro*.

Dr. Frank Gupton, Research Professor and Chair, Chemical and Life Science Engineering

Research Professor, Department of Chemistry

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School of Engineering West, 601 West Main Street

The Gupton research group is actively involved in the use of microfluidics technology with microwave irradiation and nanomaterials to serve as a bench-top platform for the continuous high throughput preparation of active pharmaceutical ingredients for drug development in a traditional laboratory environment. It is expected that drug substances can be readily produced by this approach under Good Manufacturing Practices (GMP) as required by the Food and Drug Administration (FDA) and that processes which are developed using this approach can be commercially produced by the same methodology. The initial application of this technology will focus on the continuous API synthesis of preclinical candidate molecules for the treatment of kidney cancer and pediatric cancer .

Karen Kester, Associate Professor of Biology

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Several projects related to Insect Behavior and Ecology are possible, ranging from field to PCR-based lab studies, depending on the student's interest.

Dr. Martin Lenhardt, Professor, Biomedical Engineering

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<http://www.egr.vcu.edu/bme/faculty/bme-lenhardt.html>

Communication on the next generation of aircraft carriers. *Location VCU @ the shipyard in Newport News*

- Research Area Keyword(s) hearing, speech, communication, bioscience, linguistics, noise, acoustics and science-business development.
- Partners: Northrop Grumman Newport News, Inc.
Ceres Biotechnology, LLC (in the Research Park)

The project for the summer is to design and test a communication system capable of delivering acoustic warning or messages by bone conduction using patented (or patent pending) technology. Some aspects of this system will use state of the art interactive radio wave links. Speech will be modified by ultrasonic modulation such that its frequencies are shifted upward, away from the masking effects of aircraft noise. In addition to the acoustic warning and message components a novel ear plug is being developed to complement the bone conduction hearing mechanism exploited with this system. In addition to the technology engineering, human factors design will be assessed to match the technology with the perceptual/cognitive skills of users. Physiological factors related to the deployment of this system must also be analyzed possibly resulting in design changes. The project is multidisciplinary in nature and so is the educational opportunity.

Students must be US citizens and company badges are required. The student will have to get to Newport News at least one a week.

Dr. Janina Lewis, Assistant Professor, The Philips Institute, School of Dentistry

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Wood building, Room 401

<http://www.dentistry.vcu.edu/departments/philips/Faculty/Lewis.htm>

Virulence factors of periodontopathogens such as gram-negative anaerobic bacteria *Porphyromonas gingivalis* and *Prevotella intermedia* using genome-wide approaches (bioinformatics, genomic microarrays)

Dr. James Lister, Assistant Professor, Human Genetics

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Sanger Hall, Room 11-014

<http://www.gen.vcu.edu/faculty/faculty/lister.html>

Isolating specific cell types from zebrafish embryos and generating and analyzing transcriptional profiles from these cells in different mutant backgrounds using microarrays.

Dr. Worth Longest, Qimonda Assistant Professor, Mechanical Engineering and Pharmaceutics

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School of Engineering East Hall 3234

http://www.egr.vcu.edu/me/faculty/me-faculty_longest.html

Development of an alveolar model from micro-CT scan data for the prediction of nanoparticle transport and deposition in the lungs.

Dr. Masoud H. Manjili, Assistant Professor, Microbiology & Immunology

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Massey Cancer Center 286, 401 College Street

<http://www.vcu.edu/micro/manjili.htm>

The project would involve performing RT-PCR and ELISA to identify cell and molecular mechanisms involved in tumor rejection and tumor relapse or escape from the immune-mediated destruction. We have FVBN202 transgenic mice that develop spontaneous mammary carcinoma. We also maintain wild-type FVB that reject mammary tumors aggressively but a fraction of animals end up with tumor relapse. Using these two animal models of breast carcinoma we are trying to identify immunological components that are involved in tumor recurrence and those involved in relapse-free survival.

Dr. Richard Marconi, Professor, Microbiology & Immunology

rmarconi@vcu.edu, 828-3779

Room 101 McGuire Hall

<http://www.vcu.edu/micro/marconi.htm>

Study various aspects of the infectious etiology and host pathogen interactions of Lyme disease, relapsing fever, oral polymicrobial infections, and periodontal disease. Significant emphasis is placed on assessing the molecular basis of host-pathogen interactions. The research projects are interdisciplinary and will provide experience in the study of pathogenesis, molecular immunology, genomics, molecular biology and protein structure analyses.

Dr. Ghislaine Mayer, Assistant Professor, Biology

gmayer@vcu.edu, 828-0828

Trani Center for Life Sciences, Room 345

Molecular mechanism of malaria pathogenesis, cloning and characterizing genes in *Plasmodium falciparum* invasion of erythrocytes.

Dr. D'arcy P. Mays, Stastical Sciences & Operations Research

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Room 2054, Oliver Hall

http://www.vcu.edu/cesweb/f_mays.html

A student wanting to work with Dr. Mays could choose a project that involves the statistical analysis of data. Just about any application could be chosen, possibly working in conjunction with another faculty mentor, and then the student can learn appropriate methods of analyzing the data by working with Dr. Mays.

Dr. Michael McVoy, Professor, Pediatrics

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Sanger Hall, Room 12-026

<http://www.people.vcu.edu/~mmcvoy/cmvcfe.htm>

Typical projects might involve studying the effects of genetic mutations or the impact of novel antiviral compounds on the packaging of herpesviral DNA (specifically cytomegalovirus), the molecular mechanisms by which certain compounds enhance viral replication, or the role of certain viral genes in viral entry and elicitation of neutralizing antibodies.

Dr. Michael Miles, Professor, Pharmacology/Toxicology and Neurology

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Medical Sciences Building, Room 630

<http://www.brainchip.vcu.edu/>

Molecular basis of alcohol and drug addiction: We use mouse genetic models, behavioral studies and DNA microarrays to identify gene networks regulating behaviors related to alcohol, cocaine or nicotine action. Summer students typically have projects concerning gene expression studies (PCR, microarrays), neuroanatomical studies (immunohistochemistry) or pharmacology studies (behavioral or signaling studies)

Dr. Hadis Morkoç, Professor, Electrical and Computer Engineering

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<http://www.egr.vcu.edu/ece/faculty/ece-faculty-morkoc.html>

Build certain types of sensors to sense stimuli such as electrical, optical, magnetic and or motion.

Dr. Peter O'Connell, Human Genetics

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Sanger Hall, Room 11-013

<http://www.gen.vcu.edu/faculty/faculty/oconnell.html>

My laboratory studies genetic mechanisms of breast cancer evolution, tumor progression, and treatment responses. These studies identify tumor markers that provide prognostic (untreated disease risk), and/or predictive (likelihood of treatment response) information in order to optimize the clinical management of this complex gene-environment disorder.

Dr. Luiz Shozo Ozaki, Associate Professor, Microbiology and Immunology

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Sanger Hall #5-036

<http://www.vcu.edu/micro/ozaki.htm>

Metagenomic analysis of microorganisms associated with insect vectors of pathogens. The microbial flora associated to insects which are vectors for pathogens such as dengue virus, West Nile virus, malaria, Chagas disease, and many others, seem to play an important role in the capability of the insect to transmit disease. The goal of this project is to identify microbial species associated with different mosquito species and verify the correlation between the microbial populations and the species of mosquito. The HHMI scholar will participate in the project from the design of PCR primers for the identification of mosquito species and the associated bacteria, to preparation of total mosquito DNA, amplification of specific DNA sequences, cloning and sequencing of the amplified DNA fragments, analysis of the sequences aiming at the identification of both mosquito and microbial species, and compilation of data.

Dr. Swati Palit Deb, Associate Professor, Biochemistry & Molecular Biology, Massey Cancer Center

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Goodwin Research Laboratory, 401 College Street

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My laboratory investigates how the human oncoprotein MDM2 activates oncogenic pathways and what are its functions in normal cells. Actin filament formation is a crucial regulatory step of cell proliferation. Recently we reported that MDM2 interacts with one of the factors involved

in actin filament formation. The project for the student will be "Investigating the role of human oncoprotein MDM2 in regulation of actin filament formation".

Dr. Dianne Pawluk, Assistant Professor, Biomedical Engineering

dtpawluk@vcu.edu, 828-9491

701 West Grace Street, Room 1607, Laurel Street Entrance

<http://www.egr.vcu.edu/bme/faculty/bme-pawluk.html>

Rehabilitation devices for individuals who are blind and visually impaired and tactile feedback for prosthetic users.

Dr. Michael Peters, Professor, Chemical & Life Sciences Engineering

mpeters@vcu.edu, 828-7789

601 West Main Street, Room 403A

http://www.egr.vcu.edu/ce/faculty/ce-faculty_peters.html

Stem Cell Engineering, Drug Delivery, Bioreactors, Biomolecular Computations

Dr. Ramana Pidaparti, Professor, Mechanical Engineering

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601 W Main St., Room 306

http://www.egr.vcu.edu/me/faculty/me-faculty_pidaparti.html

Computational intelligence techniques applied to DNA/collagen, self assembly, bone, smooth muscle tissue, modeling inflammation, and finite element studies

Dr. Lawrence Povirk, Professor, Pharmacology and Toxicology

lpovirk@vcu.edu, (804) 828-9640

Goodwin Laboratory 380A

Tyrosyl-DNA phosphodiesterase and Artemis nuclease are two enzymes that remove sugar fragments from the ends of DNA double-strand breaks formed by X-rays and some cancer chemotherapeutic agents, which is an essential step in their repair. The proposed research will attempt to determine biochemical details of this process by examining repair of defined double-strand break substrates transfected into cells with defects in one or both of these two enzymes.

Dr. Raj Rao, Assistant Professor, Chemical & Life Sciences Engineering

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601 West Main Street, Room 414

<http://www.engineering.vcu.edu/rao-lab>

Human embryonic stem cells have gained attention due to their potential for cell-based biomedical therapies. However, prior to their use, a thorough characterization of the cell lines are required in order to develop in vitro directed differentiation strategies. The major goal of research in our laboratory is the design of strategies that will also maintain the chromosomal integrity of cells, under specific in vitro propagation and differentiation conditions. Towards this, we are analyzing differential gene expression profiles of numerous human embryonic stem cell lines. Preliminary results point towards candidate genes that could be correlated to abnormal chromosomal characteristics. The specific goal of this project would be to correlate the gene expression changes to network connectivities using bioinformatic tools. This project is expected

to contribute to a better understanding of the mechanisms that can lead to chromosomal instability in human embryonic stem cell line.

Dr. Mark Reimers, Assistant Professor, Biostatistics
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Theater Row 3014, 730 E Broad St

1. Understanding gene regulation in the brain

We will have early access to the quantitative data from several brain data sets including Allen Brain Institute data. This is an unprecedented opportunity to study gene regulation in the brain, and in the future, brain development and evolution.

The student will search for common motifs in gene sequence and function for genes that are coexpressed in limited regions of the brain based on several brain data sets including Allen Brain Institute data. This will require familiarity with BLAST, sequence analysis methods, and bioinformatics data bases.

2. Characterizing correspondences between methylation profiles in gene promoters to splice variant expression in different tissues.

This project involves mapping transcription start sites of genes, identifying splice variants of genes (using AceView) and use of Affymetrix Exon Array data to estimate splice variant proportions. This will require familiarity with basic sequence databases and tools.

Dr Adriana Rosato , Assistant Professor, Division of Infectious Diseases
aerosato@vcu.edu, 804-828-5780
1101 E Marshall St, Sanger Hall 7-075

Laboratory focuses on the study of Molecular mechanisms of antimicrobial resistance in S.aureus, notably in MRSA (Methicillin Resistance S. aureus). Our main interest is the elucidation of pathways involved in the generation of mutations responsible for acquisition of resistance and gene regulation. These projects include genomic, microarrays and biochemistry approaches.

Dr. John Ryan, Associate Professor, Biology

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Room 318, Trani Center for Life Sciences

<http://www.has.vcu.edu/bio/people/bios/ryan.html>

My laboratory is investigating control of inflammatory diseases such as asthma and lupus, using mast cells as a model system. Mast cells initiate inflammatory responses, which develop into chronic disease if these responses circumvent homeostatic controls. We seek to understand the normal controls on cell activation, and how these controls function at the cellular and organ system level.

Dr. Martin Safo, Assistant Professor, Medicinal Chemistry

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BioTech I 212

<http://www.phc.vcu.edu/Faculty/Safo.html>

Structure-based drug design using molecular biology (making recombinant proteins), molecular modeling, X-ray crystallography and functional/biological analysis. Projects currently ongoing include cancer research, enzymes involved in vitamin B6 metabolism, and development of antisickling agents.

Dr. Rita Shiang, Associate Professor, Human Genetics

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<http://www.gen.vcu.edu/faculty/faculty.html#shiang>

1. Characterization of the Treacher Collins syndrome gene; a gene involved in craniofacial development
2. Characterization of the Wolfram syndrome gene; a gene involved in neurodegeneration
3. Identification of new genetic loci for craniofacial development using mouse models

Dr. Ronald Smeltz, Assistant Professor, Microbiology & Immunology

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1217 E. Marshall St., Medical Sciences Building Room 323/325

<http://www.vcu.edu/micro/smeltz.htm>

CD8⁺ cytotoxic T cells, or CTL, are critical to the body's defense against infection. CTL play a pivotal role in the control of viruses, intracellular bacteria, and intracellular protozoa. They are also important for the recognition and killing of tumor cells. Two primary effector mechanisms by which CTL control pathogens are via cytokine secretion (ie. IFN-g and cytotoxicity (ie. killing). Interleukin-12 (IL-12), a cytokine produced in response to infection/inflammation, is an important cytokine that can promote CTL effector functions. Subsequent to effector functions, a fraction of CD8⁺ CTL survive to become stable memory T cells to provide long-term immunity. IL-15 is a critical cytokine that is necessary for proper development of memory CTL. Many vaccine efforts aim to improve both CD8⁺ effector function and development of memory. Our main hypothesis, based on our own published laboratory data, is that *IL-15 and IL-12 have synergistic roles in enhancing both CTL effector functions and memory*. This hypothesis has been applied to 3 main projects.

First, we seek to demonstrate that the efficacy of adoptive cell therapy in models of established tumors is increased by the combined effects of IL-15 and IL-12.

Second, we are interested in CD4⁺CD25⁺Foxp3⁺ regulatory T cell-mediated suppression of CD8⁺ CTL responses. Treg, which can be naturally arising (nTreg) or induced by cytokines such as TGF-b (iTreg), are important for normal maintenance of peripheral immune tolerance.

The third project is determining the role of IL-15 in the generation of immunity to the parasite *Trypanosoma cruzi*, an organism that causes Chagas disease and infects millions of people each year, causing both acute and chronic infections.

For more information, see website.

Dr. Sarah Spiegel, Professor and Chair, Dept of Biochemistry and Molecular Biology

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Virginia Commonwealth University School of Medicine

Richmond, VA 23298

Projects involve the role of sphingosine-1-phosphate in inflammation and cancer

Dr. Jennifer Stewart, Associate Professor, Biology

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Trani Center for Life Sciences, Room 315

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Regulation of membrane transporters that take up (1) specific neurotransmitters or (2) toxins and carcinogens.

Dr. Amy Throckmorton, Assistant Professor, Mechanical Engineering

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In contrast to normal a cardiophysiology having two main pumping chambers (ventricles), the treatment of single ventricle anomalies represents a formidable challenge for clinicians caring for pediatric patients with heart disease. To address the limited treatment options, we are designing and developing circulatory support alternatives for these infants and children. The three modalities of current interest include a magnetically levitated ventricular assist device, an intravascular axial flow blood pump, and noninvasive counterpulsation technology. These projects involve the numerical modeling of designs, experimental performance evaluation of prototypes using an analog fluid and animal blood to quantify blood damage levels, and clinical testing of existing counterpulsation technology in conjunction with a redesign effort. We also seek to biologically tissue engineer parts of the intravascular axial pump for cavopulmonary assist. In support of these projects, research collaborations with pediatric cardiologists, congenital heart surgeons, biomedical engineers, medical imaging experts, and industrial partners have been established.

Dr. Robert M. Tombes, Associate Professor, Biology

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Room 306 Life Science Building

<http://www.people.vcu.edu/~rmtombes>

Cell and Molecular Biology of calcium-dependent signaling pathways in developmental systems. Projects include analysis of splice variant expression of members of the CaM kinase family of proteins. Approaches include PCR, cloning, comparative sequence analysis, in situ hybridization and antisense oligonucleotide disruption.

Dr. Kristoffer Valerie, Professor, Radiation Oncology, Massey Cancer Center

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390 Goodwin Research Laboratory, 3rd floor East

http://www.radonc.vcu.edu/acads_and_research/molecular_radiobiology_division/basic_rsrch_valerie.html

Radiation-induced signaling and DNA double-strand break (DSB) repair in human early progenitor cells. Determine whether the type of DSB repair changes from early progenitor cells to more differentiated cells. Use western blot analysis and specific DNA repair assays to assess these changes.

Dr. James R. Vonesh, Assistant Professor, Biology

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Trani Center for Life Sciences, Room 3

<http://www.has.vcu.edu/bio/people/bios/vonesh.html>

Predators not only eat prey, they scare them. Research projects this summer will focus on the 'ecology of fear', i.e., the non-lethal effects of predators on prey. We will be looking at how predators change prey behavior, morphology and physiology and how these effects scale-up to influence population, community and ecosystem ecology. Work has both field and lab components. Expect long, physical field days under uncomfortable conditions often doing monotonous tasks in aquatic habitats

Dr. Jennifer Wayne, Professor, Biomedical Engineering

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701 West Grace Street, Room 1513, Laurel Street Entrance

<http://www.egr.vcu.edu/bme/faculty/bme-wayne.html>

<http://www.people.vcu.edu/%7Ejwayne/jwayne.htm>

Despite its remarkable wear characteristics, articular cartilage degenerates in diarthrodial joints, results in functional impairment, and requires intervention to restore function. We have designed a new in vitro simulation system to assess the wear properties of articular surfaces and are evaluating the mechanical properties of various types of surfaces.

Dr. Paul Wetzel, Associate Professor, Biomedical Engineering

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<http://www.egr.vcu.edu/bme/faculty/bme-wetzel.html>

Potential areas include, a study of the effects of Parkinson's disease and essential tremor on eye movement behavior. We are specifically interested in the early effects of these diseases on oculomotor control, specificity of response and ongoing treatment. In another study, I am also involved with an examination of the coordination of suck, swallow and breathe and heart rate variability during preterm infant feeding.

Brad Windle, Ph.D., Associate Professor, Medicinal Chemistry

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Massey Cancer Center, Goodwin Laboratories, Rm 319

<http://www.phc.vcu.edu/Faculty/Windle.html> <http://www.people.vcu.edu/~bwindle/>

Research involves bioinformatic approaches for exploring how drugs interact with cellular processes and models for determining gene and protein function.

Dr. Tarynn Witten, Associate Professor, Center for the Study of Biological Complexity

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<http://www.people.vcu.edu/~tmwitten>

<http://www.vcu.edu/csbc/bbsi/people/faculty/faculty.html#witten>

<http://www.vcu.edu/csbc/vpp/>

<http://www.vcu.edu/csbc/nhlbi/>

I have many research interest areas and attempt to let my students try to define their research interests within the areas that I feel qualified to support from my expertise. Most generally, I am interested in mathematical modeling and high performance computer simulation (supercomputing, massively parallel grid computing and scientific visualization) of complex biological systems from cells to demographic populations. This means that I do not provide wet

lab experience if that is what you are looking for. The general focus of most of my work is related to processes involved with aging. However, this is not a limitation. I have a broad interest base and am interested in students who are willing to sink their teeth into some complex problems. The above websites define a variety of different project areas in which I am involved. However, please feel free to come and visit with me and spin some ideas around. You never know what might evolve. And, after all, isn't that what complexity is really all about?

Dr. Kenneth Wynne, Professor, Chemical and Life Science Engineering

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601 West Main Street, Room 444

<http://www.engineering.vcu.edu/wynne-lab>

Polymeric materials for medical applications including aspects of biocompatibility and/or antimicrobial activity.

Dr. Ping Xu, Associate Professor, The Philips Institute, School of Dentistry

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Wood Building, Room 430

<http://www.people.vcu.edu/~pingxu/>

We are studying microbial virulence using systems biology principle. A large amount of experimental data from genomics, microarray and proteomics will be analyzed for many mutants. There are two projects currently available.

(1) To study streptococcal virulence and biofilm formation.

(2) To identify vaccine candidates from streptococci.

Vamsi K Yadavalli, Assistant Professor, Chemical & Life Science Engineering

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Room 434, 601 West Main Street

Measurement of the nanomechanics of a hyperbranched polymer. We will conduct single molecule experiments on a hyperbranched polymer tethered to surfaces to understand how stiff they are at a nanoscale. These versatile surfaces can then be used to control cell differentiation or act as templates for nanoparticles. The project will involve an interdisciplinary approach combining biophysics, surface science and nanomaterials.

Dr. Hu Yang, Assistant Professor, Biomedical Engineering:

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<http://www.people.vcu.edu/~hyang2/>

Biomaterials and drug delivery.

One of our research thrusts is to engineer dendrimers, i.e., polyamidoamine (PAMAM) dendrimers, to create nanostructured materials of various functionalities depending on specific applications. Dendrimers have a highly branched, three-dimensional architecture with very low polydispersity and high functionality, and play an important role in the emerging field of nanotechnology. Dendrimer-based targeted drug delivery, nanomedicine, nanobiosensor, nanodiagnosics, and surface nanopatterning are under development in our lab. Summer students will design novel dendrimer-based drug delivery systems and test their properties in the lab.

Dr. Zendra E. Zehner, Professor, Biochemistry

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Rooms 1-108, 1-112 Massey Cancer Center

<http://www.vcu.edu/biochem/faculty/zehner.shtml>

Overall Goal: My laboratory is interested in understanding and ultimately preventing prostate cancer tumor progression.

Project #1: The transcription factor ZBP-89 or its related family member ZBP-99 has been shown to activate the transcription of variety of genes (p21). On the other hand the transcription of an equal number of genes (vimentin) has been shown to be repressed by ZBP-89. Many ZBP-89 target genes are inappropriately expressed in metastatic cancers from breast, prostate, lung, ovarian, head and neck to name a few. We are interested in determining how the same protein can be both an activator or a repressor of gene expression and how its expression is linked to tumor progression. We know that the ZBP-89 protein can be modified via sumoylation and/or phosphorylation. Our working model is that such modifications determine whether ZBP-89 functions as an activator or a repressor of gene expression. Currently, ZBP-89 contains four sites for sumoylation. Currently, we are mutating each of these four sites and determining the resulting effect of ZBP-89's ability to activate or repress gene transcription.

Project #2: Human prostate sublines representing various stages of tumor progression have been derived by in vivo selection from p69, a normal prostate epithelial subline. M12, a highly tumorigenic and metastatic subline, is missing part of chromosome 19. Restoration of a second complete copy of chromosome 19 produced the F6 subline, which is barely tumorigenic and not metastatic when injected into nude mice. Ultimately, we want to determine what genes on chromosome 19 are contributing to tumor progression. For this purpose we are growing these cells with inhibitors of various signaling pathways to determine which pathways might be important for tumorigenesis and may represent targets for drug therapy. In addition, we are replacing chromosome 19 deleted genes to determine how this affects tumor progression.

Dr. Yan Zhang, Assistant Professor, Medicinal Chemistry

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Smith Bldg, Room 534

<http://www.phc.vcu.edu/Faculty/Zhang.html>

Novel anti-HIV drug design and development

Dr. Zhongming Zhao, Assistant Professor, Psychiatry, Human and Molecular Genetics

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Biotech Center One Suite 1-118

<http://bioinfo.vipbg.vcu.edu/>

1. Bioinformatics in psychiatric genetics including gene ranking algorithm, gene feature analysis, marker selection, network and pathway analysis
2. Development computational methods for prediction of protein-protein interactions, network evolution
3. Comparative genomics analysis of sequences, genes, genetic variation.

Dr. Huiping Zhou, Assistant Professor, Microbiology and Immunology

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Medical Sciences Building, Room 511

<http://www.vcu.edu/micro/zhou.htm>

Cellular mechanisms of HIV Protease inhibitor-induced dyslipdemia