

Mentors for Undergraduate Research

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If you are a **BIOLOGY MAJOR** make an appt. with Dr. Christie L. Sahley, sahley@purdue.edu to discuss finding a research director. To make an appointment with Dr. Sahley contact her Secretary Cynthia Ponto at cponto@purdue.edu

Select at least 5 faculty members whose research interests you from the list below to bring to your appointment.

Her office location is Lilly Hall, Room 2-232.

MOLECULAR BIOSCIENCES

John N. Anderson - Lilly, 1-223B andersjn@purdue.edu (Eukaryotic gene expression) Control of eukaryotic gene expression and replication; DNA structure, virus evolution.

William A. Cramer – Hock 325 waclab@purdue.edu (Biochemistry; biophysics) Membrane biochemistry-biophysics; structure-function of membrane proteins.

Laszlo N. Csonka - Hansen Life Science Res., 327A lsonka@bio.purdue.edu (Microbiology) Mechanisms of the responses of bacteria to osmotic stress; genetic engineering of plant cells with increased tolerance of salinity stress.

Alan Friedman – Hock 329 afried@purdue.edu (Structural biology) Structural cell biology of infection, immunity, and aging.

Michael Gribskov – Hock 331, gribskov@purdue.edu (Computational biology; bioinformatics) Relationship between patterns in macromolecular sequences and the evolution, structure and function of corresponding molecules; development of databases and computational tools for functional genomics; development of systems that federate knowledge across multiple electronic resources.

Wen Jiang – Hock 131, jiang12@purdue.edu (Structural biology; computational Biology) Structural characterization of viruses and macromolecular complexes using electron cryomicroscopy; Algorithm development, high performance computing and automation towards high resolution and high throughput electron cryomicroscopy.

Daisuke Kihara – Hock 229 and LWSN 164A dkihara@purdue.edu (Bioinformatics, Computational genomics) Genome sequences, protein structure, biochemical pathways. Helping developing algorithms for protein structure or function prediction, running existing programs for analyzing structure and function of genes, analyzing protein-protein interaction network. Everything is computational, but prior experience on writing programs is not necessarily required as long as students like to work with computers.

Maureen C. McCann – Hansen Life Science Res., 301A mmccann@purdue.edu (Plant biology; genomics) Plant cell wall organization and function

Carol B. Post – RHPH 4108, cbp@purdue.edu

Michael G. Rossmann – Hock 231 mr@purdue.edu (Molecular biology; biophysics) Structure of picornaviruses (rhinoviruses, Mengo virus, coxsackievirus), parvoviruses, alphaviruses and bacteriophages; structure of HIV components; evolutionary development of proteins.

David Sanders – Hock 129 retrovir@purdue.edu (Structural virology) Entry of retroviruses and other enveloped viruses into cells; mechanism of enzymatic phosphoryl transfer.

Louis A. Sherman – Lilly G-235, lsherman@purdue.edu (Microbiology) Photosynthetic membranes – structure, function, and assembly in cyanobacteria; functional genomics and impact of environmental factors on photosynthesis; analysis of global regulation, including transcriptomics and proteomics; regulation of photosynthesis and N₂-fixation in unicellular cyanobacteria. Biofuel production in cyanobacteria.

Cynthia V. Stauffacher – Hock 327 cstauffa@purdue.edu (Biophysics; molecular biology; biochemistry) Macromolecular structure and assembly >using X-ray crystallography; membrane associated proteins; enzyme structure and function. Studies of protein-protein interactions in signaling molecules important in cancer metastasis; drug design studies targeting isoprenoid biosynthesis in resistant bacteria such as MRSA and VRE; mechanisms underlying the synthesis of cellulose in plant membranes, conformational changes in ATP-dependent membrane transport complexes.

ECOLOGY AND EVOLUTIONARY BIOLOGY

Ximena Bernal – Lilly, G-347 xbernal@purdue.edu (Evolutionary ecology; behavioral ecology) Animal communication, anuran behavior, eavesdropping, hearing in insects, learning and exploratory behavior in anurans.

Jeff Dukes - Pfendler Hall, 221A jsdukes@purdue.edu (Community, ecosystem, and global ecology) we are broadly interested in biodiversity and in the sustainability of human society.

We study how plants, microbes, and ecosystems respond to climate change and other environmental changes. We seek to improve climate change predictions through better understanding of the feedbacks from ecosystems on land. We also study how invasive species affect ecosystems, and what makes ecosystems susceptible to invasion.

Esteban Fernandez-Juricic – Lilly, G-302 efernan@purdue.edu (Visual ecology, behavioral ecology, conservation ecology): evolution of visual systems in birds (visual acuity, visual fields, color vision); anti-predator and foraging strategies in species with different degrees of sociality; human-wildlife interactions in urbanized landscapes, protected areas, and airports.

Jeffrey R. Lucas - Lilly, G-414C jlucas@purdue.edu (Evolutionary ecology; behavioral ecology) Auditory adaptations in bird hearing; effect of noise on bird song; animal communication.

Dennis J. Minchella- Lilly, 1-122 dennism@purdue.edu (Population biology; genetics) Host-parasite coevolution; influence of parasitism on host life-history patterns and community structure; genetic diversity of parasite populations; molecular epidemiology.

Nancy Pelaez – Lilly, G-224 npelaez@purdue.edu (Vascular physiology). The Pelaez lab is attempting to find out if the contractile response to hypoxia in blood vessels depends on intracellular pH and calcium signals that are intrinsic to the vascular muscle. Using a Halpern

system to experiment on pressurized blood vessels, we measure pressure, flow, and blood vessel diameter (see <http://www.livingsys.com/>) with a computerized image acquisition system that can track fluorescent pH and calcium labels as blood vessels contract and relax. We examine results from these calcium and pH imaging techniques to decipher the mechanisms that regulate vascular response to hypoxia at the interface between evolution and medicine.

DEVELOPMENT AND DISEASE

R. Claudio Aguilar - Hansen Life Science Res., 321A claudio@purdue.edu (Cell and developmental biology) Protein trafficking and membrane transport in relation to the processes of cell polarity establishment and cellular transformation.

Ed Bartlett – Martin C. Jischke Hall of Biomedical Engineering, 2023 ebartle@purdue.edu (Neurobiology and physiology) Central auditory neurophysiology and neuroanatomy at the systems and cellular levels.

Ignacio G. Camarillo – Hansen 131A, ignacio@purdue.edu (Endocrine physiology) Hormonal regulation of mammary gland development; hormone binding protein function.

Henry C. Chang – Lilly, 2-223, hcchang@purdue.edu (Cell and developmental biology) Genetic, molecular, and cellular approaches to understand mechanisms underlying membrane protein trafficking in *Drosophila*.

Alexander Chubykin – Lilly 1-229 chubykin@purdue.edu A major challenge in neuroscience is to understand how brain circuits perform computations, affect perception and behaviors. I am interested in elucidating how neuromodulatory systems induce reward-dependent plasticity of the neural circuits involved in visual perception. I use a multi-disciplinary approach: using optogenetics and robotics to map neural circuits *in vitro*, and extra- and intracellular electrophysiological recordings *in vivo*. I use the mouse primary visual cortex (V1) as a model system, as it combines the ease of manipulating visual stimulus with accessibility for *in vivo* recordings in a genetically tractable animal model. This combination of *in vitro* and *in vivo* electrophysiology with the optogenetic tools provides an integrated platform to dissect and manipulate specific circuits relevant for visual perception, and study diseases affecting perception and neural circuit function, such as autism.

Donna M. Fekete – Lilly, 2-224 dfekete@purdue.edu (Neurobiology, cell and developmental biology) Development studies of the vertebrate inner ear using zebrafish and chicken embryos as model organisms. Two major focus areas are microRNAs and Wnt signaling pathways. The tools used for gene manipulation include retroviruses, electroporation of plasmids and antisense morpholinos. We have initiated regeneration studies of inner ear hair cells using virus-mediated gene delivery into mouse models of deafness, done in collaboration with other laboratories.

Stephanie M. Gardner – Lilly, 2-226 sgardne@purdue.edu (biology education research; data analysis and visualizations; physiology education research): My research group is focused on understanding and improving how undergraduate students learn biology, especially in the areas of inquiry, data communication, and neurophysiology. To do this we employ a variety of qualitative and quantitative techniques including interviews, surveys, and assessments. Current projects include understanding the reasoning used by students and professors when handling data and creating visual displays (i.e., graphs) of them and understanding how students incorporate systems thinking when explaining physiological reflexes.

Stanton B. Gelvin - Hansen Life Science Res, 339A gelvin@bilbo.bio.purdue.edu (Plant molecular biology) Mechanism of the transfer to and expression of the *Agrobacterium tumefaciens* Ti-plasmid in plant cells. Investigates the interaction of pathogenic bacterium, *Agrobacterium tumefaciens* with host cells. A major emphasis is to understand the role of host

genes and proteins in bacterial virulence. Students working in the lab will be trained in microbial and eukaryotic genetics, molecular biology, and cell biology techniques.

Peter J. Hollenbeck – Lilly, 2-237 phollenb@purdue.edu (Neurobiology) Intracellular organelle transport in neurons.

Andrea Kasinski – Bindley 292 akasinski@purdue.edu (Cancer and Molecular Biology) Non-coding RNA biology and using this knowledge to harness their power for therapeutic use in cancer.

Stephen F. Konieczny – Bindley Biosciences, 192 sfk@purdue.edu (Cancer, Molecular, and Developmental Biology) Research revolves around using genetically engineered mouse models of pancreas development, pancreas disease and pancreatic cancer. Each research topic examines how transcriptional events control gene expression and how changes to the transcriptome either prevent or drive disease cell states. Within this framework, the laboratory takes advantage of genome editing tools (CRISPR-Cas9) to alter the genome and to correct genetic defects in mouse models of disease.

Richard J. Kuhn - Lilly, B-129 kuhnr@purdue.edu (Molecular biology and animal virology) Viral gene expression, virus-host interactions; pathogenesis; virus receptors and virus assembly.

Yuk Fai Leung - Lilly 2-236 yfleung@purdue.edu (Cell and Developmental biology) Retinal degeneration is a group of inherited eye diseases including retinitis pigmentosa and age-related macular degeneration that impair our vision. Although much has been learned about the molecular basis of these diseases, they are still incurable. To expedite discovery of new drugs for these diseases, our group at Purdue University studies zebra fish retinal-degeneration models. We are currently focused in two research directions: 1. Disease-causing gene network for retinal degeneration, and 2. Drug discovery for retinal degeneration. Please visit our lab website [<https://www.bio.purdue.edu/lab/leung/>](https://www.bio.purdue.edu/lab/leung/) for further information.

Seema Mattoo – Lilly G-227 smattoo@purdue.edu (Development and disease) Research in the Mattoo lab focuses on a newly discovered family of evolutionarily conserved proteins that are defined by the presence of a 'Fic domain'. These Fic proteins utilize nucleotides and nucleotide derivatives to post-translationally modify their substrates, thereby altering cellular signaling. Specifically, in 2009, we and others reported that bacterial toxins containing the Fic domain could utilize ATP to add an AMP (adenosine mono-phosphate) to RhoGTPases. This adenylation event (sometimes called AMPylation) inactivates RhoGTPases, thereby inducing host cytoskeletal collapse. As such, Fic-mediated adenylation allows the bacteria to evade phagocytosis by immune cells and/or breach the host's protective cellular barriers. We further demonstrated that the only human Fic domain-containing protein, HYPE/FicD, also has the ability to add AMP to RhoGTPases *in vitro*, but HYPE's physiological target remains to be identified¹. We have since shown that other nucleotides, such as GTP, CTP, and UTP, can also be utilized for Fic-mediated modifications. Most recently, another bacterial Fic protein implicated in golgi breakdown and disruption of host vesicular trafficking was shown to hydrolyze a CTP derivative, called CDP-choline, to transfer not the nucleotide moiety but rather the phospho-choline to RabGTPases. Thus, the Fic domain confers both nucleotidyl transferase as well as phospho-choline transferase activity. The goal of the Mattoo lab is to explore the role of Fic proteins in regulating prokaryotic and eukaryotic signal transduction events.

Donald F. Ready - Lilly, 2-231 readyd@purdue.edu (Biology; developmental neurobiology) Cellular, molecular, and genetic studies of *Drosophila* retinal development.

Arthur D. Rosen – Lilly, 3-305 rosena@purdue.edu (Neurophysiology, membrane physiology, biophysics) Ion channel function.

Chris J. Staiger - Hansen Life Science Res., 333B staiger@purdue.edu (Plant cell/developmental biology) Cytoskeletal function during plant development and in response to environmental signals.

Daniel M. Suter – Lilly, 2-239 dsuter@purdue.edu (Cell biology; proteomics) Understanding the molecular and cellular mechanisms of cell migration is a major goal in modern biology. Cell movements play a critical role during development, adult life, and in various diseases. Important examples include the growing tip of a nerve cell process, the neuronal growth cone, and the invasive behavior of cancer cells. Our laboratory is currently focusing on the mechanisms of neuronal growth cone motility and guidance. We use two main model systems, *Aplysia* and zebrafish. Using the large *Aplysia* neurons in culture, we investigate how the growth cone integrates its sensor, signaling, and motility functions to achieve directional movements towards target cells and establish functional connections. Specifically, we would like to understand how extracellular signals, such as from cell adhesion molecules, are transduced inside the cell to affect the underlying cytoskeleton. These changes ultimately determine speed and direction of growth cone movement. Our current studies aim at the understanding of two different types of chemical signaling, Src tyrosine kinases and reactive oxygen species (ROS) signaling, in addition to mechanical signaling in neurite growth. In the ROS project, we also take advantage of zebrafish embryo to image and manipulate early nervous system development in vivo. We use a combination of quantitative live cell imaging, cell biological, biophysical, molecular and biochemical techniques to investigate the dynamics and function of adhesion, signaling, and cytoskeletal proteins, and to quantify forces involved in cell migration. We hope that our research will not only improve our understanding of the basic cell biology of neuronal growth cones, but also assist in the development of treatments that support axonal regeneration in nervous system diseases and injuries.

Elizabeth J. Taparowsky - Bindley Bioscience Building, Room 160 taparows@purdue.edu (Immunology, Cancer and Molecular Biology) The lab studies transcription factors that function in the mammalian immune system. Utilizing genetically engineered mouse models, we have disrupted a transcriptional network that impacts the ability of animals to properly respond to antigen. By defining the cellular and molecular basis of this deficiency, we are addressing questions important for further understanding human disease states, including autoimmunity, inflammation, infection and cancer.

Daoguo "Joe" Zhou- Lilly, 1-235 dzhou@bilbo.bio.purdue.edu (Cellular microbiology) *Salmonella typhimurium* Type III secretion; host actin cytoskeleton rearrangements and bacteria-host interactions.

NEW BIOLOGY FACULTY

Mark Christie- Lilly, G-337, markchristie@purdue.edu

Qing Deng- Lilly, G-231, qingdeng@purdue.edu

Siddika Guzey- BRNG 4160, sguzey@purdue.edu

Angeline Lyon- Brown, 3130C, lyonam@purdue.edu

Nicholas Noinaj- HOCK 333, nnoinaj@purdue.edu

Yuan (Alan) Qi- LWSN 1207, alanqi@cs.purdue.edu

Catherine Searle- Lilly, G-331, searlec@purdue.edu

Josh Springer- Lilly, G-414E, springe7@purdue.edu

Possible Research Mentors outside the Dept. of Biological Sciences

Agronomy

Karen Hudson – Lilly 2-310 kkaczoro@purdue.edu Soybean seeds are an important source of protein and oils for industrial purposes as well as for human consumption. The lab studies soybean seed development. We are investigating the function and expression of the genes that control protein and oil biosynthesis in the seed using mutants as well as molecular techniques. <http://www.ars.usda.gov/Research/docs.htm?docid=20688>

Scott Jackson – Whistler Hall, 224 sjackson@purdue.edu Comparative genomics; physical mapping In order to fully exploit the genome sequence data that is being generated for several plant species, we are integrating genetic and physical maps. Genetic maps are statistical representations of sequence arrangements on chromosomes whereas physical maps portray the physical location of a sequence on a chromosome. By linking the genetic map to the physical chromosomes and thereby the genome sequence data; it is possible to locate specific genes that condition an observable trait. BAC (bacterial artificial chromosome) libraries and FISH (fluorescence *in situ* hybridization) are the main techniques used to integrate these maps for the cloning of genes and characterization of plant genomes.

Aaron Patton – Lilly Hall of Life Sciences, 2-347 ajpatton@purdue.edu Turf grass Science; culture; and ecology www.agry.purdue.edu/turf Dr. Patton's research responsibilities include planning, implementing, and leading research projects devoted to managing quality lawn, golf, and sports turf while reducing management inputs. Current projects include but are not limited to warm-season turf grass germplasm evaluation; mowing experiments in various turf grass species towards increased carbon sequestration; weed biology and control of various annual and perennial weeds; herbicide safety of newly established turf species; and product evaluation of bio pesticides for use in turf grass systems.

Diane Stott – destott@purdue.edu USDA-ARS National Soil Erosion Research Lab (Soil biochemistry) Soil quality / health issues – especially using soil enzyme activities to understand management impacts on soil quality and maintenance of productivity. Trace gas emissions from ag management systems, and monitoring dissolved carbon losses from ag dominated watersheds.

Dan Szymanski – Whistler, 226 dszyman@purdue.edu (Agronomy) To gain an understanding of how plant cells control their shape. Using Arabidopsis morphology mutants to identify new genes and pathways that define the location and extent of cell expansion.

Ronald F. Turco Jr. – Lilly, G-122 rturco@purdue.edu ()

Cliff Weil – Lilly, 2-349 cweil@purdue.edu Using genetics, genomics and molecular biology to improve the quality of cereal crops. We utilize the tremendous natural variation in cereals as well as some of the world's largest collections of induced mutations for maize and its close relative, sorghum, to understand gene function related to seed nutritional characteristics and to discover new networks of interacting genes. In addition, we are using these resources to understand how plants distribute carbon with the eventual goal of improving biomass for feed and fuel uses.

Animal Sciences

Ryan Cabot – Lilly Hall, 3-228 rcabot@purdue.edu (Early mammalian embryo development) Examine roles of how specific epigenetic modifications (modifications to chromatin that impact gene transcription) are controlled during mammalian embryogenesis. We routinely perform a variety of molecular techniques including quantitative RT-PCR and immunocytochemical analysis. We also do a lot of in vitro embryo production and manipulation (harvesting immature oocytes from pig ovaries, maturing oocytes in the laboratory, fertilizing them in vitro, embryo microinjection and embryo culture).

Scott Radcliffe – Poultry Science Bldg., 103 jradclif@purdue.edu My research focuses on "environmental nutrition" in swine and poultry. Specifically, his lab is investigating dietary additives that reduce nutrient excretion and that might serve as potential replacements for subtherapeutic levels of antibiotics in the diet. In conjunction with this research he has been involved in the development of a steered ileo-cecal valve (SICV) cannulation technique that is used in pigs to collect ileal digesta and determine amino acid digestibilities. Students in his lab will be exposed to a wide range of laboratory techniques and will be asked to address research areas on both an applied and a basic level.

Jessica Yorzinski – Poultry Science 101B, jyorzinski@purdue.edu (animal behavior; behavioral ecology; evolutionary biology) Animal communication, antipredator behavior, attention, avian behavior, mate choice, sensory ecology, sexual selection, vigilance

Basic Medical Sciences

Sophia A. Lelievre – Lynn Hall of Vet. Med., 193D lelievre@purdue.edu (Functional organization of the cell nucleus and tissue architecture in differentiation and cancer) Research work in the laboratory focuses on the relationship between tissue polarity and the chromatin and nonchromatin organization of the cell nucleus. The experimental work is based on three-dimensional cell cultures that mimic physiologically normal and cancerous breast tissues, and focuses on the study of proteins involved in the control of chromatin structure (e.g., NuMA, MeCP2) and proteins involved in the control of apical polarity. A number of projects are also translational (using tissue biopsies) with the aim of developing novel diagnostic and therapeutic tools for breast cancer.

Russell P. Main, PhD. 2177 Lynn Hall of Veterinary Medicine. Musculoskeletal biology and biomechanics. rmain@purdue.edu Research in the lab focuses on evolution of musculoskeletal function in vertebrates by establishing relationships between musculoskeletal growth and the mechanical forces experienced by the skeleton during development. We investigate these topics using a comparative approach to examine the mechanical factors and cellular pathways critical to governing bone structure, composition, and the biological response of the skeleton to mechanical load. Specific studies in the lab will examine the mechanical forces experienced by the limbs during growth, adaptation of the skeleton to controlled applied loads, and changes in cellular physiology in relation to skeletal growth and adaptation.

Chun-Ju (Alice) Chang - LYNN chunjuchang@purdue.edu (Cancer biology, Stem cell biology) Determine the involvement of dietary factors and tumor microenvironment in the regulation of cancer stem cells; Understand epigenetic and microRNA regulation of stem cell properties; Explore potential therapeutic interventions targeting cancer stem cells.

Biochemistry

Scott Briggs—B10 Biochemistry. sdbriggs@purdue.edu (Role of histone methylation in gene expression and oncogenesis.) In the eukaryotic cell, DNA is associated with protein factors to form chromatin. The fundamental repeating unit of chromatin is called the nucleosome where 146 base pairs of DNA is wrapped around two copies of each histone protein (H3, H4, H2A, and H2B). An important role for histone proteins is to help in the compaction of our genome into the nucleus of the cell. However, this compaction of DNA can restrict nuclear factors from gaining access to the DNA template. Therefore, somehow this inherently restrictive environment must be regulated and organized to allow permissive cellular processes such as gene transcription, replication, recombination, repair, and chromosomal segregation. Since posttranslational modifications on histones such as acetylation, phosphorylation, ubiquitination, and/or methylation can influence the chromatin environment and ultimately gene expression, we are interested in studying the machinery that mediates these modifications and how mis-regulation of these enzymes can lead to a disease state.

Steve Broyles—211 Biochemistry broyles@purdue.edu. (Transcriptional regulation in poxviruses). Poxviruses are a large family of viruses that are pathogenic for many species of mammals, birds, and insects. They are the largest and most complex viruses known, encoding approximately 200 different proteins. The expression of these proteins is developmentally regulated in order to coordinate DNA synthesis and progeny virus packaging. Different classes of genes are turned on or off as the virus progresses through its life cycle. Our laboratory is studying the molecular mechanisms of gene switching.

Clint Chapple—B030 Whistler Hall chapple@purdue.edu. (Biochemistry and molecular biology of plant secondary metabolism). The phenylpropanoid pathway gives rise to a wide array of soluble metabolites in plants. These compounds participate in many plant defense responses and absorb potentially-damaging UV-B radiation. The pathway also generates the monomers required for lignin biosynthesis: ferulic acid and sinapic acid. Lignin is integrated into the plant secondary cell wall where it provides structural rigidity to plant tissues and enables tracheary elements to withstand the tension generated during transpiration. The analysis of this pathway in *Arabidopsis* using the tools of biochemistry, molecular biology and genetics is the focus of our laboratory.

Harry Charbonneau—439C Hansen charbonneau@purdue.edu. (Cell cycle function and regulation of the Cdc14 protein phosphatase). We are interested in understanding how protein phosphorylation is used to orchestrate the complex and dynamic processes of mitosis, the stage in somatic cell division when duplicated chromosomes are physically separated and transmitted to each daughter cell. The successful transmission of a complete genome to each daughter cell during mitosis requires the precise coordination of multiple processes such as chromosome condensation, breakdown of the nuclear envelope, and the assembly and movement of the mitotic spindle apparatus, the molecular machinery that physically separates chromosomes. Protein phosphorylation is a key regulatory mechanism for the temporal and spatial coordination of these crucial mitotic events.

James Clemens—5 Biochemistry jclemens@purdue.edu. (Molecular mechanisms of neuron connection specificity). Specialized cells called neurons are the basic components of animal nervous systems. Similar to electrical wires, neurons link together to form circuits through specialized membrane contact points known as synapses. These circuits are further assembled into ordered networks that cooperate with each other to ultimately form a functioning nervous system. What is truly remarkable about this process is the sheer complexity of neuronal connectivity. For example it is estimated that the human brain contains a trillion neurons that are networked via a quadrillion synaptic connections. How neurons discriminate between potential synaptic partners to form specific connections presents a complex problem of molecular recognition between cell surface proteins displayed upon opposing cell surfaces. These proteins and the molecular mechanisms underlying this process are the focus of our

research. We use the *Drosophila melanogaster* brain as an experimental model system and address the issue of connection specificity using a combination of genetic, molecular, and biochemical approaches.

James Forney—208 Biochemistry forney@purdue.edu. (Regulation of differentiation in protozoa). Eukaryotic cell differentiation is generally considered to be a property of metazoa (multicellular organisms), yet dramatic examples of regulated cellular changes also occur in protozoa. Our laboratory is investigating two such examples; one is the formation of the macronucleus during sexual reproduction in ciliated protozoa and the other is the morphological differentiation of *Leishmania* parasites as they move from insect vector to human hosts. The recent availability of genome sequences for all three of the protozoa used in these studies (*Paramecium*, *Tetrahymena* and *Leishmania*) have opened new lines of investigation and created exciting research opportunities.

Frederick S. Gimble—315 Biochemistry fgimble@purdue.edu. (Protein-DNA interactions and protein engineering of homing endonucleases). The sequence of the human genome will help identify genetic mutations that cause disease, and a central goal in the post-genomic era will be to develop tools to correct these errors. The repair of complex genomes requires having reagents available that 1) are capable of locating a specific sequence from among several hundred megabases of non-specific DNA and 2) are able to catalyze specific molecular modifications of the DNA that either initiate an endogenous repair pathway or effect repair directly.

Our laboratory has focused on designing and engineering homing endonucleases with novel functions that have the potential to facilitate DNA repair and other molecular processes. Homing endonucleases are encoded by mobile DNA elements that propagate between individuals within a population by “homing,” and between species through lateral transmission. These enzymes initiate homing by introducing a double-strand break at a single genomic target sequence situated within a cognate allele that lacks the mobile element. A long term goal of our group is to harness the extreme DNA sequence specificity of homing endonucleases to catalyze specified events at targeted genomic loci.

Barbara Golden—319 Biochemistry barbgolden@purdue.edu. (Structural basis for RNA catalysis). The focus of our research is the structure and folding of functional RNAs. Unlike proteins, RNAs have a highly charged backbone, only 4 different monomeric units (compared to the 20 amino acids that make up proteins) and functional groups that are largely sequestered within the major and minor grooves of the double helix. Yet, in the presence of magnesium ion, many RNA molecules have stable, globular, tertiary structures that support biological catalysis. To understand how these molecules fold and function, we are investigating the structure and function of these RNA molecules using biochemistry, molecular biology and X-ray crystallography. Group I introns catalyze transesterification reactions by activating a guanosine nucleophile for attack on the phosphodiester backbone. The structure of a ribozyme derived from a self-splicing intron from bacteriophage Twort was recent solved at 3.6 Å resolution. The structure reveals extensive interactions between three domains that construct an active site composed of RNA, and a complex binding pocket for the guanosine nucleotide substrate.

Mark Hall-- 214 Biochemistry mchall@purdue.edu. (Regulation of the cell cycle by ubiquitin-dependent proteolysis; protein mass spectrometry). The cell division cycle in eukaryotic organisms is a complex series of strictly regulated events that ensures 1) that the genome is replicated accurately and 2) that complete copies of the genome are faithfully distributed to the daughter cells. Cancer ultimately results from loss of control over the cell division cycle, and therefore a clear understanding of the molecular processes that dictate cell cycle progression is essential to a fundamental understanding of carcinogenesis. In all eukaryotic cells the sequential stages of the cell cycle are regulated by two primary mechanisms: reversible protein phosphorylation, and ubiquitin-dependent proteolysis. These processes are interdependent, and together they drive the cell cycle forward with the proper order and timing. Our lab is interested in how ubiquitin-dependent proteolysis directed by the anaphase-promoting complex

(APC) is used to regulate mitotic and meiotic events in the budding yeast, *Saccharomyces cerevisiae*.

Xiaoqi Liu—233C Hansen xiaoqi@purdue.edu . (Roles of Polo-like kinase 1 and its interacting proteins in cell proliferation and carcinogenesis). It is now widely accepted that cancer arises at least partly due to the perturbation of normal cell cycle progression, in which reversible protein phosphorylation plays an important regulatory role. In addition to the well-documented cyclin-dependent kinases, the Polo-like kinase (Plk) family has emerged as a key player in many cell cycle related events. Genetic and biochemical experiments with several different organisms have demonstrated that polo kinases are involved in many aspects of mitosis, such as mitotic entry, sister chromatids separation and cytokinesis. To investigate the function of Plk1 in mammalian cells in more detail, we recently reported the phenotype of cultured cells after Plk1 depletion using RNA interference (RNAi). Plk1 depletion in cancer cells induces G2/M arrest, followed by apoptosis. A close correlation between mammalian Plk1 expression and carcinogenesis was recently documented. Overexpression of Plk1 was observed in various human tumors, such as melanomas, non-small cell lung cancer, etc. Constitutive expression of Plk1 in normal cells causes oncogenic focus formation and induces tumor growth in nude mice. Thus, inhibition of Plk1 function may be an important application for cancer therapy. Because inhibition of cell proliferation and reaction of apoptosis are basic principles in anticancer therapy, it will be intriguing to test the effect of Plk1 depletion in normal primary cells. A lentivirus-based RNAi approach is currently being used to deplete Plk1 in several types of normal cells. Using a yeast two-hybrid system, we have identified a battery of potential Plk1-interacting proteins, and the significance of these interactions during cell cycle progression will be analyzed.

Andrew Mesecar HOCK 311 amesecar@purdue.edu (Biochemistry, Enzymology, X-ray crystallography, Drug Discovery and Design) The fundamental research interests of the Mesecar lab involve elucidating the molecular mechanisms and function of therapeutic enzymes and proteins. We wish to understand at the molecular level how enzymes and proteins recognize their substrates, catalyze their requisite chemical reactions, and trigger signal-transduction cascades. Our ultimate goal is to utilize this fundamental scientific knowledge to develop new therapeutics to treat cancer and infectious diseases. To achieve these goals, we integrate a variety of state-of-the-art research tools and approaches including X-ray crystallography, enzyme chemistry and kinetics, molecular biology, bioinformatics, mass spectrometry, and computational chemistry to gain an understanding of the role of protein dynamics and conformational change in molecular recognition and catalysis. We then couple these technologies with high-throughput screening and structure-based design to develop compounds capable of modulating the activity of enzymes and receptors involved in cancer chemoprevention, cancer cell proliferation, cell longevity, and bacterial and viral pathogenesis. Undergraduate researchers will get hands on experience working with an enzyme that is a therapeutic target and will get the opportunity to work with graduate students and post-docs to increase their knowledge and research skills.

Joe Ogas—B020 Whistler Hall ogas@purdue.edu. (Regulation of cell identity, signal transduction, chromatin remodeling). The identity of plant cells is remarkably fluid. This property is dramatically demonstrated by the ability of an excised piece of differentiated plant tissue to regenerate into an entire plant. We are interested in characterizing the factors and mechanisms that govern plant cell identity and facilitate its flexible nature. To accomplish this goal, we are utilizing a mutant of *Arabidopsis thaliana*, *pickle (pkl)*, in which the primary root differentiates improperly and expresses embryonic characteristics after germination. *pkl* primary roots that express embryonic differentiation characteristics are called pickle roots based on their appearance. Expression of the pickle root phenotype is dependent on gibberellin (GA), a plant growth regulator known to promote such diverse processes as germination, cell elongation, and initiation of flowering.

Sandra Rossie—221A Hansen srossie@purdue.edu (Signal transduction and protein Ser/Thr phosphatases). Reversible phosphorylation is an important and common mechanism for regulating a wide variety of processes in response to incoming signals such as hormones and neurotransmitters, environmental changes or cell damage. In contrast to our knowledge of protein kinases and their roles in these processes, we know far less about protein phosphatases and their regulation. Protein phosphatase 5 (PP5) is a recently described member of the largest Ser/Thr protein phosphatase family, with a unique N-terminal domain that inhibits PP5 activity and binds other proteins. PP5 has been implicated in signal transduction pathways controlling cell growth, differentiation and apoptosis, or programmed cell death. Little is known, however, about the physiological substrates for PP5 or how its activity may be regulated.

We use biochemical and molecular approaches to define the role and regulation of PP5 in brain and other tissues. Projects include defining the structural basis for controlling PP5 activity and potential regulators of PP5 activity. We are also using a proteomics approach to identify physiological substrates for PP5. We focus on the role of PP5 in neurons and in cancer cells, since the pathways in which PP5 may function are key players in neurodegenerative diseases and in tumor cell proliferation.

W. Andy Tao—239 Hansen watao@purdue.edu (Proteomics and biological mass spectrometry). Proteomics research is highly interdisciplinary, bringing together biology, chemistry, instrumentation, statistics, and computer science. A typical proteomic research starts with an important biological problem and therefore the very first step is to extract the sample from biological matrices for efficient downstream analysis. The sample is separated and then analyzed by mass spectrometry, typically online micro-capillary liquid chromatography-tandem mass spectrometry (mLC-MS/MS). MS data are then searched against protein database to obtain sequencing information of proteins. Proteins are finally validated using traditional biological methods. Our group focuses on the first step, i.e., how to efficiently target and isolate samples of interest among complex biological matrices. Such proteins of interest are typically low in abundance, dynamically expressed, and post-translationally modified. The subject, called targeted proteomics, therefore involves the integration of a number of technologies including the selective targeting of proteins with activities of interest, multi-step sample preparation, and mass spectrometry.

Biomedical Engineering

Pedro Irazoqui - Weldon School of Biomedical Engineering pip@purdue.edu

Botany

Plant Pathology

Janna Beckerman - jbeckerm@purdue.edu Extension and research activities related to diseases of landscape ornamentals, nursery and greenhouse disease management, and small/tree fruit diseases.

Zhixiang Chen – Whistler Hall of Ag Res., B026 zhixiang@purdue.edu (Plant molecular biology) The regulatory mechanisms of plant-pathogen interactions.

Stephen Goodwin - sgoodwin@purdue.edu Molecular genetics of host-pathogen interactions; population genetics, evolution and speciation of plant pathogenic fungi; genetics and genomics of disease resistance in small grains.

Teresa Hughes - Hughestj@purdue.edu Soil borne diseases of soybean with an emphasis on elucidating the role of host and pathogen variability in disease development and pathogen biology.

Guri Johal - gjohal@purdue.edu Molecular and genetic basis of maize interactions with fungal pathogens; disease lesion mimic mutants and programmed cell death in maize.

Richard Latin- rlatin@purdue.edu Etiology, epidemiology, and management of turfgrass diseases.

L. Sue Loesch-Fries - loeschfr@purdue.edu Function of viral genes in virus replication, disease development, and virus control.

Tesfaye Mengiste - mengiste@purdue.edu Molecular genetics of plant immune responses to fungal pathogens.

Kirsten Wise- kawise@purdue.edu Epidemiology and management of diseases of corn, soybean, and wheat: state specialist for Asian soybean rust.

Charles P. Woloshuk - woloshuk@purdue.edu Genetics, biochemistry, and physiology of mycotoxin biosynthesis.

Jin-Rong Xu - jinrong@purdue.edu Characterization of infection-related signaling pathways and genes important for fungal-plant interactions in *Magnaporthe grisea* and *Fusarium graminearum*

Plant Biology

Jo Ann Banks - banksj@purdue.edu Genetic and molecular basis of sex determination and differentiation in plants.

Nicholas Carpita - carpita@purdue.edu Biochemical and molecular aspects of plant cell growth and development; structure and biosynthesis of the plant cell wall.

Peter Goldsbrough - goldsbrough@purdue.edu Understanding how plants respond and adapt to a variety of environmental stresses, including heavy metals, drought and general oxidative stress.

Robert Pruitt - pruittr@purdue.edu Molecular and genetic regulation of growth and development of plants and their interactions with bacteria.

Mary Alice Webb - webbm@purdue.edu Plant cell and developmental biology; calcium oxalate accumulation in specialized cells.

Weed Science

Kevin Gibson - kgibson@purdue.edu Ecology, biology, and management of invasive plant species and herbicide resistant weeds.

Steven Hallett - halletts@purdue.edu Biological control of weeds with emphasis on the discovery and development of bioherbicides.

Bill Johnson - wgi@purdue.edu Biology and management of economically important weeds in agronomic crops; interactions between weeds, insects, and diseases.

Chemistry

Mahdi M. Abu-Omar – Brown 5170C mabuomar@purdue.edu (transition element chemistry, catalysis of energy consequences, and biological inorganic chemistry) Investigates the reaction dynamic of metallo-enzymes. Our recent focus has been on phenylalanine hydroxylase (PAH), an iron dependent oxygenase, and chlorite dismutase (CD), a heme enzyme of environmental importance.

Ji-Xin Cheng – Biomed Bldg., 2035 jcheng@purdue.edu (Biomedical engineering and chemistry) Development and Biological applications of nonlinear optical (NLO) microscopy: new development of coherent anti-Stokes Raman scattering (CARS) microscopy; *ex vivo* and *in vivo* NLO imaging of nervous systems and neurological disorders; probing the molecular composition of membrane domains; CARS imaging of drug distribution and release; evaluating the impact of obesity on mammary tumor stroma by multimodal NLO microscopy. Delivery mechanisms and new applications of nanomedicine: intracellular transport of endocytosed folate receptor and folate linked nanocarriers; cell entry of peptides with polycationic and hydrophobic residues; polymer micelle mediated drug delivery; two-photon luminescence imaging and optical hyperthermia with gold nanorods; better repair of spinal cord injury with PEG copolymer micelles.

Philip Low – Wetherill Laboratory of Chem., 331B plow@purdue.edu (Membrane Biology) Study the structure and function of human cell membranes; design and test novel receptor-targeted therapeutic and imaging agents for cancer and inflammatory diseases.

Kavita Shah – Brown Laboratory of Chem., 5170D kavitashah@purdue.edu (Chemical Biology) Developing and applying novel chemical tools to dissect different biological processes. Our main focus is to delineate roles of different kinases in cancer and neurodegeneration.

Entomology

Jeffrey Holland – Smith Hall, B17 jdholland@purdue.edu (Landscape ecology) Landscape ecology research using insect species and overall arthropod biodiversity. Use forest beetles to look at the influence of land use and landscape patterning on the movement and population viability of both pest and ecologically important species.

Electrical & Computer Engineering

Rashid Bashir – Birck Nanotechnology Center, 2019 bashir@purdue.edu ()

Nutrition Science

John “Jay” Burgess – Stone Hall, G-1F burgessj@purdue.edu. Work in my laboratory focuses on oxidative stress and the ability of cells to adapt to protect themselves from the damaging effects of reactive oxygen species. Our studies focus on the players in the adaptive process, what role key components play, the effect of phytochemicals on adaptation, and whether oxidative stress adaptation is a factor in behavioral disorders. One project has focused on adaptation to oxidative stress and we have recently found that early events involve ubiquinol and the reductase enzymes that facilitate the effectiveness of coenzyme Q as a key lipid soluble antioxidant. A second project focuses on the mechanisms that mediate the adaptive process. A third project seeks to discover the contribution of phytochemicals to antioxidant defense. During the past year we have found that the catechin EGCG exhibits antioxidant activity in vivo and partially protects against vitamin E and selenium deficiency.

James Fleet – Stone, fleet@purdue.edu (physiology and disease processes) Uses the tools of cell and molecular biology to understand normal physiology and disease processes. We have several areas of interest. First, we are interested in the molecular mechanisms controlling the differentiation of intestinal cells with the capacity to absorb nutrients. Within this area we study the mechanism of intestinal mineral absorption and the role of transcription factors in stimulating this process. Second, we are interested in the molecular actions of the steroid hormone, 1, 25 dihydroxyvitamin D that is derived from the nutrient vitamin D. The vitamin D hormone regulates intestinal calcium absorption and also has anticancer actions. We have active projects on the role of vitamin D metabolites in the prevention of colon and prostate cancer. Finally, we study the role that genetics plays in an individual's ability to utilize essential mineral elements. All of our research uses cell and animal models.

Connie Weaver – Stone Hall, 210 weavercm@purdue.edu (Bioavailability of minerals; Calcium metabolism, exercise, nutrition and bone health, and iron status) Calcium metabolism and bone health using both rat models and clinical trials.

Food Science

Bruce Applegate – Food Science Bldg., 3161 applegate@purdue.edu (Foodborne pathogens) Genetic manipulation of magnetotactic bacteria for the purpose of making magnetic reporters to sense chemicals or other environmental stimuli. Characterization of an *E.coli* 0157:H7 specific bacteriophage. Also, genetic manipulation of the bacteriophage in order to create tools for detection and genetic manipulation of *E.coli* 0157:H7. Use of error prone PCR and an iducible selectable marker to select a regulatory gene with altered detection specificity. Investigation of factors influencing survival and metabolic activity of foodborne pathogens in food related environments. Development of nucleic acid based methods for detection of foodborne pathogens.

Forestry and Natural Resources

Andrew DeWoody – Forestry Bldg. 213 dewoody@purdue.edu (Ecology, genetics, evolution) Studies behavioral ecology, population genetics, and molecular evolution in variety of vertebrates (rodents, eagles, salamanders, fishes).

Health and Kinesiology

Howard Zelaznik – Lambert, 205D hzelaz@purdue.edu (Movement coordination and timing) Examines theoretical issues in movement coordination and movement timing. Recent proposal of new framework to explain timing processes in discrete tasks versus continuous tasks. Discrete tasks utilize explicit, event timing systems in which the central nervous system possesses a representation of the timed interval. Continuous tasks are indirectly timed by the use of emergent timing. In emergent timing, the central nervous system controls other variables of the movement trajectory, with the temporal properties emerging from this control process. These processes are studied in normal individuals (Purdue work) and in individuals with a compromised cerebellum (UC Berkeley collaboration).

Horticulture and Landscape Architecture

Avtar Handa – Whistler, 321 ahanda@purdue.edu (Molecular and postharvest biology) Genetic analysis of *Arabidopsis* mutants exhibiting hypersensitivity to polyamines. Segregation analysis of transgenic tomatoes over and under expressing spermidine synthase.

David Salt – Whistler, B024 dsalt@purdue.edu (Molecular, biochemical, physiological and evolutionary mechanisms) Broad interest in the molecular, biochemical, physiological and evolutionary mechanisms that underlie how plants regulate their mineral nutrient and potential toxic trace element contents. Applying molecular biology, biochemistry, and genetics couple to high-throughput elemental analysis, DNA microarray-based genotyping and bioinformatics to map and identify genes and regulatory elements that control these processes.

Natalia Doudareva – Horticulture building, 112 dudareva@purdue.edu (Volatile secondary metabolite production) Investigate volatile secondary metabolite production at the molecular level. We concentrate on the isolation and characterization of genes and enzymes responsible for the biosynthesis of volatile compounds as well as on the identification of biochemical and molecular mechanisms controlling the scent formation and emission in plants.

Medicinal Chemistry & Molecular Pharmacology

Eric L. Barker – RPH 202B barkerel@purdue.edu

Changdeng Hu – Robert E. Heine Pharmacy Bldg., 224D, hu1@purdue.edu. Studying the role of transcription factor AP-1 in cancer and in *C. elegans* development. A few novel approaches have been developed in the lab to address the role of AP-1 dimers in cells and in vivo.

Chiwook Park – Robert E. Heine Pharmacy Building, 224A chiwook@purdue.edu. Proteins are dynamic molecules. Even under native conditions, they do not adopt a single static conformation. Rather, they access many different conformations in their native state ensemble. This native state ensemble includes small fluctuations around the native conformation, partially unfolded forms, and even globally unfolded forms. The distribution of these conformations and the kinetic barriers between the conformational states define the conformational energy landscapes of proteins. My research interest is investigating conformational energy landscapes of proteins and deciphering the relationship between the energetics of proteins and their biochemical functions, such as catalysis, signal transduction, and ligand binding. We use proteolysis as a major tool to probe protein structures and dynamics as well as conventional spectroscopic methods. We also use proteomics extensively for investigating energy landscapes of proteins on a system level.

Val J. Watts – Robert E. Heine Pharmacy Building, 210, wattsv@purdue.edu (Molecular Pharmacology) Understanding the molecular pharmacology of dopamine receptor signaling pathways in the treatment of Parkinson's disease, schizophrenia, and drug abuse.

Psychological Sciences

Amy Brewster - Psychological Science Bldg., abrewst@purdue.edu Epilepsy is a devastating neurological condition characterized by the occurrence of recurrent unprovoked seizures, cognitive (learning/memory), behavioral (social/autism), and psychological (schizophrenia) comorbidities, and an increased risk for accidental or sudden unexpected deaths. It is estimated that antiepileptic drugs only suppress seizures in 70% of epileptic patients and do little to relieve the associated comorbidities. Thus, in order to develop treatments that attack the cause and not just the symptoms it is critical to target the underlying mechanisms. Dr. Brewster aims to do translational research with the goal to identify, study, and understand candidate molecular mechanisms underlying the pathophysiology of epilepsy and can be therapeutic targets for the prevention, treatment, and control of this disease. *Dr. Brewster's research focuses on the central hypothesis that neuroinflammatory modulators such as microglial cells and its associated signaling cascades play a role in dendritic dysfunction, unprovoked seizures, cognitive and behavioral impairments in epilepsy.*

Julia Chester – Psychological Science Bldg., Room 3162, jchester@psych.purdue.edu

Edward Fox – Psychological Science Bldg., 3128 foxe@purdue.edu ((1) neural control of eating and body weight and (2) neural development) We use mice with gene mutations that affect nerve development to study their effects on nerve development, eating and body weight. We use nerve tracing methods in embryos and adult mice, study gene expression patterns during development and patterns of eating behavior.

Kimberly Kinzig – Psychological Science Bldg., 3168. kkinzig@purdue.edu. In my laboratory we investigate the neural and endocrine controls of food intake and regulation of body weight. We are currently investigating how macronutrient content of the diet influences neural signaling in energy balance. Additionally, we use rodent models of eating disorders to examine neuroendocrine correlates and consequences of disordered eating.

Susan Sangha – Psychological Science Bldg., Room 3182. sangha@purdue.edu

Susan Swithers – Psychological Science Bldg., B151 swithers@psych.purdue.edu. Research is on the ontogeny of motivated behaviors, in particular the development of behavioral, neural and physiological controls of feeding and drinking. Recent work has also examined the consequences of dissociating sensory properties of foods and calories on body weight gain and obesity.

Comparative Pathobiology

Veterinary Parasitology

Joseph W. Camp, Jr. – Veterinary Pathology Building, 124 jcamp@purdue.edu (Parasitology)
Field collection, life cycle studies, cell culture techniques. *Sarcocystis neurona* which causes neurologic problems in horses. Using the proteome facility in the Bindley Life Science Center to do preliminary proteomic studies on this parasite.

Candace Croney – ?, ccroney@purdue.edu

Keke Fairfax – VPTH 123, kfairfax@purdue.edu Research is focused on understanding the mechanisms of immunomodulation during chronic infection with the parasitic helminth *Schistosoma mansoni*. My laboratory also studies the mechanism of B cell and macrophage trafficking both during *S. mansoni* infection and in response to immunization with parasite extracts.

Yava Jones-Hall – ?, yljones@purdue.edu

Sulma I. Mohammed – Lynn Hall, 1294 mohammes@purdue.edu (Cancer Biology)
Identification of specific and sensitive biomarkers for early detection of cancer. Laser capture microdissection (LCM), proteomics, and nanotechnologies. LCM allows us to procure pure populations of neoplastic cells or normal cells and compare them either at the DNA, RNA or protein level.

Purdue Cancer Center

E-mail - cancerresearch@purdue.edu; www.cancerresearch.purdue.edu