Natural Sciences & Math Faculty Research Interests

Biology

Morgan Benowitz-Fredericks
I am interested how hormones both constrain and enable birds (and other animals) to respond to their environment. The endocrine system integrates external and internal cues to orchestrate developmental, physiological and behavioral changes, but it is very sensitive to conditions during development. I am particularly interested in the ways in which conditions early in development permanently affect the endocrine system and therefore the behavior and physiology of birds.

Elizabeth Capaldi Evans
I am a behavioral biologist who studies the relationship between insect behavior and brain structure. One goal of my research is to explore the neurobiological underpinnings of ecologically relevant behaviors. I focus my research on honey bees, but I also study other bees found in temperate and tropical habitats. I am interested in how insects find their way in the world and in how social behavior is shaped by the environment. My work fits within the integrative discipline of neuroethology, which combines field research using insects in nature with laboratory studies of learning and the brain.

- Studies of honey bee biology, including harmonic radar
- Comparative studies of tropical bees, brains, and behaviors
- Native bee distributions in Pennsylvania

Mitchell Chernin
- Molecular Biology. Regulation of gene expression. Regulation of the cardiac renin-angiotensin system. Regulation of bone remodeling and growth.
- Interaction between osteocalcin and oxytocin in osteosarcoma cell growth.
- Oncogene, growth factor and extracellular matrix gene expression in cardiac specific angiotensin II transfected mice.
- Characterization of MC3T3-E1 osteoblastic cells transfected with TGF-B gene.
- Transformation of MC3T3-E1 cells by plasmids containing SV40 regulatory sequences.

Kenneth Field
Farnesyltransferase inhibitor effects on lymphoid cancers and immune function.

Julie Gates
During development of a single cell, the fertilized egg, is transformed into a mature organism. This remarkable transformation not only requires the generation of a large number of cells, but also requires that these cells organize themselves into the various tissues and organs that comprise the mature organism. To do this the cells of the embryo must undergo orchestrated changes in cell shape, cell migrations and cell rearrangements, all of which require remodeling of the actin cytoskeleton. The actin cytoskeleton is composed of a network of actin filaments that underlie the plasma membrane. Filaments grow by the preferential addition of actin subunits to one end. Remodeling of the actin cytoskeleton is achieved through the interplay of numerous proteins that affect the formation, continued growth or disassembly of actin filaments. This alters the geometry of the actin meshwork underlying the plasma membrane, which in turn dictates cell shape and influences the ability of cells to migrate as single cells or sheets of cells. A long-term goal of my research is to determine how the different actin regulators
cooperate to generate the incredible diversity of cell behavior seen in the intact animal during development.

Mark Haussmann
My interests in biology are diverse and my research draws from physiology, ecology, evolution and molecular biology. Most of my work explores questions related to the biology of aging. Why do we age? Why do some animals age more quickly than others? On a cellular level what is responsible for the aging process. Much of my work has been with birds, but I have also worked with reptiles, mammals and plants.

Matthew Heintzelman
My lab studies a rather unique form of cell locomotion known as gliding motility. While most cells move either by swimming (using cilia and flagella) or by crawling (like an amoeba), other cells glide along their substrate without any obvious distortion of their form and without an obvious locomotory organelle. Included among the gliders are the apicomplexan parasites *Toxoplasma* and *Plasmodium* (the malaria parasite) and their huge relative the gregarines, this last protozoan being a primary focus of this lab. Other gliders include raphid diatoms (also a focus of the lab), the green alga *Chlamydomonas*, and the colonial protist *Labyrinthula*. In most gliding systems, the actin-myosin cytoskeleton plays an essential role, and so much of the work in the lab is dedicated to identifying and characterizing the molecular motors and macromolecular assemblies used by cells to power gliding motility. A broad range of molecular and morphological techniques is employed to study gliding motility and the cytoskeletal architecture that supports this fascinating form of cell locomotion.

Steve Jordan
I am a molecular systematist and entomologist. My principle research area is the systematics and biogeography of the damselflies of Pacific islands. I have worked extensively in Hawaii and the Marquesas Islands. My recent postdoc in France involved the comparative genomics and phylogenetics of the bovid genus *Capra*, and testing for selection signatures at multiple nuclear loci.

Elizabeth Marin
I use the model organism *Drosophila melanogaster* to study fundamental problems in nervous system development. How do newly born cells know what types of neurons they're supposed to be? How does a neural stem cell produce distinct types of neurons at the right time during development? How do insect nervous systems reorganize during metamorphosis to accommodate radical transformations in body plan from limbless larvae to adults designed for mating and dispersal? And how have nervous systems evolved variations on the basic arthropod model to enable novel brain functions or dramatic differences in appendage type and number?

Chris Martine
- Plant reproductive ecology and evolution
- Plant systematics and molecular phylogenetics
- Invasive plant biology
- Pollination and seed dispersal
- Floristic projects such as field guides, floras and keys
Matthew McTammany  
Stream Ecology, Human impact on aquatic ecosystems, Restoration and management of aquatic ecosystems, Carbon and nutrient dynamics in ecosystems and GIS and remote sensing

Kathleen Page  
Our studies are designed to investigate the effects of dexamethasone on gene expression of key hypothalamic-pituitary-adrenal axis negative-feedback regulation. Dexamethasone is a synthetic steroid analog of corticosterone, the major glucocorticoid secreted from the rat adrenal, and we found that prenatal exposure to this steroid results in HPA axis hyperactivity and increased levels of circulating CORT in the experimental animals. These studies are particularly pertinent for biomedical databases since dexamethasone is used clinically as a therapeutic to avert preterm delivery and to promote lung development in the fetus. It is important to investigate the long term effects of drugs that are used clinically, especially if the therapeutics are used during pregnancy. In addition, we are studying the effects of dexamethasone because it is a corticosterone analog and high levels of this hormone mimic the conditions of maternal stress. We are investigating how this physiological state in the mother would affect postnatal development in the offspring. We are especially interested in potential changes in gene expression that may underpin behavioral abnormalities.

We have already found that corticosteroid receptor expression in the brain changes in the DEX-exposed offspring. This change is particularly important since the ratio of corticosteroid receptor I (MR) and corticosteroid receptor II (GR) governs the “pulse” of hippocampal signaling to the hypothalamus. It has been hypothesized that a disturbance in this ratio may result in abnormal adrenal output of “stress” hormones such as cortisol (human) or corticosterone (rat) and that this disturbance may also alter serotonergic function since high levels of CORT affect serotonin function adversely. High circulating levels of CORT have been associated with reduced serotonergic transmission which may underpin affective disorders in humans such as anxiety and depression.

Le Paliulis  
We study cell division in the Paliulis lab. We use different arthropod species as my model organisms because of the ease of maintaining laboratory culture and of obtaining good cellular material for experiments.

We are interested in how cells get the different types of cell division (meiosis and mitosis) right, and what happens when they mess it up.

Errors in cell division can lead to birth defects and diseases like cancer. These errors are very rare, and cells put a huge amount of effort into avoiding errors and fixing errors when they do happen. Moths and butterflies, however, have cell divisions in some parts of their bodies that make errors most of the time, seemingly "on purpose." Our aim is to understand how these cells make errors when there are so many controls stopping errors from being made. The ultimate goal is to use this information to understand how the errors that cause diseases are made.

In addition, we study meiosis in the milkweed bug. The milkweed bug has holocentric chromosomes (chromosomes with spindle attachment sites along their entire length). In meiosis, sites on the chromosome are designated as the spindle attachment site, and chromosome separation occurs just like it does in cells with single spindle attachment sites.
However, the sex chromosomes are thought to "re-pair" prior to the second meiotic division. We are interested in understanding how this re-pairing process happens. We also have several projects studying the distinctive processes of cell division in other arthropod species. We hope that understanding these processes will give us a better understanding of cell division as a whole.

Marie C. Pizzorno
The main focus of my research has been on the molecular and cellular biology of eukaryotic viruses, specifically herpes viruses. Cytomegalovirus (CMV) is a herpes virus which is very species and cell-type specific, preferring to grow in differentiated cells. Work that I started as a post-doctoral fellow suggested that one of the blocks to infection by CMV in many cell types may be during entry and uncoating of the virus particle in the host cell. Students in my lab are involved in using several experimental approaches to study this problem. These include localizing viral structural proteins and DNA during early events of infection using immunofluorescence and in-situ hybridization, studying protein-protein interactions between viral and cellular proteins by expressing cloned genes in bacteria, and identifying biochemical differences between permissive and non-permissive cells using protein purification. In addition, students learn how to manipulate cells and virus in tissue culture and basic recombinant DNA and protein biochemistry techniques. Studying events that occur early during infection in several cell types will elucidate both the virus-cell interactions that control permissivity in CMV and the molecular details of virus entry.

DeeAnn Reeder
- Comparative behavior and physiology in mammals
- Stress responsiveness in nature; changes across life history stages and in response to the environment
- Mammalian systematics and biodiversity

Mark Spiro
My research interests focus on molecular and cellular aspects of plant growth and development. I am currently studying the interaction between light and hormones on photomorphogenic development in the model systems *Ceratopteris richardii* and *Arabidopsis thaliana*. I am also engaged in pedagogical research on the use of inquiry based laboratory procedures and active-learning techniques in the biological sciences.

Tristan Stayton
Evolutionary and functional morphology of vertebrates, especially reptiles, convergence in morphology and function, paleobiology, biomechanics and modeling of vertebrate functional systems.

Emily Stowe-Evans
Light regulated developmental processes in photosynthetic organisms. I use molecular genetic and physiological approaches to study how photosynthetic organisms (plants and cyanobacteria) adapt to changes in their light environment. My current research focuses on how the cyanobacterium *Fremyella diplosiphon* adapts its photosynthetic apparatus to changes in light color in a process called complementary chromatic adaptation. Ultimately I would like to put the molecular understanding of complementary chromatic adaptation that we are developing into an ecological and evolutionary context.

Mizuki Takahashi
My interests broadly rest on evolutionary ecology, behavioral ecology and conservation biology. Despite rich species diversity on the earth, processes of species diversification have not been fully understood. I am especially interested in ecological speciation, in which reproductive isolation evolves through ecological processes (i.e., divergent selection). My research approach to conservation biology is to explore pesticide effects on non-target species such as amphibians, while I am also very interested in invasive species. I am tackling these issues using amphibians, insects and plants as study organisms. Here at Bucknell, I am collaborating with Dr. Abrahamson on host-race formation via insect-plant interaction.

**Chemistry**

*Dee Ann Casteel*
Organic synthesis, synthesis of peroxides, antimalarial, medicinal chemistry

*Karen Castle*
Kinetics and dynamics of atmospheric processes

*Charles Clapp*
Enzyme mechanisms and enzyme inhibitors

*Margaret Kastner*
X-ray crystallography, chemical education

*William Kerber*
Inorganic coordination chemistry; multinuclear iron(III) complexes

*Michael R. Krout*
Natural product chemistry and total synthesis; reaction methods development

*Molly McGuire*
Environmental chemistry, environmentally important redox chemistry at clay mineral surfaces; spectroscopic characterization of aqueous colloids

*David Rovnyak*
Biophysical chemistry, application of magnetic resonance techniques to the study of biological macromolecules

*Thomas Selby*
Biochemistry, Structural biology, X-ray crystallography

*Thomas Shawe*
Organic synthetic methodology: stereo-selective reactions and alkaloid synthesis

*George Shields*
Computational chemistry, structural biochemistry, chemistry education
Robert A. Stockland Jr.
Organic and Inorganic Chemistry

Timothy Strein
Capillary electrophoresis of biological fluids, charge transfer reactions at ultrasmall electrodes, GC/MS of environmental samples

James Swan
Bioanalytical chemistry: Mass Spectrometry of Peptides

Berhane Temelso
Structural biochemistry, computational chemistry

Eric Tillman
Synthesis and characterization of macromolecules possessing interesting photophysical or electronic properties

Brian Williams
Synthesis and spectroscopic characterization of solvent sensitive materials; photophysical processes; molecular modeling

Geology

Christopher Daniel
The interaction of metamorphic, plutonic and deformational processes in the lower crust; 3-D visualizations and interpretations of metamorphic minerals, compositional zoning and deformational fabrics; Crustal evolution of the southwest U.S., New England and the Himalayas.

Mary Beth Gray
Progressive deformation in fold and thrust belts; Central Appalachian tectonics.

Ellen Herman
Karst hydrology; sediment transport in karst aquifers; subsurface fluid flow.

Robert Jacob
Non-invasive monitoring of subsurface hydrology in the unsaturated zone and comparison to hydrodynamic models of unsaturated zone flow; Applying signal-processing techniques to remotely-sensed data; Seismic refraction for bedrock delineation; Using geophysical methods to investigate environmental sites and direct invasive activities.

Carl Kirby
Acid mine drainage (AMD); iron oxidation kinetics; AMD sediment chemistry and comparison to pigment; AMD treatment; net alkalinity and net acidity; aeration to increase AMD treatment efficiency; impact of geology on neutralization of acid precipitation in headwater streams and brook trout.
**R. Craig Kochel**  
Appalachian debris fans; Virginia Barrier Islands; Geomorphology of Mars.

**Jeffrey Trop**  
Tectonics and sedimentation of forearc, fold-thrust, and strike-slip orogens; Physical sedimentology and petrology of clastic deposystems; Origin and evolution of sedimentary basins along accretionary convergent plate margins.

**Kaustubh Patwardhan**  
Magma dynamics and crystallization, silicic-mafic magma interaction and its implications for magmatic evolution.

**Mathematics**

**Carmen Acuña**  
Statistics, Stochastic Processes, Image Processing

**Greg Adams**  
Operator Theory

**Jodi Black**  
Galois Cohomology

**KB Boomer**  
Applied Statistics, General Linear Mixed Models, Missing Data

**John Bourke**  
Mathematical Logic

**M. Lynn Breyfogle**  
Elementary and Secondary School Mathematics Education, Professional Development for Mathematics Teachers, Verbal Discourse

**Peter Brooksbank**  
Computational Algebra, Group Theory, and Combinatorics.

**Tom Cassidy**  
Noncommutative Ring Theory, Noncommutative Algebraic Geometry, Mathematical Demography

**Ulrich Daepp**  
Algebraic Geometry: Monomial curves and number of generators  
Commutative Algebra: Local rings arising from geometric situations

**Emily Dryden**  
Spectral Geometry, Riemannian Geometry
George Exner  
Operator Theory, Mathematical Cognition

Gabrielle Flynt  
Statistics, Missing Data

Michael Frey  
Quantum Information Theory, Statistics

Sharon Garthwaite  
Number Theory, Partitions, Modular Forms

Pamela Gorkin  
Function-Theoretic Operator Theory

James Hutton  
Probability, Quasi-likelihood, Martingales

Paul McGuire  
Functional Analysis, Operator Theory, Reproducing Kernels

Peter McNamara  
Algebraic Combinatorics

Amy Miko-Donner  
Probability, Statistics, and Operations Research

Christopher Phan  
Noncommutative Ring Theory

Adam Piggott  
Group Theory

Alex Rice  
Commutative algebra and combinatorial commutative algebra

Nathan Ryan  
Computational Number Theory, Modular Forms

Howard Smith  
Group Theory

Linda Smolka  
Fluid Mechanics, Mathematical Modeling, Applied Mathematics

Karl Voss  
Applied Mathematics, Partial Differential Equations
Stephen Wang
Geometric Group Theory, Lie Groups

Constance Ziemian
Process Modeling and Optimization, Manufacturing Effects on Material Properties

Physics

Katelyn Allers
Low-mass stars and brown dwarfs, star and planet formation

Jeff Bowen
Gravitation, general relativity, black holes

Jack Gallimore
Active galactic nuclei, very long baseline interferometry (VLBI)

James Higbie
Experimental atomic physics

Sally Koutsoliotas
Experimental particle physics, neutrino physics

Ned Ladd
Astronomy, star formation, and molecular cloud physics

Martin Ligare
Quantum optics, optical pumping, geometric phases

David Schoepf
Low energy positron beams, positronium, surface physics

Tom Solomon
Dynamical systems: chaos, turbulence, and pattern formation

Michele Thornley
Astronomy: molecular gas, star formation, and dynamics in nearby galaxies

Ben Vollmayr-Lee
Theoretical condensed matter physics, non-equilibrium statistical physics

Katharina Vollmayr-Lee
Theoretical condensed matter physics, computer simulations