Summer 2009
Neuroscience Research

Regulation of Life-long Neurogenesis Barbara Beltz
New neurons are born throughout life in the brains of many organisms, including humans. My laboratory's primary focus is understanding the sequence of events that leads to the production of new nerve cells and the regulatory events that influence this process. We have identified the precursor (stem) cells that produce the newneurons, the migratory pathway followed by the newborn cells, and the timing of neuronal differentiation. Using the crustacean brain as our experimental model, we are testing how environmental (e.g., day-night cycle; tides; diet), behavioral (locomotion; social interaction) and endogenous (hormones; serotonin; melatonin; electrical activity in the brain) signals result in the selective activation of neuronal and molecular pathways controlling neuronal birth, migration, differentiation and apoptosis. Students are involved in all phases of this work, which can involve immunocytochemical, electrophysiological and behavioral methods. Specific research projects are planned in consultation with each student to insure that the student's interests as well as the lab's goals are addressed.

Mechanisms of Visual Perception Bevil Conway
The Conway lab uses a variety of techniques to address the neural mechanism of visual perception. We are using psychophysical tests in humans, squirrels and macaque monkeys to determine the visual acuity and behavioral salience of different visual stimuli, along with neurophysiological recording, anatomical tract tracing, computational modeling, and functional brain imaging to tease apart the neural machinery and mechanism for vision. In addition, we are investigating the ways in which art and artistic practice may inform our understanding of brain function; and vice versa, if, and if so how, an understanding of brain function may inform our

understanding, appreciation, and practice of art.

Hormone Action in Brain Marc Tetel
Steroid hormones act throughout the body to regulate development, growth and reproduction. Our lab is interested in how the ovarian steroid hormones, estradiol and progesterone, act in brain to regulate gene expression and female reproductive behavior in rodents. Estradiol and progesterone elicit many of their biological effects by binding to their intracellular receptors, ER and PR respectively, located in specific brain regions. These receptors are members of a nuclear receptor superfamily of transcriptional activators. The transcriptional activity of ER and PR has been found to be dramatically enhanced by nuclear receptor coactivators. Our lab is exploring how these coactivators function with steroid receptors in brain to activate behaviorally-relevant genes. We have found that nuclear receptor coactivator action in behaviorally-relevant brain regions is critical for the expression of estrogen-responsive genes and the display of hormone-dependent female reproductive behaviors. More recently, we have been using protein-protein interaction assays to explore if coactivators from brain physically interact with steroid receptors isoforms. Taken together, our findings provide mechanisms by which steroid receptor action can be modulated in specific brain regions to influence a variety of hormone-dependent behaviors and functions. One goal of our future research is to use a proteomics-based approach to identify novel coactivators and other proteins that function in the hormone-receptor complex in brain. By enhancing our knowledge of steroid action in brain, we may better understand how steroid hormones influence disorders such as depression and Alzheimer's disease.

Neural correlates of sensory perception Mike Wiest
I'm interested in the physical basis of consciousness. What is it about the matter in a living brain that makes it experience perceptions, feelings, and thoughts? A first step in the

neuroscientific approach to this perplexing question is to relate the activities of neurons to different mental states. Because we can only infer mental states in rats from their behavior, I use arrays of micro-wire electrodes to record neural activities while they perform behavioral tasks that depend on correctly sensing various stimuli. My research has focused on sensory integration in the brain area that represents the rat's facial whiskers. The goal is to understand how multiple sensory inputs get combined into a single coherent perception, and how such sensory processing can be altered according to a rat's changing goals in different behavioral tasks. Understanding these mechanisms could lead to insights into human disorders that disrupt normal perceptual integration, such as Alzheimer's disease, dyslexia, or attention deficit disorder.