Neuroscience Department

Neuroscience is an interdisciplinary field that studies brain function and behavior. As an interdisciplinary endeavor, it integrates knowledge physiology, molecular biology, pharmacology, medicine, psychiatry, cognitive science, psychology, philosophy, and computer science to achieve a better understanding of how the brain works and how it makes behavior and consciousness possible.

During the last 30 years, neuroscience has been one of the fastest growing and most exciting areas in science. Over 30,000 Ph.D. and M.D. trained neuroscientists now work in the field in the United States. Oberlin College was one of the first undergraduate institutions in the country to recognize the importance of this growing field, first offering an undergraduate major in neuroscience in 1972. Oberlin's Neuroscience Department is seen by many as one of the model undergraduate programs of its kind in the country, as indicated by its recent recognition as a "Program That Works" by Project Kaleidoscope, a National Science Foundation supported group interested in the improvement and reform of science education.

The department is staffed by seven Ph.D. neuroscientists. All faculty are engaged in research and students are actively involved in that research. Grants from the National Science Foundation or the National Institutes of Health support the work of many of the faculty. Currently, our scientists are conducting research that examines the neuroprotective effects of exercise in Parkinson's disease, the neuroendocrine control of reproductive behavior and learning and memory, the neural mechanisms of decision making, the evolution of the vertebrate forebrain, the neuroanatomy of the lateral line and auditory systems, the biology of learning, and the cellular and molecular mechanisms regulating development of the auditory system.

The facilities available to the department are unrivaled by most other undergraduate science programs. The Oberlin College Science Center, completed in 2002, houses state-of-the-art teaching and research labs, classrooms, and office and research space for the faculty and students. With the help of several private foundations and grants from the federal government, the department has purchased a wide array of research equipment that enables both the faculty and students to conduct significant research in areas such as neuroanatomy, neuropharmacology, neurochemistry, molecular neurobiology, biophysics, and behavior.

The Neuroscience Department emphasizes training in several traditional scientific disciplines (biology, chemistry, psychology) as the basis for advanced study in neuroscience. The major is unique in the sciences in that it emphasizes an interdisciplinary scientific focus rather than training in a single traditional scientific discipline, and it attempts to demonstrate how data and ideas in different areas can interact synergistically to enrich scientific understanding. In addition to general course work in the sciences, a wide range of courses with specific neuroscience content are also offered, including: introductory neuroscience, neurophysiology, neuropharmacology, neuroanatomy, neuroendocrinology, behavioral neuroscience, animal behavior, developmental neurobiology, molecular neurobiology, computational neuroscience, and psychophysiology. The department currently serves approximately 60 majors.

In developing its curriculum, Oberlin's Neuroscience Department has attempted to develop course offerings that are rigorous, diverse, and timely, and which emphasize direct experience in the laboratory. Since laboratory and research experiences are critical features of the learning experience in science, we offer laboratory and research opportunities that involve our students in problems, methodologies, and technical approaches that are representative of current research in the neurosciences. Students are exposed to research in laboratory courses, in the Honors Program, and through the many opportunities available to students to work directly with faculty on their research during the school year, Winter Term, and/or summer. Since Oberlin has no graduate students, undergraduates have the opportunity for hands-on research experiences that would normally not be available to undergraduates at larger universities.

Oberlin has a strong history of producing graduates who do exceptionally well in the sciences. Recent Oberlin neuroscience majors were winners of Goldwater Science

Fellowships, National Science Foundation pre-doctoral fellowships, and the Marshall Fellowship. Oberlin also continues to lead all primarily undergraduate institutions in the number of its graduates who go on to receive their Ph.D. in science. A third indication of Oberlin's success in training future scientists is the unusually large number of prominent neuroscientists who have received their undergraduate degrees at Oberlin. For instance, among the school's graduates is Roger Sperry, who received the Nobel Prize in Medicine for his neuropsychological work on "split-brain" patients. Other graduates, including Larry Squire, Robert Wurtz, and Bruce McEwen, were past presidents of the Society for Neuroscience. Consistent with this history of achievement, we find that the majority of students who become neuroscience majors have aspirations of ultimately continuing their education after graduating from Oberlin. Many students choose to go on to careers in research and teaching in neuroscience or in related scientific areas. Approximately 30-40% of the department's graduates enter medical school after graduation. Although our surveys show that 75% of our graduates eventually end up working in biomedical fields, others have gone on to work as psychologists, lawyers, educators, scientific writers, or in other fields. Neuroscience is an area that provides students with a strong foundation for a number of career options.

NEUROSCIENCE DEPARTMENT FACULTY

LYNNE M. BIANCHI
Ph.D. 1994, State University of New York at Buffalo. David H. and Margaret W. Barker, Associate Professor of Neuroscience. Teaching Interests: Introductory Neuroscience, Developmental Neurobiology, Molecular Neuroscience, Sensory Systems. Research Interests: How factors influence the development of the inner ear and the nerve fibers that innervate the ear. In two of her current research projects, Dr. Bianchi and her students are using cell culture combined with molecular and cellular techniques to study specific factors that regulate growth of nerve fibers and patterning of the inner ear. These basic studies on the development of the ear may give us new insights into therapeutics to prevent or repair hearing loss.

ALBERT BORRONI
Ph.D. 1992, Northeastern Ohio College of Medicine. Lecturer in Neuroscience and Computer Science. Teaching Interests: The Neurobiology of Learning and Memory. Mind and Machine. Dr. Borroni's research focuses on understanding learning and memory. He uses pharmacological, behavioral, and computer simulation techniques to help explain the physiological and computational processes that account for memory.

MARK BRAFORD, JR.
Ph.D. 1971, Case Western Reserve University. Professor of Biology and Neuroscience. Teaching Interests: Neuroanatomy, Introductory Neuroscience, Neurobiology of the Mind, Evolution of Brain and Behavior. Research Interests: Organization and evolution of the vertebrate nervous system. Using anatomical methods, Dr. Braford studies brain organization in different animals and interprets the results in a comparative and evolutionary context. In recent work on the organization of the forebrain, he has studied the extent to which non-mammalian vertebrates, particularly fishes, have evolved their own specialized patterns of forebrain organization and the extent to which they possess brain structures that are homologous to the mammalian neocortex, basal ganglia, and limbic structures.

MICHAEL D. LOOSE
Ph.D. 1986, University of Wisconsin. Associate Professor of Neuroscience. Teaching Interests: Cellular Neurophysiology, Neural Circuits and Cognitive Function. Research Interests: Decoding neural activity during human decision-making using EEG and computer modeling of neural circuits. Dr. Loose and his student collaborators use EEG signals recorded from human participants making rapid decisions to examine how various factors, including probability, reward, and personality, affect cortical circuits underlying decision-making. In parallel with the EEG experiments, the lab employs computational modeling of neural circuits in the frontal cortex to simulate how neurons might accomplish similar high level cognitive processing.

CATHERINE A. MCCORMICK

Ph.D. 1978, University of Michigan. Professor of Biology. Teaching Interests: Introductory Biology, Vertebrate Biology, Neuroanatomy, Animal Behavior. Research Interests: Evolution and anatomy of the vertebrate auditory and lateral line systems. Dr. McCormick studies sensory systems. She is particularly interested in sensory systems that utilize hair cells (or modified hair cells) as receptors: the mechanosensory and electrosensory lateral line systems and the auditory and vestibular systems. A question of major importance in her work is to discover the extent to which specialized modifications in these systems in the periphery (such as additions, losses, changes in size or in function) are reflected in the organization of the central nervous system.

DENNISON A. SMITH

Ph.D. 1970, University of Massachusetts. Norman D. Henderson Professor of Neuroscience and Psychology. Teaching Interests: Neuropharmacology, Human Neurobiology, Mind, Brain and Behavior. Research Interests: Neuropharmacology of synaptic plasticity, learning and memory. The neuroprotective effects of exercise in Parkinson's Disease. The synaptic plasticity research in Dr. Smith's lab is directed at obtaining a better understanding of the cellular and neurochemical events that account for long-term changes in communication at synapses and their contributions to memory. His lab uses slice preparations along with electrophysiological and neuro-pharmacological techniques to assess changes in synaptic plasticity and brain chemistry that may be responsible for long-term alterations in synaptic transmission. Smith's research also explores the neuroprotective aspects of exercise in an animal model of Parkinson's disease.

JANICE THORNTON

Ph.D. 1983, University of Wisconsin. Associate Professor of Neuroscience and Biology. Teaching Interests: Behavioral Endocrinology, Neuro-endocrinology, Cell and Molecular Biology, Behavioral Neuroscience, Experimental Methods. Research Interests: Effects of hormones on the brain, hormonal control of reproduction, effects of hormones on learning and memory, sex differences and behavior. In her research, Dr. Thornton uses a variety of techniques and levels of analysis, from behavioral to molecular, to examine how hormones exert their effects on the brain. Currently, her lab is using an animal model to examine the effects of gonadal hormones on spatial memory and hippocampal plasticity.

SAMPLES OF RECENT FACULTY/STUDENT PUBLICATIONS AND PRESENTATIONS

(STUDENT AUTHORS INDICATED BY *)

Alla, J.*, Kralik, K*., Romeo R, McEwen B, and **Thornton**, JE. (2006). Androgen modulation of spatial learning and memory in male rats. Society for Behavioral Neuroendocrinology.

Berry A*, Tomidokoro Y, Ghiso J, and **Thornton** J, (2006). Human Chorionic Gonadotropin (a Luteinizing Hormone homologue) decreases learning and increases brain amyloid-ß levels in female rats. Society for Neuroscience.

Bianchi,, LM, *Dinsio, K, *Davoli, K and Gale, NW (2002). LacZ histochemistry and immunochemistry reveal ephrin-B ligand expression in the inner ear. J Histochem Cytochem. 50, 1641-1645.

Bianchi, LM, *Daruwalla, Z, Roth, T.M., Attia, N., Lukacs, N.W. *Richards, A-L , Roth, TM, Lukacs, NW, *White, IO, Allen, SJ and Barald, KF (2005) Immortalized Mouse Inner Ear Cell Lines Reveal a Role for Chemokines in Promoting the Growth of Developing Statoacoustic Ganglion Neurons, JARO 6, 355-367.

Bianchi, L.M., *Huri, D., and *White, I.O. (2006) Embryonic inner ear cells use migratory mechanisms to establish cell patterns in vitro. J Neuro Res 83:191-198

Braford, Jr. M, McCormick, CA, and Saidel, WM (2006) The lateral line system of Typhlonectes and other adult gymnophionan amphibians. Brain, Behav. Evol., In Press.

Getzin A*, White I*, Bartlett M*, **Braford** M, Wallen K, and **Thornton** JE (2006). Sexual dimorphism in the medial preoptic nucleus of the guinea pig brain is not due to prenatal estrogen. Soc. for Neuroscience.

Hoffman, AF, Macgill, AM, **Smith** D, Oz M, and Lupica, CR (2005) Species and strain differences in the expression of a novel glutamate-modulating cannabinoid receptor in the rodent hippocampus. European Journal of Neuroscience 22: 2387-2391.

McCormick, CA (2002) Variations on a Vertebrate Theme: Central Anatomy of the Auditory System in Fish. Bioacoustics 12: 134-137.

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Romeo, RD., Staub, D*., Jasnow, AM Karatsoreos, IN, **Thornton**, JE and McEwen, BS. (2005). Dihydrotestosterone increases hippocampal N-methyl-D-Aspartate binding but does not affect choline acetyltransferase cell number in the forebrain or choline transporter levels in the CA1 region of adult male rats. Endocrinology, 146: 2091-2097.

Wallace*, AC and **McCormick** CA 2005. Otolith endorgan input to auditory projection in neurons in the goldfish: A confocal microscopic analysis. Soc. for Neuroscience.

Woodside, BL, **Borroni**, AM Hanndons, MD Teyler, TJ (2004) NMDA receptors and voltage-dependent calcium channels mediate different aspects of acquisition and retention of a spatial memory task. Neurobiology of Learning and Memory, 81:105-114

Loose, M, Jakaitis*, R, Wheat*, E and Porterfiled, A (2005) Modifying the Probability of a Go Stimulus Prior to each Stimulus Presentation Alters the N2 Component of Event-Related Potentials. Soc. for Neuroscience.

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