

CURRICULUM VITAE

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UNDERGRADUATE EDUCATION:

University of North Carolina Chapel Hill, NC., Chemistry, 1984

GRADUATE STUDY:

Department of Pharmacology, Quillen College of Medicine, East Tennessee State University, Johnson City, TN, 1984-1985.

Department of Physiology and Pharmacology, 1985-1992, Bowman Gray School of School of Medicine, Wake Forest University, Winston-Salem, NC. Ph.D. Pharmacology and Physiology, May 1992.

SCHOLASTIC AND PROFESSIONAL TRAINING

Laboratory Technician, Department of Anesthesiology, UNC School of Medicine, Chapel Hill, NC, 1976-1980 (summers). Measurement of plasma catecholamines by radioenzymatic assay and TRH levels by RIA in stress and ethanol treated animals. General Laboratory duties. Supervisor: Dr. Robert A. Mueller.

Electronic Technician, Department of Psychiatry, Biomedical Engineering, UNC School of Medicine, Chapel Hill, NC, 1980-1984. Assisted in the development of a portable computer-based blood pressure monitoring device and was subsequently named as a co-inventor on the original patent application. Fabrication of electronic devices, analog and digital circuit board layout, programming, assembly, and debugging of completed devices. Supervisors: Dr. Paul Obrist and Mr. Stanford Hutchinson.

Teaching Assistant, Department of Chemistry, East Tennessee State University, Johnson City, TN, 1984-1985. Supervised 3 general chemistry laboratories per semester. Undergraduate teaching supervisor: Dr. Thomas Haug.

Graduate Assistant, Department of Pharmacology, Quillen College of Medicine, East Tennessee State University, Johnson City, TN, 1985. Graduate advisor: Dr. Richard Kostrzewa.

Graduate Assistant, Department of Physiology and Pharmacology, Bowman Gray School of Medicine, Wake Forest University, Winston-Salem, NC, 1985-1992. Under the direction of Dr. Sam Deadwyler, performed electrophysiological analysis of neuronal firing and evoked potentials in the hippocampus of awake behaving animals. Studies included effects of chronic Δ^9 -tetrahydrocannabinol (THC) treatment, and aging on behavior and brain electrical activity. Performed studies on hippocampal 'place cells' (CA1 pyramidal cells) involving the isolation and behavioral manipulation of place cell activity, and analysis of the factors which control in-field firing. Techniques utilized include acute and chronic *in vivo* electrophysiological recording, behavioral testing, small animal surgery, computer-based data and statistical analysis, programming (machine language, FORTRAN, and BASIC), and training of laboratory personnel. (1985-1989)

Under the direction of my graduate thesis advisor, Dr. William Sonntag, completed or assisted in studies on the effects of aging on plasma and hepatic IGF-1 and IGF-binding proteins, and brain *c-fos* expression. Thesis studies examined the effect of prenatal ethanol exposure on the regulation of IGF-1, IGF-2, IGF-binding proteins, and growth hormone in periphery and CNS, and their relationship to the post-natal growth and mental retardation observed in fetal alcohol syndrome. Techniques included western ligand blotting, radioimmunoassay and radioreceptor assays, receptor autoradiography, RNA isolation, and *in situ*, northern, and dot-blot hybridization. (1989-1992)

Postdoctoral Fellow, Departments of Pharmacology and Psychiatry, University of Colorado Health Sciences Center, Denver, CO 1992-1996. Utilized western blotting techniques to examine protein expression of glutamate receptor subtypes in human postmortem brain and the changes in these receptor subtypes in alcoholism and schizophrenia. Examined the temporal and cellular expression of neuronal growth factors and their receptors in the CNS following MPTP, mechanical, and cytotoxic lesions. Techniques utilized include postmortem brain collection, characterization and management, western blotting protocols, cloning of PCR products, cDNA and cRNA probe preparation, PCR techniques, *in situ* hybridization, and other basic molecular biology techniques. Assisted in graduate lecture/laboratory course in molecular biology techniques and supervised laboratory technicians and graduate students. Advisors: Dr. Sherry Leonard and Dr. Robert Freedman.

Faculty Instructor, Department of Psychiatry, University of Colorado Health Sciences Center, Denver, CO 1996-1998. Utilized molecular biology and homogenate binding techniques to examine protein and gene expression of the neuronal nicotinic and NMDA receptor subtypes in human postmortem brain. Studies included the examination of nicotinic receptor subtypes in nicotine addiction and schizophrenia, including gene mutation screening of schizophrenic patients. Examination of the role of chronic neuroleptic treatment in the expression and regulation of the neuronal nicotinic receptors. Examination of distribution of nicotinic receptor subtypes in tissues of neural crest origin and continuation of studies on the temporal and cellular expression of neuronal growth factors and their receptors in the CNS following brain injury. Received FIRST award (NIAAA # AA11164) to examine fetal alcohol and nicotine exposure on the growth and mental deficits observed in alcohol-exposed offspring. Techniques utilized including those listed above include ligand binding assays, differential display, ribonuclease protection assay, sequencing and general molecular biology techniques. Also served as co-instructor in graduate lecture/laboratory course in molecular biology techniques and direct supervision of laboratory technicians and graduate students.

Adjunct Instructor, Department of Psychology, Neurosciences Program, Regis University, Denver, CO Spring Semester 1998. Course coordinator of Neuroscience Seminar course for advanced neuroscience majors on traumatic brain injury and the recovery of function. Program Director: Dr. Eugene Delay.

Assistant Professor, Auburn University School of Pharmacy, Department of Pharmacal Sciences, Pharmacology Division, Auburn University, AL, 1998-2003. See *Description of Scholarly Program, Teaching philosophy, and Course Teaching* for more information.

Associate Professor, Auburn University School of Pharmacy, Department of Pharmacal Sciences, Pharmacology Division, Auburn University, AL, 2003-2006. See *Description of Scholarly Program, Teaching philosophy, and Course Teaching* for more information.

Professor and Chair of Pharmaceutical, Social, and Administrative Sciences, University of Appalachia College of Pharmacy, Department of Pharmaceutical, Social, and administrative Sciences, Grundy and Oakwood, VA. See *Description of Scholarly Program, Teaching philosophy, and Course Teaching* for more information.

PROFESSIONAL DUTIES AND COMMITTEES:

Ad hoc grant reviewer for American Institute of Biological Sciences, Department of Defense Congressional Interest Research on Health-Related Topics peer review panel. 1998-1999.

Grant reviewer for American Institute of Biological Sciences, Department of Defense Congressional Interest Research on Health-Related Topics peer review panel. 1999-2000.

Ad hoc grant reviewer, American Alzheimer's Association, 2003.

Manuscript *ad hoc* reviewer for Neuroscience, Experimental Neurology, Alcoholism: Clinical and Experimental Research, Brain Research, Science, Brain Research Bulletin, Life Sciences, Pharmacology Research, Nicotine & Tobacco Research.

Colorado Health Sciences Center and the Denver Veterans Affairs Administration

Animal Studies Subcommittee for Animal Welfare, Denver Veterans Affairs Administration, Research Division, 1996-1998.

Auburn University Committees:

Creative research awards selection committee, Office of the Vice President for Research, 1999-2003.

Policy development committee for biological agents and pathogens (*ad hoc*), Office of the Vice President for Research, 1999-2002.

Grant-in-aid Review Committee, Office of the Vice President for Research, 2001-2004.

Basic Sciences subcommittee Chair 2003-2004

Institutional Biosafety Committee (Committee Chair 2004-2006), Office of the Executive Vice President, 2003-2006.

Biogrant Review Committee, Office of the Vice President for Research, 2005-present.

Advisory Committee for a Drug-Free Campus and Workplace, Office of the Vice President for Student Affairs (2005-2006).

Auburn University School of Pharmacy / Department of Pharmacal Sciences committees:

Annual outcomes assessment committee, 1998-1999.

Faculty search committee for pharmaceuticals (2 positions), 1999.

Faculty search committee for Pharmacology (2 positions), 2000.

Faculty search committee for Pharmacology (2 positions), 2001-2002.

Curriculum and annual outcomes assessment committee, 1999-2002.

Professional Education Committee, 2002-2005

Subcommittee: Third Professional year (P3) 2002-2005

Pharmacokinetics Assessment subcommittee (chair) 2002-2003

"Drugs and Disease-2" course development committee (chair) 2005-2006

"Drugs and Disease-3" course development committee 2005-2006

Faculty Development Committee, 2001-2005.

Ad Hoc Combined Pharm.D./Ph.D./MBA Programs developmental committee, 2001-2006.

Faculty search committee, associate dean for research, 2004-2006

University of Appalachia College of Pharmacy committees:

Curriculum committee (co-chair), 2006-present.

GRANT SUPPORT (Previous and Active)

NIAAA 1 F31 AA05315-01, 'Effects of ethanol on IGF-1 regulation in fetal alcohol syndrome.' NRSA, pre-doctoral fellowship, 7/15/91-12/31/91.

NIAAA 5 T32 AA07464-17, 'Behavioral pharmacogenetics of drug and alcohol abuse.' Institutional NRSA, Department of Pharmacology, post-doctoral fellowship, 12/31/91-12/31/94.

NIAAA 1R29 AA11164, 'Fetal alcohol and nicotine-induced growth retardation.' FIRST Award, 10/1/96-9/30/01.

National Alliance for Research on Schizophrenia and Depression (NARSAD), Young Investigators Award. 'High affinity nicotinic receptor regulation, smoking, and the mentally ill.' 8/1/98-12/30/00.

Philip Morris External Research Program, "Assessment of the developmental teratogenicity of nicotine: Pharmacological intervention by nootropic drugs." 06/01/03-05/31/06.

Intramural Grants

Auburn University Biogrants, 'Role of Glutamatergic function on nicotinic receptor regulation', 05/01/01-07/30/03.

Auburn University Biogrants, Co-investigator (Principal Investigator: Vishnu Suppiramaniam), "Induction of lysosomal dysfunction in hippocampal neurons: A model to investigate Alzheimer disease". 05/01/02-04/30/04.

Graduate Student Advisor and Committees

University of Colorado Health Sciences Center, Denver, CO:

- ***Graduate Students Supervised:***

Amber Buhler, UCHSC, Department of Pharmacology (rotation student), 1997.
Michael Lee, UCHSC, Neuroscience Program (Ph.D. candidate), 1996-1998.

- ***International Exchange Students:***

Keiron Gillen, Department of Biology, University of Bath, Great Britain, International exchange student, 1996-1997.

Auburn University School of Pharmacy:

- ***Master' Degree Students:***

Usha Narayanan (major advisor): *Effect of prenatal and postnatal alcohol and nicotine exposure on the regulation of insulin-like growth factor-1 and the high affinity neuronal nicotinic receptors.* Graduated, 2001.

Zhan Wang (Vicki) (committee member), *Potentiation and inhibition of glutamate (AMPA) receptors: a dual role for benzamide molecules.* Graduated Summer 2002.

Veena Pujari (committee), *Poly (lactide-co-glycolide) surfaces: the effect of surface modifications on microsphere interfacial properties.* Graduated Fall 2004

- ***Ph.D. Student Committees:***

Sanjay Birru (major advisor), *Effect of reduced NMDA receptor function on expression and function of neuronal nicotinic receptors: theoretical implications for schizophrenia*. graduated, Fall 2004

Ed Bell (committee member), *The Effects of St. John's Wort on the Pharmacokinetics of Corticosteroid and Non-steroidal Drug Preparations*. Graduated, Spring 2005

Thirumalini Subramaniam (committee member), *Glutamate receptor dysfunction in streptozotocin (STZ) diabetes rats*. graduated, Spring 2005

Patrick Kanju (committee member), *Synaptic glutamate receptor dysfunction in tissue and animal models of Alzheimer's disease*. graduated, Spring 2005

Bessy Thrash (co-major advisor)

Kuruppu N. Wijayawardhane (co-major advisor)

Kodeeswaran Parameshwaran (committee member)

Catrina M. Sims (committee member)

Sandipta Talukdar, Madhu Sanga, (Rotational Students)

- **Post-doctoral, research fellows and research assistant professors supervised:**
Julia Vaglenova, Post-doctoral Fellow (2000-2001), Research fellow (2001-2003), and Research Assistant Professor (2003-present). Behavioral pharmacology of fetal drug exposure.
- **International Exchange Students:**
Noemi Munyoz Pandiella, Autonomous University of Barcelona, Summer International Students and Scholar Program, 2002.

AWARDS and HONORS

Young Investigators Travel Award, Fifth International Congress on Schizophrenia Research, Warm Springs, Virginia, April 8-12, 1995.

NARSAD Research 11th Annual Scientific Symposium, "Schizophrenia, Smoking, and neuronal nicotinic receptors." Invited presentation to NARSAD contributors and Board of directors. October 13-14, 1999, Le Parker Meridien Penthouse, New York, NY.

Student Government Association (SGA) Outstanding Faculty Member award, Auburn University Harrison School of Pharmacy, 2001-2002.

PUBLICATIONS IN JOURNALS AND BOOK CHAPTERS

Breese, C.R., Hampson, R.E., Deadwyler, S.A. Hippocampal place cells: stereotypy and plasticity. *J. Neuroscience*, 9:1097-1111, 1989.

Deadwyler, S.A., Breese, C.R., Hampson, R.E. Factors controlling place cell activity in an open field. *Psychobiology*, 17:221-227, 1989.

Breese, C.R., Boyd, R.L., Sonntag, W.E. Influence of aging and dietary restriction on the regulation of plasma insulin-like growth factor-1 (IGF-1), IGF gene expression, and IGF-1 binding proteins. *J. Gerontology*, 46:B180-187, 1991.

D'Costa, A., Breese, C.R., Boyd, R.L., Booze, R.M. Sonntag, W.E. Attenuation of FOS-like immunoreactivity induced by a single electroconvulsive shock in brains of aging mice. *Brain Research*, 567:204-211, 1991.

- Breese, C.R., D'Costa, A., Boyd, R.L., Lenham, J.E., Sonntag, W.E.** Long term suppression of insulin-like growth factor-1 in rats following *in utero* ethanol exposure: relationship to somatic growth. *J. Pharmacology and Experimental Therapeutics*, 264:448-456, 1993.
- Breese, C.R., Leonard S.** Glutamate receptor subtype expression in human postmortem brain. *J. Molecular Neuroscience* 4:263-275, 1994.
- Breese, C.R., D'Costa, A., Sonntag, W.E.** Effect of ethanol on the postnatal ontogeny of insulin-like growth factor-1 (IGF-1) mRNA, IGF-1 and IGF-2 receptor autoradiography, and IGF-1 and IGF-2 receptor mRNA localization in the rat brain. *Neuroscience* 63:579-589, 1994.
- Breese, C.R., Freedman, R., Leonard S.** Glutamate receptor subtype expression in human postmortem brain tissue from schizophrenics and alcohol abusers. *Brain Research* 674:82-90, 1995.
- Breese, C.R., D'Costa, A., Sonntag, W.E.** Effect of ethanol on plasma and hepatic insulin-like growth factor regulation in the pregnant rat. *Alcoholism: Clinical and Experimental Research* 19:867-873, 1995.
- Breese, C.R., D'Costa, A., Rollins, Y., Adams, C.E., Booze, R.M., Sonntag, W.E., Leonard S.S.** Expression of insulin-like growth factor-1 (IGF-1) and IGF binding protein 2 (IGF-BP2) in the hippocampus following cytotoxic lesion of the dentate gyrus. *J. Comparative Neurology* 369:388-404, 1996.
- Leonard, S., Adams, C., Breese, C., Adler, L.E., Bickford, P., Byerly, W., Coon, H., Griffith, J.M., Miller, C., Myles-Worsley, M., Nagamoto, H.T., Rollins, Y., Rose, G., Waldo, M., Freedman, R.** Nicotinic receptor function in schizophrenia. *Schizophrenia Bulletin* 22:431-445, 1996.
- Breese, C.R., Rollins, Y.D., Adams, C.E., Logel, J., Drebing, C., Freedman, R., Leonard, S.S.** Regional expression of the glutamate receptor subtypes GluR1, GluR2, and GluR3 in human postmortem brain. *J. Molecular Neuroscience* 7:277-289, 1996.
- Freedman, R., Coon, H., Myles-Worsley, M., Orr-Urtreger, A., Olincy, A., Davis, A., Polymeropoulos, M., Holik, J., Hopkins, J., Hoff, M., Rosenthal, J., Waldo, M.C., Reimherr, F., Wender, P., Yaw, J., Young, D.A., Breese, C.R., Adams, C.E., Patterson, D., Adler, L.E., Kruglyak, L., Leonard, S., Bylerley, W.** Linkage of a neurophysiological deficit in schizophrenia to a chromosome 15 locus. *Proceedings of the National Academy of Sciences USA* 94:587-592, 1997.
- Breese, C.R., Marks, M.J., Logel, J., Adams, C.E., Sullivan, B., Collins, A.C., Leonard, S.** Effect of smoking history on ³H-nicotine binding in human postmortem brain. *J. Pharmacology and Experimental Therapeutics* 282:7-13, 1997.
- Breese, C.R., Adams, C.A., Logel, J., Drebing, C., Rollins, Y., Barnhart, M., Sullivan, B., DeMasters, B.K., Freedman, R., and Leonard, S.** Comparison of the regional expression of the neuronal nicotinic acetylcholine receptor $\alpha 7$ mRNA and α -bungarotoxin (α -BTX) binding in human postmortem brain. *J. Comparative Neurology* 387:385-398, 1997.
- Frazier, J., Rollins, Y., Breese, C.R., Leonard, S., Freedman, R., Dunwiddie, T.** Acetylcholine activates an α -bungarotoxin sensitive nicotinic current in rat hippocampal interneurons, but not pyramidal cells. *J. Neuroscience* 18:1187-1195, 1998.
- Gault, J., Robinson, M., Berger, R., Drebing, C., Logel, J., Hopkins, J., Moore, T., Jacobs, S., Merriwether, J., Choi, M.J., Kim, E.J., Walton, K., Buiting, K., Davis, A., Breese, C., Freedman, R., Leonard, S.** Genomic organization and partial duplication of the human $\alpha 7$ neuronal nicotinic acetylcholine receptor gene. *Genomics* 52:173-185, 1998.
- Leonard, S., Gault, J., Adams, C., Breese, C.R., Rollins, Y., Adler, L.E., Olincy, A., Freedman, R.** Nicotinic receptors, smoking and schizophrenia. *Restorative Neurology and Neuroscience* 12:195-201, 1998.

- Leonard, S., Breese, C.R., Adams, C., Benhammou, K.M., Gault, J., Stevens, S., Lee, M., Adler, L.E., Olincy, A., Ross, R., Freedman, R.** Smoking and Schizophrenia: abnormal nicotinic receptor expression. *Eur. J Pharmacol* 393:237-242, 2000
- McCallum, S.E., Caggiula, A.R., Booth, S., Breese, C.R., Lee, M.J., Donny, E.C., Leonard, S., Sved, A.F.** Mecamylamine prevents tolerance but enhances whole brain [³H]-epibatidine binding in response to repeated nicotine administration in rats. *Psychopharmacology* 150: 1-8, 2000.
- Breese, C.R., Lee, M.J., Adams, C.E., Sullivan, B., Logel, J., Gillen, K.M., Marks, M.J., Collins, A.C., Leonard, S.** Abnormal regulation of high affinity nicotinic receptors in subjects with schizophrenia. *Neuropsychopharmacology* 23:351-364, 2000.
- Lee, M.J., Breese, C.R., Strook, M.L., Leonard, S.** The effect of nicotine and haloperidol co-treatment on high and low affinity nicotinic receptor levels in the rat brain. *Molecular Brain Research* 86:115-124, 2001.
- Leonard, S., Adler, L.E., Benhammou, K., Berger, R., Breese, C.R., Drebing, C., Gault, J., Lee, M.J., Logel, J., Olincy, A., Ross, R.G., Stevens, S., Sullivan, B., Vianzon, R., Virnich, D.E., Waldo, M.C., Walton, K., Freedman, R.** Smoking and mental illness. *Pharmacology, Biochemistry and Behavior* 70:561-570, 2001.
- Narayanan, U., Sanjay, B., Vaglenova, J., Breese, C.R.** Nicotinic receptor expression following nicotine exposure via maternal milk. *Neuro Report* 13: 961-963, 2002.
- Vaglenova, J., Sanjay, B., Pandiella, N.M., Breese, C.R.** An assessment of the long-term developmental and behavioral teratogenicity of prenatal nicotine exposure. *Behavioral Brain Research* 150:159-170, 2004.
- Overstreet, D.H., Criswell, H.E., Breese, C.R., Tizabi, Y., Kranzler, H.R., Rohrbaugh, J.W.** Nicotine-Alcohol Interactions: from the Laboratory to the Clinic and Beyond. *Alcoholism: Clinical and Experimental Research* (*in submission*), 2005.
- Birru, S., Knapp, D., Overstreet, D., Breese, G.R., Vaglenova, J., Breese, C.R.,** MK 801 Neuronal nicotinic receptor expression and gene regulation following chronic nicotine exposure in 6-hydroxydopamine lesioned rats. (*in submission*).
- Vaglenova, J., Sanjay, B., Pandiella, N.M., Breese, C.R.** Effect of chronic nicotine exposure and withdraw in adolescents on learning and memory. (*in submission*).
- Birru, S., Hubbard, J.E., Mayo, T.A., Gustman, T., Narayanan, U., Vaglenova, J., Breese, C.R.,** MK-801 inhibition of nicotine induced upregulation of neuronal nicotinic receptors: theoretical implications for schizophrenia. (*in preparation*).
- Narayanan, U., Birru, S., Vaglenova, J., Breese, C.R.** Effect of fetal alcohol and nicotine exposure on growth and development: role of insulin-like growth factor-1. (*in preparation*).
- Vaglenova, J., Wijayawardhane, K.A.N., Pandiella, N., Vaithianathan, T., Birru, S., Sims, C.M., Clark, C.R., Suppiramaniam, V.D., Breese, C.R.,** Aniracetam modulates synaptic AMPA receptor function and ameliorates the neurobehavioral deficits following prenatal alcohol exposure. (*in preparation*)
- Narayanan, U., Birru, S., Vaglenova, J., Breese, C.R.** Effect of fetal alcohol and nicotine exposure on the ontogeny of nicotinic receptor regulation and developmental reflexes. (*in preparation*).
- Vaglenova, J., Birru, S., Breese, C.R.** Comparison of the behavioral teratogenicity of prenatal alcohol and nicotine exposure: Are the teratogenic effects of prenatal nicotine and ethanol co-exposure similar to those of each drug alone? (*in preparation*).
- Birru, S., Vaglenova, J., Breese, C.R.,** Effect of MK 801 on nicotine-induced tolerance and cognitive behavior in rats. (*in preparation*).
- Wijayawardhane, K.A.N., Vaglenova, J., Vaithianathan, T., Sims, C.M., Pandiella, N., Breese, C.R., Suppiramaniam, V.D.,** K.A.N. Wijayawardhane, J. Vaglenova, T. Vaithianathan, C.M. Sims,

N.M. Pandiella, C.R. Breese, V.D. Suppiramaniam. Glutamatergic synaptic dysfunction in prenatal alcohol exposure. (*in preparation*)

Breese, C.R., Birru, S., Hubbard, J.E., Mayo, T.A., Gustman, T., Narayanan, U., Vaglenova, J. Role of nicotine re-exposure on nicotine-induced tolerance and nicotinic receptor regulation. (*in preparation*).

BOOK CHAPTERS:

Deadwyler, S.A., Heyser, C.J., Michaelis, R., Hampson, R.E., Breese, C.R. Behavioral and electrophysiological effects of delta-9-THC. *Proceedings from the 50th Annual Scientific Meeting of the Committee on Problems of Drug Dependence. National Institute on Drug Abuse Research Monograph Series.* Rockville, MD, 223-233, 1988.

Sonntag, W.E., Boyd, R.E., D'Costa A., Breese, C.R., Influence of ethanol on functional and behavioral characteristics of skeletal muscle. In: *Drug and Alcohol Abuse Reviews: Liver Pathology and Alcohol.* Ed: Ronald R. Watson, Humana Press, Totowa, NJ, 404-423, 1991.

Breese, C.R., D'Costa, A., Booze, R.M., Sonntag, W.E. Distribution of insulin-like growth factor-1 (IGF-1) and 2 (IGF-2) receptors in the hippocampal formation of rats and mice. In: *Molecular Biology and Physiology of Insulin and Insulin-like Growth Factors.* Eds: M.K. Raizada, D. LeRoith, Plenum Press, New York, NY, Adv. Exp. Med. Biol. 293:449-458, 1991.

Breese, C.R., Breese, G.R. The use of neurotoxins to lesion catecholamine-containing neurons to model clinical disorders: approach to define adaptive neural mechanisms and role of neurotrophic factors in brain. In: *Highly Selective Neurotoxins: Basic and Clinical Applications.* Editor: Richard M. Kostrzewa. Humana Press, Totowa, NJ, pages 19-73, 1997.

Leonard, S., Breese, C.R., Gault, J., Adams, C., Rollins, Y., Adler, L.E., Olincy, A., Freedman, R. The role of nicotine and nicotinic receptors in psychopathology. In: *Neuronal nicotinic receptors: pharmacology and therapeutic opportunities.* Editors: S.P. Arneric and J.D. Brioni. John Wiley and Sons, Inc. New York, NY, pages 307-321, 1998.

Knapp, D.J., Breese, C.R., Mueller, R.A., Breese, G.R. Drugs and the Synapse. *Encyclopedia of Life Sciences,* Macmillan Reference Ltd, 1999.

Breese, C.R., Narayanan, U. Effect of chronic nicotine exposure on nicotinic receptor expression in pre-weaning pups and mothers. Society for Neuroscience Press Book Summary, 1999.

Parameshwaran, K., Vaithianathan, T., Kanju, P.M., Pandiella, N.M., Vaglenova, J., Breese, C.R., Suppiramaniam, V. Memory deficits related to prenatal nicotine exposure: role of hippocampal synaptic glutamatergic (AMPA) neurotransmission. Society for Neuroscience Press Book Summary, Washington, DC, 2005.

Wijayawardhane, K.A.N., Vaglenova, J., Vaithianathan, T., Sims, C.M., Pandiella, N., Breese, C.R., Suppiramaniam, V.D.. Prenatal alcohol exposure and glutamatergic synaptic dysfunction. Society for Neuroscience Press Book Summary, Washington, DC, 2005.

Breese, C.R., Parameshwaran, K., Wijayawardhane, K.A.N., Sims, C.M., Thrash, B., Vaglenova, J., Suppiramaniam, V.D.. "The Long-term developmental, behavioral and functional teratogenicity of prenatal nicotine exposure." *Frontiers in Bioscience (In preparation, 2006)*

ABSTRACTS and PRESENTATIONS

Breese, C.R., Hampson, R.E., Deadwyler, S.A. Direction contingent firing of hippocampal place cells. *Neurosci. Abs.* 173.6, 1987.

Breese, C.R., Hampson, R.E., Deadwyler, S.A. Significance of spatial location determine the firing characteristics of rat hippocampal place cells. *Neurosci. Abs.* 51.1, 1988.

- Hampson, R.E., Breese, C.R., Deadwyler, S.A.** In search of the "Oddball": Cognitive processing of stimulus sequence in the rat hippocampus. *Neurosci. Abs.* 405.19, 1988.
- Heyser, C.J., Breese, C.R., Hampson, R.E., Deadwyler, S.A.** Effects of delta-9-THC on signal detection and delayed matching to sample performance in rats. *Neurosci. Abs.* 410.10, 1988.
- Hampson, R.E., Willis III, H.H., Breese, C.R. Deadwyler, S.A.** Tone evoked potentials indicate differential processing of sensory information in the rat hippocampus and neocortex. *Neurosci. Abs.* 37.8, 1989.
- Sonntag, W.E., Breese, C.R., Boyd, R.L.** Influence of age and dietary restriction on plasma insulin-like growth factor-1 (IGF-1), IGF-1 gene expression, and IGF-1 binding proteins. *Endocrine Society Abstracts* 503, 1990.
- D'Costa, A., Booze, R.M., Breese, C.R., Sonntag, W.E.** Age related changes in *c-fos* expression in mice. *Neurosci. Abs.* 480.2, 1990.
- Breese, C.R., D'Costa, A., Booze, R.M., Sonntag, W.E.** Insulin-like growth factor-1 (IGF-1) receptor distribution in the hippocampal formation of rats and mice. *Third International Symposium on Insulin, IGFs, and their Receptors*, University of Florida, 1990.
- Breese, C.R., D'Costa, A., Booze, R.M., Sonntag, W.E.** Alterations in plasma insulin-like growth factor 1 (IGF-1) in fetal alcohol syndrome. *Alcoholism: Clinical and Experimental Research* 15:342, 1991.
- Breese, C.R., D'Costa A., Boyd, R.L., Lenham, J.E., Booze, R.M., Sonntag, W.E.** Mechanical and chemical lesions induce insulin-like growth factor-2 (IGF-2) but not IGF-1 receptor binding in the adult rat brain. *Neurosci. Abs.* 26.9, 1991.
- D'Costa A., Breese, C.R., Booze, R.M., Sonntag, W.E.** The effect of aging and dietary restriction on insulin-like growth factor-1 (IGF-1) binding sites in the brain. *Neurosci. Abs.* 319.22, 1991.
- D'Costa A., Ingram, R.L., Lenham, J.E., Breese, C.R., Sonntag, W.E.** Effect of age and moderate dietary restriction on type-1 IGF receptors in the liver and brain. *Endocrine Society Abstracts*, 1992.
- Breese, C.R., Bartell T.M., Rogers S.W., Browning, M.D., Leonard S.** Characterization of the glutamate receptor subunit GluR1 in human postmortem tissue. *Neurosci. Abs.* 45.2, 1992
- Breese, C.R., Bartell, T.M., Rogers, S.W., Leonard, S.** Characterization of glutamate receptor subunits in human postmortem brain tissue from normal, alcoholic, and schizophrenic patients. *Schizophrenia Research* 9:215, 1993.
- Logel, J., Antle, C., Breese, C., Dill, D., Drebing, C., Rollins, Y., Sullivan, B., Leonard, S.** Collection and evaluation of normal and schizophrenic postmortem brain tissue. *Schizophrenia Research* 9:223, 1993.
- Breese, C.R., Hall, M.E., Rogers, S.W., Leonard, S.** Characterization of glutamate receptor subunits in human postmortem hippocampi from normal, and schizophrenic patients. *Neurosci. Abs.* 340.1, 1993.
- Breese, C.R., D'Costa, A., Sonntag, W.E.** Effect of *in utero* ethanol exposure on IGF regulation: relationship to somatic growth. Invited presentation to Research Society on Alcoholism Annual Meeting, Maui, Hawaii, 1994.
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REGIONAL MEETING PRESENTATIONS:

- Birru, S., Hubbard, J.E., Narayanan, U., Talukdar, S., Madhu, S., Vaglenova, J., Breese, C.R.** MK-801 inhibition of nicotine induced upregulation of neuronal nicotinic receptors: theoretical implications for schizophrenia. Southeastern Pharmacology Symposium, Jackson, MS, August 2000.
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- Birru, S., Mayo, T., Gustman, T., Vaglenova, J., Breese, C.R.** NMDA Receptor Blockade By Dizocilpine (MK-801) Inhibits Nicotine-Induced Upregulation Of The High Affinity Neuronal Nicotinic Receptors: Theoretical Implications For Schizophrenia." Auburn University Graduate Student forum, 2003 (Third place as best poster in Basic Sciences division).
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INVITED PRESENTATIONS:

- Breese, C.R.**, NARSAD Research, 11th Annual Scientific Symposium, "Schizophrenia, Smoking, and the neuronal nicotinic receptors." Invited presentation to NARSAD contributors and Board of directors. October 13-14, 1999, Le Parker Meridien Penthouse, New York, NY.
- Breese, C.R., Mayo, T., Gustman, T., Hubbard, J.E., Birru, S., Vaglenova, J.** Glutamatergic inhibition of nicotine-induced upregulation of the high affinity neuronal nicotinic receptors: theoretical implications for schizophrenia. *Southeastern Pharmacology Symposium*, Mercer University, Atlanta, GA, October, 2003.
- Breese, C.R., Birru, S., Vaglenova, J.** Developmental effects of prenatal alcohol and nicotine exposure. *Symposia: Nicotine-Alcohol Interactions: from the Laboratory to the Clinic and Beyond*. Annual meeting of the Research Society on Alcoholism, Vancouver, BC, 2004.
- Breese, C.R.** Developmental and long term consequences of prenatal nicotine exposure. 13th World conference on tobacco or health. Washington, DC, 2006.

Description of Scholarly Program:

My research program is primarily centered on examining the molecular and behavioral neurobiology of drug and alcohol abuse, and mental and neurological disorders. My laboratory has several different areas of research with the common goal of understanding the behavioral, biochemical, and molecular basis of disease. The most active area of research involves the examination of the neurobehavioral and neurochemical consequences following fetal alcohol and nicotine exposure. In collaboration with Dr. Suppiramaniam, we are also examining the functional consequences of fetal alcohol and nicotine exposure using electrophysiological measures to examine alterations in glutamatergic neurotransmission in hippocampus and cortex, results which are then correlated with our behavioral, biochemical, and molecular data. The goal of these studies is not only to elucidate the functional, biochemical and molecular basis for fetal teratogenesis and the growth and mental deficiencies observed in alcohol and nicotine exposed offspring, but perhaps most importantly, we are examining a number of possible pharmacotherapies that have shown the potential to ameliorate some of the long-term neurochemical, behavioral, and learning and memory deficits that are seen following fetal alcohol and nicotine exposure. Our laboratory is currently funded by a grant from the Philip Morris External Research Program to examine the consequences of prenatal nicotine exposure, and is seeking a continuation from Philip Morris to examine the long-term effects of maternal smoke exposure on the offspring.

Another active component of our research involves the relationship of the molecular and functional changes in various ligand gated ion channels in addictive and psychiatric disorders. One area involves the investigation of an abnormality in the regulation of neuronal nicotinic receptors, in which schizophrenic patients that smoked had a significantly reduced level of nicotinic receptor up-regulation as compared to control subjects (Breese et al., *Neuropsychopharm.*, 2000). Since it has been long theorized that some of the symptomology observed in schizophrenics may be related to reduced glutamatergic neurotransmission, we hypothesized that hypoglutamatergic function may modulate the expression of neuronal nicotinic receptors following chronic nicotine exposure. In order to understand the underlying causes of the changes in nicotinic receptor regulation in schizophrenic subjects, we are examining the role of glutamatergic neurotransmission on the regulation of neuronal nicotinic receptors during chronic nicotine exposure. We have completed several studies in which this hypothesis was tested using NMDA receptor antagonists that indicate NMDA receptor function is necessary for the increased expression of nicotinic receptors following chronic nicotine exposure. We are also examining nicotinic receptor regulation in the neonatally 6-OHDA lesioned rat model of hypoglutamatergic function. A newly initiated research avenue involves the examination of chronic nicotine exposure and the role of nicotine withdraw and re-exposure on nicotinic receptor regulation and tolerance, anxiety, and learning and memory measures in adolescent and adult animals, as well the effects of chronic nicotine exposure on the expression of specific neuronal nicotinic receptor subunits and the mechanism by which nicotinic receptors paradoxically increase following chronic nicotine treatment.

In addition to the above listed research areas, I also have interests that involve the expression of neurotrophic factors following lesions or neuropathologies of specific neuronal populations in the CNS. Considerable research remains concerning the explicit role of growth factors in regulating neuronal differentiation and development in the fetus and neonate, and their role in the maintenance and modulation of neuronal function in the adult. Knowledge of the modulatory role of growth factors may provide an additional means of manipulating specific neurotransmitter systems as a result of, or in response to, specific neuronal disorders. Since neurotrophic factors have been shown to act as neuroprotective agents to inhibit neuronal degeneration and cell death, the examination of various types of lesions in the CNS, and the resultant changes in neurotrophic factor expression could be used to develop methods to reverse or ameliorate the effects of brain trauma, neuronal degeneration, and loss of neuronal function. These studies are also directly related to the goals of the previously mentioned studies on fetal drug exposure and would continue to play a role in my future research.

Teaching Philosophy:

The educational context of a professional school in which everyone majors in pharmacy is unique compared to other academic divisions on many campuses. An important characteristic of a typical pharmacy student is the commitment to a predetermined career and course of study. Many of these students are practical, goal-oriented, and comfortable with their early career choice. As an educator of pharmacy students, the outcome I wish to achieve is the creation of practitioners equipped with the knowledge and skills necessary to care for patients in a competent manner; and graduates that are capable of independent thinking, who can critically assess evidence, and find answers to their questions prior to making informed decisions. It is my responsibility to provide accurate and current information, and the opportunity to learn how to apply that knowledge. In the constantly changing field of healthcare, it is imperative to motivate students to become active, life-long learners, as well as train practitioners that are capable of conveying information accurately and effectively. In addition to teaching, I have also been an active member of the curriculum committee during my tenure in the Harrison School of Pharmacy. As a member of the curriculum committee, I believe it is important to appropriately react to perceived needs and criticisms of students, as it relates to the curriculum. I was actively involved with the development of the original traditional Pharm.D. curriculum that was implemented with the class entering in 1997. As a result of numerous discussions with both students and faculty, I consider myself one of the major influences in proposing and putting together the newly designed integrated systems-based curriculum that is currently in its first year of implementation in our School of Pharmacy.

To develop a philosophy of teaching is to define my role as an educator of pharmacy students. I find that I must strive to continually develop a broad array of teaching skills and adjust them to meet the ever-changing needs of my students; challenging students to master course material while at the same time helping them to develop broader skills such as independent and critical thinking. I have found teaching to be very fun, very rewarding, and extremely hard work. I continually reassess and try new approaches, and revise my materials to more effectively guide students based on feedback and personal reflection. Since students have different personalities and learning styles, I make a conscious effort to vary my presentation and teaching techniques to "connect with" as many students as possible. In most of my courses, I provide some combination of lecture outlines, copies of lecture slides, and various handouts on course material; as well as supplemental instructional activities including worksheets, case-based problem sets, computer-assisted learning (CAL) modules, and homework assignments that are meant to provide a basis for student-centered learning activities outside the classroom. On the Internet, students can find my lecture materials, tutorials, pertinent additional readings, and other resources to facilitate the learning of the material. The variety of these resources is designed to appeal to as many students as possible. I believe to be an effective teacher I must also have a good understanding of the subject matter, engaging in research, participating in or attending supplemental classes or seminars, conferences, and workshops that improve command of the subject matter, as well as my teaching performance in the classroom.

Teaching and learning are not passive processes; it requires motivation, effort, and persistence, and most importantly requires students to be an active participant in the learning process. Good students enter the classroom with a commitment to scholarship, a willingness to work, and a sense of personal responsibility toward achieving their educational goals. Despite the best intentions, the most effective teacher cannot teach someone unwilling to learn or participate in the learning process. I tell students at the beginning of every semester that ultimately they are responsible for their own learning, and that in my role as the teacher, I will try to provide an environment that is challenging and yet supportive to these goals. My role is to highlight features of the subject matter and focus attention on major points, important concepts, relevant issues, and significant relationships. While there is some degree of latitude, it is ultimately my responsibility to decide how much emphasis is placed on each subject area. In this regard, I state the instructional objectives of the course and what the student should be able to do at the completion of the course; which are reiterated throughout the course so the students know where the class is headed, why we are covering each topic, and how

it supports course objectives. I often ask questions of my classes that depend not just on recall of factual material, but require the students to apply, analyze and evaluate the material (Bloom, 1984). This form of active learning is an essential component if I expect the students to retain the material longer than the next exam. In addition, I expect the students to make every attempt to understand the material, not just memorize it till the next examination. It is only with understanding that a student can begin to assimilate and use the information, so they can communicate their ideas effectively and apply that knowledge to new situations. It is also disappointing, and ultimately unhelpful to students, when they are more motivated only by being “done” with the material and receiving their grade, or when they are uninterested in knowing why something works, but only how to get “the answer.”

As an instructor, I am also responsible for setting standards of achievement and for evaluating the progress of my students against those standards. Assessment of student performance is a key aspect of teaching, and it is absolutely essential to employ methods of assessment that are honest and fair. Inflated grades do not reflect achievement. A straight scale, published in the course syllabus, reflecting appropriate expectations, allows students to gauge their performance at any time during the semester, and emphasizes that a student's achievement is their own, regardless of the performance of other students in the class. I have found that some students will meet my expectations no matter how reasonably high I set them; conversely, I have also found that some percentage of students will fail to meet them. With this in mind, I think a major part of my role as a teacher is to challenge my students and help them rise to the level of that challenge. I do not reward laziness or sloppy thinking and I believe most of my students will say that I have high expectations. I prefer not to grade on a curve, and while the “bar” is initially set at a fixed height, I also try to be fair in adjusting the bar as necessary, but usually only after a course is completed and if there is a compelling reason to do so. Consistently awarding artificially inflated grades throughout the semester “to make the students happy” leaves them believing that their level of mastery is higher than it actually is; I believe that truly meaningful self-esteem grows naturally from a sense of academic and personal achievement. Similarly, failing to penalize academic dishonesty only ensures it will happen again, and this is clearly detrimental to the student in the long run, not to mention unfair to the honest students in the class.

Finally, a teacher is responsible for building a relationship with the students, demonstrating respect, and caring about their success. This is particularly important in a School of Pharmacy setting where I instruct students throughout their academic careers. I believe that in order to be effective, I need to know my students and be aware of the knowledge they bring into the classroom, as well as how to tap that knowledge and build on it. As a teacher, I must respect my students and believe that all students are capable and have something to contribute. I am committed to student success and making my subject matter accessible to those who want to learn it. I make myself accessible to my students, talking with students in and out of class, and being available to students outside class. In this regards, I have an open door policy for office hours and hold frequent review and recitation sessions, enabling the motivated student who needs additional, more individualized instruction the opportunity to do so. Furthermore, I am a member of a number of student organizations that allows me to get to know and interact with the students on a more casual basis outside of the classroom. I have found this may be one of the most important ways of gaining student trust and respect.

Reflection and Efforts to Improve My Teaching:

I believe that effective teaching skills are developed and I continue to work hard to develop the knowledge and skills that will make me a more effective teacher. I have sought to improve my teaching through workshops, talking with students about their problems and concerns, careful consideration of student and peer evaluations, and personal reflection of both classroom experience and the comparison of my expectation of the students and their performance on course assessments. As a result, I feel my teaching effectiveness has shown considerable improvement since I first joined the faculty at Auburn University as evidenced by the consistent improvement in my course evaluations, and most significantly, from the students honoring me with the “**SGA Outstanding Faculty Member Award**” in 2002. While being an effective teacher is a difficult task, as a teacher who has accepted teaching as a challenge and perhaps my most important responsibility and contribution

to the future of pharmacy, I have found that it provides rewards that are well beyond the effort, and this will continue to drive my desire to be the best teacher I can for my students.

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- Meyers, C. and T.B. Jones, 1993. *Promoting Active Learning*. San Francisco, Jossey-Bass Publishers.

Course teaching:

Teaching responsibilities during my tenure at the Harrison School of Pharmacy primarily involve coursework related to the pharmacy professional program, and the teaching and training of graduate students in our departmental Masters and Ph.D. degree programs. The courses I teach in the professional pharmacy program include team-taught, didactic and case-based coursework in autonomic, endocrine, and CNS pharmacology and psychopharmacology (Principles of Drug Action, Drugs and Disease 1, 2, and 3); and pathophysiology of hypothalamic pituitary diseases, diabetes, and neurodegenerative and psychiatric disorders (Human Pathophysiology, Drugs and Disease). I am presently the course coordinator for Drugs and Disease-2. I also teach in our case-based pharmacotherapy “module” courses in the diabetes section of the Endocrine Module, and the neurodegenerative disorders, schizophrenia, depression and anxiety sections of the Neurology and Psychiatry Module. Both of these courses are integrated, multidisciplinary team-taught courses, which primarily employ a case-based instructional approach using pharmacotherapy cases I developed in collaboration with the Clinical Pharmacy Practice faculty. The coursework and cases were developed to integrate various aspects of the physiology, pathophysiology, pharmacology, and pharmacotherapy related to the various disease states. Teaching and learning activities in the modules include a mix of course handouts, workshops, and review lectures on the disease and its treatment; as well as extensive large and small group discussions in collaboration with the Clinical faculty, in which we cover the case content related to the course objectives. I am the course coordinator of the neurology-psychiatry pharmacotherapy module, which also includes numerous administrative responsibilities in addition to those described above (e.g. organization of the faculty and course, syllabus preparation, and providing general support services for module faculty). I also instruct students in the professional program in elective courses, in which students are required to research and present on various topics related to mental illness, drug abuse, use of drugs and medications during pregnancy and lactation, and how to develop a primary care practice for diabetes care; as well as opportunities to assist in laboratory research. I also participate as a faculty mentor in the Early Pharmacy Practice Experience, a service learning course related to developing patient care skills by placing students in community healthcare settings during their first 3 years of pharmacy school.

I participate in the teaching and training of graduate students and in Pharmacy post-graduate education. Courses in our graduate program are typically team taught, and include courses related to neuropharmacology, psychopharmacology, bionucleonics, and methods and laboratory techniques (which include behavioral pharmacology, molecular and protein biology and electrophysiological techniques). As a member of the Graduate School, I am directly involved with graduate student laboratory training, preliminary examinations, thesis preparation and final thesis defense within the pharmacology and pharmaceuticals division of our department. I have also been actively involved with the continuing education program (C.E.) and non-traditional Pharm.D. program, both of which are administrated out of the Office of Postgraduate Education. The C.E. Programs have involved diabetes, Parkinson’s disease and mental illnesses. Coursework in the non-traditional program includes the delivery of the diabetes and Neurology and Psychiatry “module” coursework in an online format. Listed below is a summary of the courses I have developed or assisted in the development of during my tenure at the Harrison School of Pharmacy.

Professional Pharmacy Curriculum (University of Appalachia, College of Pharmacy):

- **Block 1.4: Introduction of pharmacodynamics (2006).**

- Introduction to concepts in pharmacology, receptor pharmacology and dose-response curves.
- **Block 1.5: ANS / CNS (Block coordinator, 2006)**
 - Pharmacology and related pathophysiological disease states related to autonomic systems, CNS diseases, neurodegenerative diseases, psychopharmacology and psychiatric disorders.

Professional Pharmacy Curriculum (Auburn University, Harrison School of Pharmacy):

- **Principles of Drug Actions I (this course was replaced by *Drugs and Disease I and II* course in our new curriculum); August 1999 – December 1999 (Fall quarters); January 2000- May 2005 (Spring semesters)**
 - Introduction to concepts in pharmacology, CNS pharmacology, and autonomic pharmacology (approximately 25 lectures plus weekly recitation sessions).
- **Drugs and Disease I; August 2005– present (Fall semester)**
 - Introduction to pharmacological concepts (8 lectures plus 2 weekly recitation sessions).
- **Drugs and Disease II, course coordinator; January 2006 (Spring semester)**
 - Pharmacology and related pathophysiological disease states related to autonomic systems, CNS diseases, neurodegenerative diseases, psychopharmacology and psychiatric disorders (projected 50 lectures plus weekly recitation sessions).
- **Human Pathology (course absorbed by *Drugs and Disease* in new curriculum); March 2000-December 2005 (Fall semester)**
 - Pathophysiology of HPA axis diseases and diabetes (type-1 and type-2; 9 lectures plus 3 weekly recitation sessions).
- **Early Pharmacy Practice Experience (Faculty Mentor); September 1998-Present (Fall and Spring semester)**
 - Service learning course in which students provide pharmaceutical care in the community (weekly meetings and evaluation).
- **Pharmacotherapy Modules**
 - Endocrine Module; (Spring semester 1999-present)**
 - Assist in development of instructional and assessment methods
 - Develop cases and co-coordinate the diabetes section of the module
 - Develop materials for diabetes (type-1 and type-2).
 - Serve as pharmacology and physiology and pathophysiology content expert throughout module
 - Includes the delivery of this course in the non-traditional Pharm.D. program in an online format.
 - Neurology and Psychiatry Module; module coordinator (2000-2006); (Spring semesters, 1999-2006)**
 - Assist in development of instructional and assessment methods
 - Develop cases for the psychosis section of the module
 - Develop materials for depression, bipolar disease and psychosis.
 - Served as pharmacology and physiology and pathophysiology content expert throughout module
 - Perform administrative duties related to course coordination (eg. copying, grades)

- Includes the delivery of this course in the non-traditional Pharm.D. program in an online format.
- **Special Problems Electives:**
 - **Readings in Mental Illness 2000-2006 (Fall and Spring semesters)**
 - **Readings in Drugs of Abuse 2001-2006 (Fall and Spring semesters)**
 - **Readings in Drugs in Pregnancy and Lactation 2004-2005 (Fall semesters)**
 - **Readings in Diabetes, 2005- 2006 (Summer terms, 2005-present)**
 - **Introduction to Research (usually in the Summer terms)**
 - Opportunity to assist in ongoing research studies and present results at local, regional or national conferences.

Graduate curriculum:

- **Special Problems:** Graduate level laboratory instruction related to neuropharmacology and molecular neurobiological research techniques.
- **Directed Readings:** Readings and class lectures on basic and advanced molecular and protein biology techniques used in the laboratory. Application of techniques to pharmacological problems. Readings of research relevant to ongoing studies within the laboratory
- **Bionucleonics:** Laboratory exercises for bionucleonics class. Exercises in handling radiation, receptor binding techniques, receptor autoradiography, and *in situ* hybridization.
- **Cellular Pharmacology:** Second messenger systems related to autonomic, growth factor, and insulin pharmacology.
- **Pharmacology I and II:** Pharmacology and related pathophysiological disease states related to autonomic systems, CNS diseases, psychopharmacology, neurodegenerative diseases, and psychiatric disorders.
- **Neuropharmacology and Neuropharmacology of Drug Dependence:** Neuropharmacology and topics related to drug dependence.
- **Pharmacology Research Methods:** Protein and molecular biological techniques laboratory course

Many of the courses listed above are generally team taught courses with members of the pharmacology, medicinal chemistry or clinical pharmacy practice faculty.