

# Blaise Costa MPharm. PhD.

## Associate Professor and Chair of Pharmacology

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**Molecular pharmacology ● Neuroscience ● Computational biology ● Drug discovery**

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## Academic Positions

Feb 2022 Chair of Pharmacology, Edward Via College of Osteopathic Med – Virginia

2017 - Associate Professor of Pharmacology  
*Edward Via Virginia College of Osteopathic Medicine  
Center for One Health Research, Virginia Tech*

2013 -2017 Assistant Professor of Pharmacology  
*Edward Via Virginia College of Osteopathic Medicine*

## Education and Training

2007-2013 Senior research fellow  
*University of Nebraska Medical Center, Omaha, NE.  
Project: NMDA receptor pharmacology and drug discovery*

2006-2007 Postdoctoral fellowship  
*Max Planck Institute for Brain Research, Germany.  
Project: Molecular biophysics and pharmacology of NMDA receptors*

2005-2006 Royal society research fellowship  
*School of Pharmacy, University of London, UK.  
Project: Biochemical analysis of NMDA receptor intersubunit interaction*

2001-2005 PhD in Psychopharmacology  
*National Institute of Mental Health and Neuroscience, India  
Project: Molecular dynamics of NMDA ionotropic glutamate receptors*

1995-2001 Bachelor of Pharmacy & Masters in Pharmacology  
*MGR Medical University, Chennai, India*

## Publications

- France G, Volianskis R, Ingram R, Bannister N, Rothärmel R, Irvine MW, Fang G, Burnell ES, Sapkota K, Costa BM, Chopra DA, Dravid SM, Michael-Titus AT, Monaghan DT, Georgiou J, Bortolotto ZA, Jane DE, Collingridge GL, Volianskis A. Differential regulation of STP, LTP and LTD by structurally diverse NMDA receptor subunit-specific positive allosteric

modulators. **Neuropharmacology**. 2021 Oct 19;:108840. doi: 10.1016/j.neuropharm.2021.108840. [Epub ahead of print] PubMed PMID: 34678377.

- Costa BM, Kwapisz LC, Mehrkens B, Bledsoe DN, Vacca BN, Johnston TV, Razzaq R, Manickam D, Klein BG. A glutamate concentration-biased allosteric modulator potentiates NMDA-induced ion influx in neurons. **Pharmacol Res Perspect**. 2021 Oct;9(5):e00859. doi: 10.1002/prp2.859. PubMed PMID: 34476911; PubMed Central PMCID: PMC8413904.
- Costa BM. NMDA receptor modulation and severe acute respiratory syndrome treatment [version 1; peer review: awaiting peer review]. **F1000Research** 2021, 10(Chem Inf Sci):1060 (<https://doi.org/10.12688/f1000research.73897.1> )
- Anandkrishnan R, Tobey H, Nguyen S, Sandoval O, Klein K, Costa, BM. Cranial manipulation affects cholinergic pathway gene expression in an animal model of age-related cognitive decline. **Jol of Osteo Med (in press)**.
- Tobey H, Lucas T, Paul S, Berr S, Mehrkens B, Brolinson PG, Klein B, Costa BM Mechanoceutics Alters Alzheimer's Disease Phenotypes in Transgenic Rats: A Pilot Study. **J Alzheimers Dis**. 2020;74(2):421-427. doi: 10.3233/JAD-191071. PubMed PMID: 32039851.
- Bledsoe D, Vacca B, Laube B, Klein BG, Costa B. Ligand binding domain interface: A tipping point for pharmacological agents binding with GluN1/2A subunit containing NMDA receptors. **Eur J Pharmacol**. 2019 Feb 5;844:216-224. PubMed PMID: 30553788.
- Tobey H, Lucas T, Bledsoe D, Mykins M, Campbell C, Berr S, Sasser T, Helm R, Brolinson PG, Klein B, Costa BM Effect of Cranial Osteopathic Manipulation on Aged Rat Model of Alzheimer's Disease. **J American Osteopathic Association** 2019 Oct 15. doi: 10.7556/jaoa.2019.121. PMID: 31613309.
- Irvine MW, Fang G, Sapkota K, Burnell ES, Volianskis A, Costa BM, Culley G, Collingridge GL, Monaghan DT, Jane DE. Investigation of the structural requirements for N-methyl-D-aspartate receptor positive and negative allosteric modulators based on 2-naphthoic acid. **Eur J Med Chem**. 2019 Feb 15;164:471-498. PubMed PMID:30622023.
- Bledsoe D, Tamer C, Mesic I, Madry C, Klein BG, Laube B, Costa BM. Positive Modulatory Interactions of NMDA Receptor GluN1/2B Ligand Binding Domains Attenuate Antagonists Activity. **Front Pharmacol**. 2017 May 9;8:229. doi:10.3389/fphar.2017.00229. eCollection 2017. PubMed PMID: 28536523
- Kane LT, Costa BM. Identification of Novel Allosteric Modulator Binding Sites in NMDA Receptors: A Molecular Modeling Study. **J Mol Graph Model**, 2015.61:p.204-213

- Irvine MW, Fang G, Eaves R, Mayo-Martin MB, Burnell ES, Costa BM et al. Synthesis of a Series of Novel 3,9-Disubstituted Phenanthrenes as Analogues of Known N-Methyl-d-aspartate Receptor Allosteric Modulators. **Synthesis**, 2015 March 19; 47(11):1593.
- Gautam V, Trinidad JC, Rimerman RA, Costa BM, Burlingame AL, Monaghan DT. Nedd4 is a specific E3 ubiquitin ligase for the NMDA receptor subunit GluN2D. **Neuropharmacology**. 2013 Nov;74:96-107.
- Collingridge GL, Volianskis A, Bannister N, France G, Hanna L, Mercier M, Tidball P, Fang G, Irvine MW, Costa BM, Monaghan DT, Bortolotto ZA, Molnár E, Lodge D, Jane DE. The NMDA receptor as a target for cognitive enhancement. **Neuropharmacology**. 2013 Jan;64:13-26.
- Costa BM, Yao H, Yang L, Buch S. Role of Endoplasmic Reticulum (ER) Stress in Cocaine-Induced Microglial Cell Death. **J Neuroimmune Pharmacol**. 2013 Jun;8(3):705-14.
- Irvine MW, Costa BM<sup>‡</sup>, Volianskis A, Fang G, Ceolin L, Collingridge GL, Monaghan DT, Jane DE. Coumarin-3-carboxylic acid derivatives as potentiators and inhibitors of recombinant and native N-methyl-D-aspartate receptors. **Neurochem Int**. 2012 Sep;61(4):593-600.‡ - equally contributed as first author
- Costa BM, Irvine MW, Fang G, Eaves RJ, Mayo-Martin MB, Laube B, Jane DE, Monaghan DT. Structure-activity relationships for allosteric NMDA receptor inhibitors based on 2-naphthoic acid. **Neuropharmacology**. 2012 Mar;62(4):1730-6.
- Irvine MW, Costa BM<sup>‡</sup>, Dlaboga D, Culley GR, Hulse R, Scholefield CL, Atlason P, Fang G, Eaves R, Morley R, Mayo-Martin MB, Amici M, Bortolotto ZA, Donaldson L, Collingridge GL, Molnár E, Monaghan DT, Jane DE. Piperazine-2,3-dicarboxylic acid derivatives as dual antagonists of NMDA and GluK1-containing kainate receptors. **J Med Chem**. 2012 Jan 12;55(1):327-41.
- Buch S, Yao H, Guo M, Mori T, Costa B, Singh V, Seth P, Wang J, Su TP. Cocaine and HIV-1 interplay in CNS: cellular and molecular mechanisms. **Curr HIV Res**. 2012 Jul;10(5):425-8.
- Monaghan DT, Irvine MW, Costa BM, Fang G, Jane DE. Pharmacological modulation of NMDA receptor activity and the advent of negative and positive allosteric modulators. **Neurochem Int**. 2012 Sep;61(4):581-92.
- Costa BM, Irvine MW, Fang G, Eaves RJ, Mayo-Martin MB, Skifter DA, Jane DE, Monaghan DT. A novel family of negative and positive allosteric modulators of NMDA receptors. **J Pharmacol Exp Ther**. 2010 Dec;335(3):614-21.

- \*Costa BM, Feng B, Tsintsadze TS, Morley RM, Irvine MW, Tsintsadze V, Lozovaya NA, Jane DE, Monaghan DT. N-methyl-D-aspartate (NMDA) receptor NR2 subunit selectivity of a series of novel piperazine-2,3-dicarboxylate derivatives: preferential blockade of extrasynaptic NMDA receptors in the rat hippocampal CA3-CA1 synapse. *J Pharmacol Exp Ther.* 2009 Nov;331(2):618-26. \*- corresponding author
- Delev D, Pavlova A, Heinz S, Costa BM, Chandra T, Poetsch B, Seifried E, Oldenburg J. Modelling and expression studies of two novel mutations causing factor V deficiency. *Thromb Haemost.* 2008 Nov;100(5):766-72.
- Costa BM, Sowdhamini R, Pradhan N. Comparative analysis of different competitive antagonists interaction with NR2A and NR2B subunits of N-methyl-D-aspartate (NMDA) ionotropic glutamate receptor. *J Mol Model.* 2005 Nov;11(6):489-502.
- Costa BM, Bhattacharyya D, Sowdhamini R, Pradhan N. Structural consequences of D481N/K483Q mutation at glycine binding site of NMDA ionotropic glutamate receptors: a molecular dynamics study. *J Biomol Struct Dyn.* 2005 Feb;22(4):399-410.
- Costa BM, Sowdhamini R, Rao MR, Pradhan N. Evolutionary trace analysis of ionotropic glutamate receptor sequences and modeling the interactions of agonists with different NMDA receptor subunits. *J Mol Model.* 2004 Dec;10(5-6):305-16.

PubMed key: <https://www.ncbi.nlm.nih.gov/myncbi/18117wm0VP5/bibliography/public/>

## Active Research Support (as of Dec 31st 2021)

- Virginia Tech ICTAS & VCOM \$100,000  
**Pharmacological characterization of NMDA receptor modulators using engineered microenvironments representing brain disorders.**  
 The specific aim of this project is to study glutamate concentration dependent effect of novel NMDA receptor modulators in engineered brain microenvironments.
- NIH- NCCIH & NIA \$480,000  
**To identify the role of brain lymphatic systems in cranial osteopathic manipulative therapy on animal models of Alzheimer's disease.**  
 The major goal of this proposal is to understand the specific role of meningeal lymphatic system in cranial osteopathic manipulation.

## Recently Completed

- 1915733 (Costa) 09/1/2020 – 08/31/2021  
 American Osteopathic Association (AOA) \$124,999  
**Clearance of Brain Metabolic Waste in a Natural Animal Model of Alzheimer's Disease by Cranial Osteopathic Manipulation.**  
 The major goal of this project is to study the effect of cranial osteopathic manipulation in rodent models of disease.

- 16SDG27480023 (Costa) 7/1/2016 – 12/31/2020  
American Heart Association –SDG \$308,000  
**Development and pharmacological characterization of mechanistically distinct NMDA receptor allosteric modulators.**  
The overall aim of this study is to design, synthesis, and screening of novel NMDA receptor modulators.

## **Experimental Drug Patents** (*US Patents and Trademark Office*)

- Biased NMDA Receptor Modulators and uses thereof. PCT/US2019/061308. Role: Inventor
- Novel positive and negative allosteric aromatic ring modulators for composition of matter and methods of use. International publication number: WO2012/019106. Role: Co-inventor

## **Awards & Fellowships**

2021 VCOM Researcher of the year award  
 2015, 18&19 Golden Apple Award for excellence in teaching, sigma sigma phi VCOM  
 2010 UNMC-Unemed stimulus to expedite NMDAR drug discovery & patents process  
 2010 Annual performance stipend for extraordinary contribution for the project  
 2009 UNMC-Unemed new invention notification award  
 2009 Eli Lilly NMDA receptor drug discovery collaboration fund  
 2007 Listed key personnel for NIH R01 grant  
 2007 UNMC Postdoctoral travel award  
 2007 Max Planck Society short term training fellowship, Germany  
 2005 The Royal Society International Exchange Researcher Award, UK  
 2001 PhD through nationwide entrance examination for a single position at NIMHANS  
 2001 Best outgoing student during Masters from JSS Department of Pharmacology  
 1995 Admitted for B.Pharmacy course through state-wide entrance examination

## **Selective Invited Lectures**

2021 St John's University, Queens, New York  
 2019 Speaker at American Association of Osteopathy Annual Convocation, FL  
 2015 Department of Biochemistry, Virginia Tech, VA  
 2013 Virginia College of Osteopathic Medicine, Blacksburg, VA  
 2012 University of Findlay, OH  
 2010 Massachusetts General Hospital, Harvard University, MA  
 2007 Max Planck Institute for Brain Research, Frankfurt, Germany  
 2007 Indian Institute of Technology, Chennai, India  
 2006 Dept of Pharmacology, University College London, UK  
 2005 International Institute of Information Technology, India  
 2005 Indian pharmacology quality improvement program, India  
 2004 Institute de Structural Biology, CEA/CNRS, Grenoble, France

## **Medical Pharmacology Lectures**

(*Didactic lectures to a class of ~180 Osteopathic Medical Students*)

MED 7160: General and Musculoskeletal Pharmacology

- Pharmacokinetics I&II
- Drugs for Osteoporosis
- Pharmacology of Non-Steroidal Anti-inflammatory Drugs
- Pharmacologic Basis of Antibacterial Drugs I&II
- Drugs for Osteoarthritis and Gout
- Drugs for Rheumatoid Arthritis
- Anti-fungal and Non-HIV Antiviral agents

#### MED 7165: Pharmacology of Neurological System and Special Senses

- Local Anaesthetic Agents
- Pharmacology of General Anaesthetics

#### MED 7170: Cardiovascular and Respiratory Pharmacology

- Antihyperlipidemics I&II
- Antiplatelets, Anticoagulants and Thrombolytic drugs I&II
- Pharmacologic Management of Ischemic Heart Disease I&II
- Management of Supraventricular and Ventricular Arrhythmias-I&II
- Pharmacologic Management of Congestive Heart Failure I&II
- Treatment of Upper Respiratory Tract Infections
- Antibiotic Agents for Lower Respiratory Tract Infections

#### MED 7175: Gastrointestinal Pharmacology

- Medications for Gastroesophageal reflux disease & Peptic Ulcer Disease
- Anti-nausea/Anti-Emetic Drugs
- Drugs for Constipation/diarrhoea and Irritable Bowel Syndrome I & II
- Inflammatory Bowel Disease
- Antiparasitic Drugs
- Drugs used in Hepatic Diseases
- Medications for the Treatment of Urinary Tract Infections
- Pharmacology of Drugs Acting on Vasopressin Receptors

#### MED 7180: Reproductive and Endocrine Systems

- Growth Hormones & Drugs for Adrenal Disorders
- Drugs for Benign Prostatic Hyperplasia and Incontinence
- Androgens and Drugs for Impotence

#### Case-Based Learning (CBL):

- Block-2: Antimicrobials for Bone & Joint infections
- Antimicrobials for Bone & Joint infections
- Urinary Tract Infections
- Gastrointestinal Infections
- Inflammatory Disorders and Crystalline Arthropathy and Osteoarthritis

#### 2012-2013 teaching to graduate students:

- Signal Transduction mechanisms
- Electrophysiology

2004 -2005 teaching to pharmacy students:

- Cardiovascular pharmacology
- Neuropharmacology
- Cancer chemotherapy
- Drugs acting on GI tract
- General pharmacology (pharmacokinetics and pharmacodynamics)

## College Services

- Application review and recommendations for admission in medical school
- Conducted interviews seven days each semester since 2013
- Serve as faculty advisor for first and second-year medical students
- Advise students on COMLEX and USMLE exam preparations

## Professional Affiliations

2020- Associate editor Journal of Alzheimer's Disease\*

2016 - Member, The American Society for Pharmacology and Experimental Therapeutics (ASPET)\*

2013 - Member, American Heart Association

2007 - Member, Society for Neuroscience

\*Require professional accomplishments

## Journal Articles Periodically Reviewed

Journal of Pharmacology and Experimental Therapeutics

Neuropharmacology

American Chemical Society

Journal of Medicinal chemistry

Journal of Clinical Medicine

Journal of Biomedicine and Biotechnology

Journal of Neurochemistry International

PLOS One

Neurotoxicity

Molecules

MDPI Cells

Journal of Molecular Graphics and Modelling

Journal of Biomolecular Structure and Dynamics

International Journal of Developmental Neuroscience

## Pharmacy School Internship

1998 Industrial training in pharmaceutical production and management

1998 Pharmaceutical quality control and quality assurance protocols

1998 Industrial business management and marketing strategy training

1999 Forensic pharmacy, drug prescription handing, and compounding

## Experimental Technics Used for Research

In *vitro*:

- Neurons and astrocytes cell-based screening assays
- Patch-clamp electrophysiology using Port-A-Patch semi-automated electrophysiology
- TEVC electrophysiology with semi-automated 16 channel solution change equipment, cRNA synthesis, microinjections in frog oocyte.
- Neuronal culture, immunostaining and fluorescent microscopy
- Chimeric DNA, point mutations, hybrid primer designing OEpcr, subcloning, transformation, mini/maxi DNA synthesis, RT-pcr
- HEK273 cells, transfection, protein isolation, immunoblotting
- High throughput drug screening using fluorescent plate reader
- Pharmacological data analysis (Graph pad Prism)
- Radio ligand-binding assay for recombinant and native receptors

#### **In vivo:**

- Transgenic (TgF344-AD) and naturally aged rat model of Alzheimer's disease
- Cognitive function assays: Morris water maze & novel object recognition assay
- Live animal imaging using positron emission tomography (PET)
- Euthanasia protocols, organ isolation and enzymatic assays
- Cryosection and immunohistochemistry
- Drug administration -oral, intraperitoneal, intramuscular and subcutaneous LD<sub>50</sub> and EC<sub>50</sub> assay and histopathology
- Pharmacological screening of experimental drugs for various activities including antidiabetic, antiepileptic, antiurolithiasis and nephrotoxicity

#### **In silico:**

- Molecular dynamics simulations of protein-ligand complexes and analysis of trajectories
- Protein 3D structure modelling, drug designing, docking, virtual drug screening
- Currently working with VT Advances Research Computing Supercomputer Clusters
- SGI ONYX3200, SGI O2 workstations and Linux cluster machines
- Operating systems including unix, linux, and windows
- Trained graduate students in molecular modelling software (Schrodinger maestro suite, modeller, sybyl, insightll & gromacs)

#### **Omics:**

- Transcriptome and proteome assay and analysis are done in collaboration with other labs.

### **Selected Posters Presented in International Conferences**

- Regularly attend Society for Neuroscience (SfN) annual conference and present poster almost every year since 2007. 2020 SfN went virtual. Some remarkable presentations are listed below.
- BN Vacca, TV Johnson, DN Bledsoe, AK Wagner, **BM Costa** An agonist concentration dependent allosteric modulator separates triheteromeric (GluN1/2A/2B) from diheteromeric (GluN1/2A) NMDA receptors SfN poster #118.07 / B13.
- Bledsoe D, Tamer C, Mesic I, Madry C, Klein4 BG, Laube B, **Costa BM** Positive Modulatory Interactions of NMDA Receptor GluN1/2B Ligand Binding Domains Attenuate Antagonists



Activity. Poster (#396.07) presented at 2016 Society for Neuroscience meeting in San Diego.

- **Costa BM**, Kane LT, Identification of Novel Allosteric Modulator Binding Sites in NMDA Receptors, poster presented at 2015 Society for Neuroscience meeting in Chicago.
- **Costa BM**, Yang L, Yao H & Buch S; Endoplasmic Reticulum (ER) Stress in Cocaine Induced Microglial Cell Death, Poster #96, 11th International Symposium on NeuroVirology, 2012 New York.
- **Costa BM**, M. W. IRVINE, G. FANG, M. MAYO-MARTIN, D. E. JANE, D. T. MONAGHAN; A novel family of negative and positive allosteric NMDA receptor modulators. Society for Neuroscience, San Diego, Poster: 2010-S-16779-SfN.
- Mark W. Irvine, **Costa BM**, Daniel Dlaboga, Palmi Atlason, Elek Molnar, Graham L. Collingridge, Daniel T. Monaghan, and David E. Jane. Development of a series of piperazine-2,3-dicarboxylic acid derivatives as dual antagonists of NMDA and kainate receptors. Society for Neuroscience, San Diego, Poster: 2010-S-16779-SfN.
- **Costa BM**, B. FENG, R. M. MORLEY, M. W. IRVINE, D. E. JANE, D. T. MONAGHAN; NMDA receptor subtype selectivity of a series of novel piperazine-2,3- dicarboxylate derivatives. Society for Neuroscience, Chicago, Poster No. 613.13/B98.
- V. GAUTAM, J. C. TRINIDAD, R. A. RIMERMAN, **Costa BM**, A. L. BURLINGAME, D. T. MONAGHAN Proteomic identification of Nedd4 as a specific E3 ubiquitin ligase for NMDA receptor subunit NR2D. Society for Neuroscience, Chicago, Poster No. 511.2/B63.
- C. TAMER, **Costa BM**, H. BETZ, \*B. LAUBE; Role of the extracellular N-terminal domains of NMDA receptor subunits for ligand-binding domain interface interactions. Society for Neuroscience, Chicago Poster No. 613.10/B95.
- **Costa BM**, Bihua Feng, Richard M. Morley, Mark W. Irvine, David E. Jane, and Daniel T. Monaghan NMDA receptor subtype selectivity of a series of novel piperazine-2,3-dicarboxylate derivatives. British Neuroscience Association (BNA), Liverpool, UK April 2009.
- **Costa BM**, Ivana Mesic, Christian Madry, Heinrich Betz, Bodo Laube. Distinct Role of Intersubunit Interaction Sites in NR1-NR2A and NR1-NR2B Subunits Containing NMDA Receptors. Society for Neuroscience, San Diego, 2007.
- **Costa BM**, Cousins S. L. & Stephenson F. A. An investigation into the role of sub-domains of the N-terminal LIVBP domain in the assembly of functional NMDA receptors. Federation of European Neuroscience (FENS), Vienna, Austria, July, 10, 2006.
- **Costa BM**, Sowdhamini R, Metpally RPR, Pradhan N Molecular Modelling of LBD of NMDA ionotropic glutamate receptors and docking. NCBS Symposium on Molecules, Machines and Network, Bangalore 6–9 Jan 2004.
- **Costa BM**, Metpally RPR, Sowdhamini R, Pradhan N. Prediction of transmembrane domain regions of NMDA Ionotropic glutamate receptor subunits. Symposium of the Protein Society: Protein Structure and Function, Indian Institute of Technology-Bombay, Mumbai, October 18-20, 2002.

## Students Received Training in Costa Lab

Name	Duration	Training Provided	Publication/Contribution	Current Status
Lucas Kane	07/2013 -07/2015	Computational structural biology, electrophysiology	First author Kane & Costa 2015	2019 VCOM Graduate
Douglas Bledsoe	12/2015 -07/2018	Electrophysiology, basic molecular biology, transgenic rat breeding, genotyping, spatial learning and memory assay, live animal imaging, DNA, RNA, protein extraction and various immune assays	Two first author papers Bledsoe et al., 2017 Bledsoe et al., 2018 Co-authored Tobey et al., 2019	VCU Medical School
Caroline Campbell	10/2016 -06/2017		Co-authored Tobey et al., 2019	Grad student at UVA
Mike Mykins	06/2017 -06/2018		Co-authored Tobey et al., 2019	PhD student at Uni. Tennessee, Knoxville
Anushri Wagner	01/2018 -12/2019		Contributed for drug discovery project.	3 <sup>rd</sup> yr Med Student VCOM
Bryanna Vacca	06/2018 - 6/2019		Second author in Bledsoe et al, 2018	PhD Student at UNC Chapel Hill
Tullia Johnston	08/2018 - 6/2019		Contributed for drug discovery project.	Grad Student at VCOM
Brittney Mehrkens	07/2019 - 1/2020		Co-authored Costa et al., 2021 & Tobey et al., 2020	Research Specialist
Lina Kwapisz	07/2019 - 6/2020		Co-authored Costa et al., 2021	Graduate Student Costa lab
Rehan Razzaq	07/2019 - present		NMDA receptor desensitization rate constant analysis	Co-authored Costa et al., 2021
Nish Patel	07/2019 - 12/2020	NMDA receptor deactivation rate constant analysis	Electrophysiology data analysis	3 <sup>rd</sup> yr Med Student VCOM
Hetu Patel	07/2019 - 12/2020		Electrophysiology data analysis	3 <sup>rd</sup> yr Med Student VCOM
Alyssa Ingram	5/2021 - present	Neuron culture, drug screening, Immunoassays	Contributed for NMDA receptor drug discovery project.	Graduate Research Assistant

Seth Boehringer	6/2021 - present	Electrophysiology, molecular biology	Contributed for NMDA receptor drug discovery project.	UG Res Assistant
Yeeun Bae	08/2021 -present	IHC, Electrophysiology	Contributing for Cranial Osteopathic Manipulation Project	MCB PhD Student - Rotation
Swathi Sambatha	04-/2021 -present	Rat brain tissue section, IHC and data analysis	Contributing for Cranial Osteopathic Manipulation Project	Medical students doing research distinction credit work
Alex Gordon				
Elizabeth McDonald				
Annie Lin				

## References

- Jim Mahaney, PhD**  
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 Associate Department Head  
 Dept. of Biomedical Sciences & Pathobiology (0442)  
 Virginia-Maryland College of Veterinary Medicine  
 Virginia Tech  
 Blacksburg, VA 24061  
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