Dr. Benson Akingbemi: *Action of xenostrogens in the male gonad and neuroendocrine axis.*

Our long-term research goal is to understand how developmental exposure to environmental chemicals predispose to adult-onset disease related to male infertility. The increasing incidence of testicular disorders in the population was associated with exposure to chemicals which have the capacity to mimic and/or antagonize hormone action. Of interest, there is increasing public concern that exposures to chemical mixtures may cause unpredictable effects not seen with individual compounds. However, studies on the safety profile of chemicals commonly encountered in the environment are limited. The present study is focused on chemicals which are present in consumer products, including phthalates, bisphenols, 17α-ethinyl estradiol, and soy isoflavones. We hypothesize that exposures to combinations of chemicals intensify disruption of male reproductive function due to their single counterparts. Following exposure of male rats to test chemicals, we will analyze testicular steroid hormone secretion, androgen-stimulated germ cell development, sperm function, and identify mechanisms of chemical disruption of the pituitary-hypothalamus axis. The results will address whether chemical combinations cause additive effects in reproductive tract tissues, describe gene networks mediating chemical action, and inform development of screening protocols for risk assessment of the population. Students will be involved in executing the experimental protocol, sample analyses, data preparation, and presentation of results at scientific meetings.

Dr. Christine Charvet: *New tools to translate time across the lifespan of animals*

Our goal is to identify corresponding ages across the lifespan of humans and other species. Our work builds on an easily accessible online resource that finds equivalent developmental ages across 19 mammalian species ([http://www.translatingtime.org](http://www.translatingtime.org)). We previously relied on the timing of abrupt transformations that span prenatal ages of development. Accordingly, our approach was constrained to find corresponding ages at prenatal stages. We are broadening our dataset to find corresponding ages across the lifespan. We have recently collected state of the art neuroimaging scans to visualize brain pathways, RNA sequencing data to detect gene expression, and ATAC sequencing data to capture chromatin accessible regions of the genome. We currently have large datasets capturing transcriptomic and connectomic information from individuals of different ages and from different species (e.g., mice, macaques, marmosets). You will have the opportunity to analyze neuroimaging data and gain programming skills with the programming language R to analyze transcriptional and epigenetic data to translate ages across species. These valuable skill sets in neuroimaging and statistical genetics can be used to address a range of problems in basic and clinical sciences. Our laboratory website houses additional information about our work: [www.charvetlab.com](http://www.charvetlab.com).

Dr. Dillon Devathasan: *Development of an Augmented Reality Software for Preoperative Spinal Neuronavigation.*

Current techniques for spinal localization rely on intraoperative palpation or identification of anatomical landmarks. Specifically, to localize the correct surgical site during thoracolumbar surgery, identification of the 13th rib and L1 transverse process is necessary. This technique requires extensive surgical dissection and prolongs surgical time (especially if the hemilaminectomy site is further caudal/cranial from the T13-L1 junction). Our goal is to develop an Augmented Reality software that will superimpose a CT or MRI spinal reconstruction over the patient (pre-operatively) to accurately localize the surgical site. Consequently, this minimizes surgical dissection and time. The summer scholar will gain exposure to the fundamentals of neurosurgery, neuroimaging and assist with the development of the software.
**Dr. Megan Grobman and Dr. Dana LeVine:** *Evaluation of Neutrophil Extracellular Trap (NET) formation in dogs with chronic bronchitis with and without bronchiectasis.* Neutrophil extracellular traps (NETs) are important antimicrobial structures comprised of webs of DNA, nucleosomes, histones and granular proteases, designed to trap and kill invading microorganisms as a part of the innate immune system. However, NETs are also increasingly recognized as contributors to several respiratory diseases including pneumonia, bronchiectasis, COPD, and COVID-19 in people. Importantly, reduction of NETs by recombinant DNase (which breaks down NETs) have been associated with recovery and improved oxygenation in human patients. The role of NETs in canine respiratory disease, including chronic bronchitis (CCB), is unknown. Canine chronic bronchitis is a non-infectious, inflammatory disorder of the lower airways characterized by neutrophilic inflammation in bronchoalveolar lavage fluid (BALF). Canine chronic bronchitis is implicated in significant patient morbidity and mortality through the development of secondary bacterial infections and airway remodeling including bronchiectasis. The current standard of treatment of CCB involves lifelong treatment with corticosteroids to suppress airway inflammation. However, chronic treatment with steroids can be associated with significant systemic side effects. We hypothesize that NETs are increased in the airways of dogs with CCB compared to healthy dogs and propose to determine if NETs are increased in BALF of dogs with CCB. New insights into the pathogenesis of CCB is critical to the development of new therapies such as NETosis regulating drugs and DNases. Through this project you will learn to isolate canine neutrophils and help develop an assay to identify NETosis in BALF from dogs. You will also get to observe bronchoscopies and BALs. This work will help advance our understanding of the pathogenesis of CCB, opening the door for the development of novel therapies. We hope you will join us in working in the confluence of the two most exciting areas of internal medicine: hematology and respiratory disease!

**Dr. Reid Hanson:** *A Study of the Visco-elastic and Friction Profiles of Equine Articular Cartilage* Our lab seeks to characterize and compare the material properties of cartilage located within various joints of the equine limb. Specifically, we will investigate the visco-elastic stiffness and friction coefficient of the biphasic cartilage structure. These biphasic properties affect the performance of the joint as it carries different loads and motions. We are investigating to determine if different types of joints with different ranges of motion possess similar or different material properties and which properties are best suited for the joint’s individual conditions. Analyzing the various cartilage surfaces within each joint and between joints will lead to a better understanding of the mechanisms controlling the performance of healthy joints in horses and humans. This data will be used to translate onto the design of better human artificial joints. Articular samples will be extracted from horses and analyzed in the Multiscale Tribology Laboratory, a multidiscipline lab between the Samuel Ginn College of Engineering and the College of Veterinary Medicine. Cartilage surface geometries will be characterized using either nano-scale surface profilometry, scanning and transmission electron microscopy and mathematical/numerical modeling techniques to analyze the structure of the surfaces over many scales. The key is to mesh the geometries at multiple different scales into one complete model.

**Dr. Erik Hofmeister:** Internships are one-year experiences pursued after earning the DVM degree. Intern ranking does not correlate with intern performance. The purpose of this study is to determine if there are any detailed components of an intern’s application which correlates with
their performance during the intern year. Students will do a qualitative data analysis of intern applications to identify themes and consistent findings which may relate to scores provided on the interns’ performance. Students will meet weekly with the faculty mentor to discuss the project and progress. It is expected students will be the first author on a research-quality study to be submitted to the Journal of Veterinary Medical Education.

**Dr. Katie Horzmann:** *Developmental toxicity of trichloroethylene metabolites in the zebrafish model.* I work with emerging and legacy environmental toxicants and study the effects of developmental exposure to these chemicals using the zebrafish (*Danio rerio*) biomedical model. One legacy contaminant is trichloroethylene (TCE), an industrial solvent and degreaser that contaminates over half of all Superfund sites, is a known carcinogen, and is linked to other adverse health outcomes including congenital cardiac defects and neurotoxicity. TCE is rapidly metabolized and the metabolites are thought to contribute to the overall toxicity. Our laboratory’s hypothesis is that the metabolites of TCE mediate aspects of developmental TCE toxicity. Student scholars would be able to join in a project investigating the developmental toxicity of TCE metabolites in embryonic and larval zebrafish. In addition to learning zebrafish husbandry and handling skills, scholars would evaluate embryonic mortality and hatching, embryonic behavior, larval behavior, and larval morphology in zebrafish with developmental exposure to TCE metabolites.

**Dr. Jeff Huang:** *Lineage trace cells of gonadal origin in the adrenal gland.* The adrenal cortex can be divided into different zones based on its histological features and function. The current model of the adrenal cortex development is based on two lineage tracing mouse lines. Data from these two genetic models suggested that the adrenal cortex is composed of two distinct populations: the fetal zone and the adult zone. The fetal zone originates from the adrenogonadal primordium, whereas the adult zone is developed from the stem/progenitor cells reside in the adrenal capsule. During development, cells in the fetal zone undergo regression and are replaced by the continuously renewing adult cortical cells from the capsule. AMHR2 (Anti-Müllerian Hormone Receptor Type 2) is mainly found in Müllerian duct, the primordial anlage of the female reproductive tract. It is also expressed in fetal ovary and testis. Surprisingly, by using the lineage tracing mouse model that labels *Amhr2*-positive cells, we found that the *Amhr2*-positive cell population contributes to both fetal zone and the adult zone. This is the first lineage tracing model that labels cells in both fetal zone and adult zone. The student will use double immunostaining to characterize the cell population originates from the *Amhr2*-positive cell population to further confirm this groundbreaking finding.

**Dr. Aime Johnson:** This summer, we will be testing a sedation protocol involving dexmedetomidine for semen collection in tom cats. A technique involving urethral catheterization has been described and the original study looked at medetomidine vs dexmedetomidine. The student will be in charge of organizing the project and sedating adult intact male cats for semen collection. The student will perform the full semen evaluation (with oversight). During the summer, the males will be collected several times and the semen will be cryopreserved for future use. The student would be involved with all aspects of this as well. The student will assist with other aspects in Scott Ritchey and will receive hands on training in feline (and other small animal) Theriogenology.
Dr. Candace Lyman: *Quantitative analysis of stress in the equine following handling and medical procedures.* A day in the life of a teaching horse at a veterinary school includes participating in various teaching activities such as transrectal palpation, transvaginal aspiration of oocytes, nasogastric intubation, or even just standing for a physical exam performed by a novice veterinary student. Some reports describe welfare concerns for teaching horses if inexperienced students display inconsistent or improper equine handling skills, potentially increasing the level of stress experienced by the animals. However, removal of live animals within the veterinary curriculum would significantly minimize the amount of “real-life” experiential education provided to veterinary students, interns, and residents. Our summer scholar will collect appropriate samples from horses and perform biomarker analysis utilizing markers for stress and pain such as substance P, cortisol, noradrenaline, testosterone, etc., and perform quantitative data analysis in efforts to describe a horse’s stress response to handling and medical procedures performed. The student will be allowed to be present with senior veterinary students on the equine clinical rotations at the AU Equine Reproduction Center and attend other academic meetings (i.e. journal club) with faculty and residents in theriogenology during their weeks of research. The goal of the performed research will be submission of a manuscript to a peer-reviewed journal.

Dr. Doug Martin: *Gene therapy of neurologic disease* Dr. Martin’s laboratory focuses on characterization and therapy of neurologic diseases common to animals and humans. Among such conditions are Tay-Sachs and related diseases, rabies encephalitis and dementias like Alzheimer disease / canine cognitive dysfunction. Over the past two decades, Dr. Martin and colleagues have shown that engineered versions of naturally occurring viruses are safe and effective vehicles for delivery of gene therapy to the nervous system. Gene therapy proven effective in cats and sheep with Tay-Sachs and related diseases is now in human clinical trials, and gene therapy to treat rabies encephalitis shows great promise. With the viral gene therapy platform firmly established, it can theoretically be used to treat any disease for which a genetic intervention is beneficial. Students will participate in ongoing projects related to therapy of neurologic diseases.

Dr. Richard McMullen – Equine Ophthalmology – *The effect of experimentally induced corneal edema on applanation and rebound tonometry.* Both applanation (TonoPen) and rebound (TonoVet) tonometry are routinely utilized to measure the intraocular pressure (IOP) in veterinary patients. However, studies evaluating the efficacy of these instruments generally utilize normal eyes and eyes with glaucoma independent from one another, and clinical patients with glaucoma often have diffuse corneal edema, making interpretation of the tonometry results challenging. The effects of corneal edema on the accuracy of commonly used tonometers in veterinary medicine has not been previously evaluated. This study will utilize enucleated equine globes harvested from horses euthanized for reasons unrelated to this study. The IOP will be measured following enucleation, prior to the creation of corneal edema in the central and/or peripheral cornea. Corneal edema will be induced by injecting 0.5 – 0.8 ml of saline into the corneal stroma using a 30-gauge needle/1ml syringe combination to create an area of corneal edema roughly 10mm x 10mm in diameter. Following creation of the corneal edema previously described, the IOP will be measured with both the TonoVet and the TonoPen in the center of the area of edema as well as in the superior, medial, temporal, and inferior corneal quadrants free from corneal edema. The student selecting this project will gain proficiency in practical surgical
(enucleation of equine globes following euthanasia) and diagnostic evaluation (ophthalmic examination, including applanation and rebound tonometry) skills.

Dr. Richard McMullen and Dr. Tom Jukier – Equine Ophthalmology & Neurology, respectively. 
Comparison of effects between the auriculopalpebral and palpebral blocks in adult horses. Local eyelid blocks (frontal and palpebral) are routinely utilized to facilitate ophthalmic examination by immobilizing the eyelids (especially the upper eyelid). Additionally, eyelid blocks are also commonly used in combination with local orbital anesthesia (retrobulbar block) to perform a wide variety of ocular and periocular surgical procedures in the horse. The use of local anesthesia in combination with sedation have made standing ophthalmic surgery, to some extent, routine within the field of Equine Ophthalmology. The goal of this study is to evaluate and map out the anatomical regions effectively blocked following subcutaneous (palpebral) and subfascial (auriculopalpebral) injection of 1mL and 5mL of local anesthetic, respectively. The initial stage of the study will utilize equine heads obtained from horses following euthanasia for reasons unrelated to this study. Following dissection and preparation of the trigeminal and fascial nerves, nerve stimulation and electrophysiological testing will be used to help us further isolate areas affected by individual nerves. This is an exploratory project that has the goal of identifying the individual nerves or nerve branches that are susceptible to tactile responses, such as are observed during some surgical procedures, e.g., enucleation. The knowledge gained from this study may help us to provide more complete pain control in our equine patients during and following ophthalmic surgery via local anesthesia, and may help to gain a more complete understanding of the innervation of the equine orbit. The student selecting this project will gain experience in equine orbital and periorbital anatomy and neurology, as well as with specialized electrophysiological diagnostic equipment.

Dr. Melissa Singletary and Dr. Lucia Lazarowski The detection canine is the most capable tool for the detection of many hazardous and other targeted substances. The Canine Performance Sciences (CPS) Program conducts research and development to enhance the technology of using dogs for detection of such substances. This effort includes research and development focused on health and welfare management of working dogs throughout all life stages from production to field operations and retirement. CPS summer scholar participants usually perform research that is aimed toward direct application of working dog performance in a supportive partnership with the department of clinical sciences and services such as theriogenology which provide our summer scholars with an opportunity to become familiar with the production, clinical assessments, and health care of performance/working dogs. Throughout exposure and experience across the program, Summer Scholars at CPS will learn about the development, training, and application of detection dogs in addition to performing a chosen project examining metrics for working dog health, welfare and performance in behavioral/cognitive, physical fitness and olfactory-based tasks.

Dr. Bruce F. Smith: Molecular Genetics of Cancer. Several projects are available in the area of the molecular genetics of, and gene therapy for, cancer. Projects include laboratory studies and pre-clinical and clinical trials for dogs with osteosarcoma, lymphoma, melanoma, and breast cancer. These studies the preparation of tumor cells or sections, isolation of RNA, analysis of the tumor transcriptome. They also include creation, evaluation, and administration of novel gene therapy vectors, and the assessment of patient progress, as well as detailed laboratory
assessments of the impact of the therapy. The latest genetic approaches may be used to understand the basis of the disease. Projects involve the use of a wide variety of techniques including RNA and DNA isolation, quantitative PCR amplification, cell culture and flow cytometry as well as animal handling, phlebotomy, tissue biopsy and necropsy.

**Dr. Rachel West:** *Sex-specific differences in placental innate immunity.* Male and female embryos have differences in cell proliferation, metabolism, and growth. These differences often leave male fetuses at risk of complications during pregnancy. Recently, it has been shown that there are significant differences between male and female placentas exposed to SARS-CoV-2 in utero. Pregnancies carrying male fetuses had lower IgG titers, reduced placental antibody transfer, and higher antibody receptor expression. Additionally, male placentas had higher placental expression of interferon stimulated genes. These data provide evidence that fetal sex plays a key role in the placental innate and adaptive immune response. Our lab uses human placental stem cells to better understand the molecular mechanisms behind the sexual dimorphism of immunity during pregnancy. We will expose placental cells to inflammatory agents like lipopolysaccharides and poly:IC to stimulate the placental immune response in male and female placental stem cells then quantify the differences in the immune response between cells. Students will learn stem cell culture, cell differentiation, immunofluorescence and confocal imaging, and molecular gene expression techniques including how to measure RNA and protein levels in placental stem cells.

**Dr. Robyn Wilborn:** *Canine Theriogenology Research Opportunity.* In canine reproduction, accurate prediction of the female’s peak fertile window is paramount to a successful outcome. The Small Animal Theriogenology service commonly monitors normal and abnormal canine estrous cycles via a variety of tools, including vaginal cytology analysis and hormonal testing. Outside of client-owned dogs, the Theriogenology service is responsible for year-round reproductive management of the Canine Performance Sciences (CPS) detection dogs (adult breeding animals, neonates, and puppies). The student working in this position will help our lab investigate the prediction of the peak fertile window and accurate whelping dates using various diagnostic tools. We will compare data between different methodologies used to predict these events; specifically, the use of a point-of-care machine measuring serum progesterone values, and how these values compare to values obtained through the AUCVM Endocrinology service. This student will be exposed to all aspects of clinical canine theriogenology including planned breedings, pregnancy diagnosis, C-sections, and neonatal care. Additionally, they will assist with nursery care, puppy development, and training alongside CPS staff to gain a better understanding of the CPS program and reproductive management goals. Active participation in all CPS activities (neonatal care, puppy development and training) will be scheduled in partnership with another summer student working under the direction of the CPS program. Both students will become proficient in canine theriogenology techniques by the end of the program, as well as develop their clinical skill set with a tremendous degree of hands-on experience.