Drs. Dawn Boothe and Kamoltip Thungrat. *Genetic Analysis of Canine Cannabinoid Receptor-1* The use of cannabinoid products in veterinary medicine is an area of growing interest, largely due to the therapeutic benefits being observed in human medicine. However, the challenge in veterinary professionals is a lack of evidence in companion animals. Current research projects in our lab revolve around the use of cannabinoid products and their therapeutic effects in veterinary medicine. One of the studies is focusing on characterizing cannabinoid receptor (*CNR*) genes in companion animals. We analyzed the canine *CNR1* gene and found two novel point mutations in dogs; therefore, further investigation is needed to verify how these mutations could be related to DNA transcription, receptor structure, and functions, e.g., ligand-binding and signal transduction. The summer scholar will join our lab group and work focus on characterizing the canine *CNR* gene project to explore the roles of canine *CNR-1* mutations.

Dr. Kayla Corriveau: One of the following two projects may be selected:

Bacterial adherence to metal orthopedic implants. A study to test thebacterial adherence to different orthopedic implants based on metal composition and surface roughness. We will be inoculating sterile orthopedic implants with Staphylococcus. The objective is to determine if the metal composition or surface roughness of the implant will affect the bacterial numbers that colonize the plate. The testing samples will include 3 metals (316L stainless steel, CP titanium, and Titanium 64) with four surfaces (commercial product, 3D printed, 3D printed after single shot peening, and 3D printed after dual shot peening). The reason for this project is the industry's increased interest and use of additive manufacturing (aka 3D printing) for metal implants. When they come out of the printer, the surface is very rough and is often post-processed to a more desired finish. There are times that we want a rough finish for bone integration but, on standard fracture plates, a smooth finish is the standard for commercially available implants.

Surgical gown permeability study. A study to test disposable versus reusable surgical gown permeability to fluid and bacterial translocation. In this period of COVID19 and future outbreaks that could limit veterinary medicine's access to disposable surgical PPE, it is prudent to put more reusable surgical PPE to the test. In this experiment, we will compare the permeability of disposable gowns to a variety of reusable options at baseline (first use) and subsequent uses after several sessions of washing, dry, and re-autoclaving. This will help determine relative permeability at baseline and over time.

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. 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 adrenaogonadal 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: I will be working on a technique to use the canine transcervical scope in cats. This study will consist of a cohort of cats that will be set up hormonally for insemination. Half the cats will be inseminated using fresh semen collected from the male via electroejaculation and half will be inseminated with frozen semen. There is not a described technique using vaginoscopy to pass a catheter nonsurgically into the uterus in cats or using this technique to produce kittens.

Dr. Constantinos Kyriakis: *Antigenic and genetic evolution of influenza A viruses in the presence of preexisting homologous or heterologous immunity in the porcine model* Influenza A viruses (IAVs) infect a wide range of host species, including wild birds and poultry, humans, swine, horses and other mammals. Influenza is one of the leading causes of outbreaks of respiratory disease in humans, resulting in approximately half a million deaths every year world-wide. At the same time, it is the second most important viral disease in pigs, contributing to severe economic losses to the swine production industry. One important characteristic of IAVs is the fact that they escape immunity by antigenic drift, which is the result of the accumulation of point mutations, mainly in the gene segment expressing the hemagglutinin (HA) protein. This mechanism, which is not fully understood, is responsible for the annual outbreaks of disease in

the human population despite previous exposures and preexisting immunity due to infection or vaccination. It is also the main reason why influenza vaccines in both humans and pigs are not highly efficient. In the proposed study we will use the porcine model to study this phenomenon. We will infect or vaccinate pigs with one of two strains of H1N1 IAVs: A/California/07/2009 or A/swine/North Carolina/154076/2015, generating a homologous or heterologous to challenge immune response. We will then monitor both humoral and cell-mediated responses, and finally challenge pigs with A/California/07/2009. Following challenge, we will collect nasal swabs over a period of 10 days and deep-sequence them by Next Generation Sequencing (NGS). By analyzing the NGS data and combining them with our serology, we will identify patterns in virus evolution under different types of immune pressure, develop a model that could predict the trajectory of viral quasispecies and discover novel correlates of protection against infection and disease.

Dr. Richard McMullen: One of the following two projects may be selected:

Comparative evaluation of the equine fundus using fundic images and optical coherence tomography. This is a retrospective evaluation of fundic and optical coherence tomography images as a means of increasing our understanding of many posterior segment changes observed in horses. Both imaging techniques are non-contact in nature and are utilized routinely during equine ophthalmic examinations at Auburn university. Fundic imaging utilizes a dedicated camera that focuses directly on the posterior segment, allowing for visualization of the retina (tapetum and non-tapetum), and optic disc similar to the view obtained during direct ophthalmoscopy. The optical coherence tomography utilizes infrared light to obtain a high-resolution image comprised of hundreds of A-scans. Examples of common posterior segment abnormalities that we are interested in evaluating are: optic nerve head cupping, peripapillary retinal folds, retinal detachment, retinal degeneration and pigment clumping.

Influence of viscoelastic on corneal tissue welding using indocyanine and infracyanine green photosensitive agents. This study will attempt to determine the effect of viscoelastic material on corneal tissue welding via indocyanine and infracyanine green photodynamic therapy. In a follow-up study evaluating infracyanine green – based photodynamic therapy on full-thickness corneal incisions, the introduction of viscoelastic material into the anterior chamber prior to the application of laser energy completely prevented any discernible tissue welding effect, contrary to our initial study results. This study would use an in-vitro evaluation of corneal tissue buttons variably coated with viscoelasted both prior to or following the application of the photosensitive dye to the cut surface. Following diode laser energy application, the buttons will be placed in formalin and submitted for histopathologic evaluation.

Dr. Amarjit Mishra: *Molecular mechanism of asthma pathogenesis*. The main goals of the laboratory is to identify novel pathways that regulate distinct feature of asthma pathogenesis in obesity, which then may inform us regarding the development of new treatment approaches. Obese asthmatics have a higher incidence of asthma complications and respond poorly to typical asthma medications, leading to greater healthcare utilization and a reduced quality of life. The major research theme of the laboratory centers on how obesity contributes to the proliferation and differentiation of dendritic cell (DCs) - restricted common DC progenitor cells (CDPs) and focused on understanding the imperative signals in progenitor cells involve in obesity-associated

airway inflammation. The hypothesis is based on that obesity exacerbates airway inflammation in asthma by inducing the proliferation and differentiation of CDPs, which enhances the ability of DCs in the lung to promote adaptive immune responses. A specific objective of the research in the proposal is to identify novel endogenous signaling pathways and druggable targets in CDPs related to adaptive immunity that regulates airway inflammation in obesity. The proposal will utilize synergistic combination of murine models of experimental obesity induced airway inflammation and cellular investigations of immune and progenitor cell functions. The laboratory employs experimental techniques including airway hyperactivity measurements, multicolor flow cytometry, biochemical and immunological evaluation of the disease. Students may participate in both experimental procedures and laboratory research. This work is supported by the National Heart, Lung, and Blood Institute of the National Institutes of Health.

Drs. Melissa Singletary and Lucia Lazarowski: *Evaluating Impact of Maternal Behavior on Puppy Development.* The lack of domestic production of detection dogs has been identified as a critical security gap by the U.S. Congress. The U.S. Congress has directed the Department of Homeland Security to advance the domestic production of detection dogs. This initiative will result in new opportunities for veterinary medical research, development, and practice. The AUCVM is at the forefront of this initiative, which will provide its veterinary students with valuable experience to apply in research and/or clinical practice. The increase in domestic production of detection dogs will create a market for veterinarians with specialized experience in the production and care of working detection dogs. Post-whelping experiences of puppies is largely dependent on maternal behavior and has a significant impact on the subsequent physical and behavioral development of puppies. The Canine Performance Sciences (CPS) Program produces elite dogs that go on to serve high-profile roles in the United States in detection of explosives and other contraband/hazardous materials. CPS is investigating the influence of maternal behavior on the development and future outcome of offspring. The student shall engage in all areas of the research process from study design, literature review, data collection, data analysis, and reporting. As a collaborative activity in association with the Theriogenology Service, the student will be exposed to clinical duties in the Bailey Small Animal Teaching Hospital under the guidance of Dr. Robyn Wilborn (e.g., canine breeding, management of pregnancies and C-sections, postpartum and neonatal care). Additionally, this person will gain hands on experience in puppy development activities and observe training sessions with CPS staff to better understand what is required of these dogs and how performance is measured. Some weekend duties may be required (depending on due dates and C-sections), but schedules will be arranged with ample planning and weekend duties will be shared with the student from Dr. Wilborn's Summer Scholar project.

Dr. Bruce F. Smith: *Molecular Genetics of Cancer.* Several projects are available in the area of gene therapy for cancer. Projects include laboratory studies and pre-clinical and clinical trials for dogs with osteosarcoma, lymphoma, melanoma, mast cell tumor and breast cancer. These studies involve the creation, evaluation and administration of gene therapy vectors and novel biological molecules, 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. Amol Suryawanshi: *Cancer Immunotherapy & Anti-viral Immunity*. Our laboratory's research mainly focuses on targeting immuno-regulatory signaling pathways in dendritic cells (DCs) to regulate $CD4^+$ and cytotoxic $CD8^+$ T cell responses during tumor progression and viral infections (Influenza A Virus and Herpes Simplex Virus). The long-term goal of our lab is to develop novel immunotherapies targeting DCs to suppress tumor progression and promote anti-viral immunity. We are using different *in vitro* and *in vivo* experimental approaches to identify DCs-specific molecular and cellular targets that play an important role in evasion of host tumor and anti-viral immunity. Summer scholar working in our lab will have an opportunity to learn different cellular & molecular immunology techniques such as- cell surface, intra-cellular and intra-nuclear staining, flow cytometry, cell-sorting using magnetic beads, ELISA, Western-blot, mouse genotyping, PCR, RT-PCR, mammalian cell culture including various tumor cell lines, primary immune cell isolation and culture, bone marrow differentiation to DCs, T cell differentiation and proliferation assays, apoptosis assay, phenotypic and functional characterization of immune cells, virus culture, virus quantification by plaque assay, immuno-metabolism etc. Summer scholar will get an exposure to design hypotheses, experimental plan of study, conduct basic cellular immunology research, analyze and interpret data. Preliminary *in vitro* studies will be conducted using mouse bone marrow derive DCs (BMDCs) treated with tumor cell supernatants or co-cultured with various tumor cell lines (melanoma, lymphoma, breast cancer etc.) in the presence or absence of different agonist/antagonists of immunoregulatory signaling pathway/s to analyze the DCs immunogenicity. Further *in vitro* studies will be carried out using BMDCs generated from DCs-specific conditional knock-out mice followed by *in vivo* studies using mouse syngeneic tumor models.

Dr. Haroldo Toro: *Viral diseases of commercial poultry*. Our laboratory seeks to understand infectious diseases affecting the poultry industry and develop strategies/tools to prevent outbreaks of disease.

Dr. Robyn Wilborn: For pregnant dogs, accurate prediction of whelping date is paramount to a successful delivery. The Small Animal Theriogenology service commonly monitors normal and abnormal canine pregnancies via ultrasonography 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 based on available diagnostic tools, and will compare data between different methodologies used to predict these events. 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 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. The student will become proficient in canine theriogenology techniques by the end of the program, as well as develop their clinical skill set with a great degree of hands-on experience. Some weekend duties will be required (depending on estrus cycles), but schedules will be arranged with ample planning and weekend duties will be shared with the student from Dr. Singletary and Lazarowski's project.