EXAMPLE EXPLANATIONS AND DESCRIPTIONS:

The following are examples of capstone proposal prompts that have been approved in prior years. Please work with your Honors advisor and faculty mentor to ensure that your proposal is complete and ready for approval by the Director of Academic Affairs.

Section A

Example 1: Traumatic injury to the trigeminal nerves can lead to debilitating chronic orofacial neuropathic pain in humans (Ma et al., 2012). In this study, we will stimulate the trigeminal nerve in a model called trigeminal inflammatory compression (TIC). TIC surgery involves placement of a piece of chromic gut suture (2mm) along the infraorbital nerve (the second branch of the trigeminal nerves), which causes inflammation of the nerve and hyper-sensitivity at the whisker pad (Ma et al., 2012).

This capstone aims to take the trigeminal nerve injury model and evaluate pain neuron activity with a marker gene that is expressed during neuropathic pain: extracellular signal-regulated kinases (ERK). ERK is a protein kinase intracellular signaling molecule that regulates many bodily functions, including meiosis, mitosis, and post-mitotic functions in differentiated cells. This protein is a classical Mitogen-activated protein (MAP) kinase (Noma et al, 2008). These kinases are activated via phosphorylation (addition of a phosphoryl group) to the kinase (pERK is the phosphorylated ERK). pERK is the marker of trigeminal neuron activation that I will be quantifying. I expect that stimulation of the orofacial region in mice with trigeminal nerve injury will induce pERK expression in specific regions of interest, including the trigeminal nucleus, which lies in the caudal brainstem and cervical spinal cord.

My capstone will focus on a molecule that we hypothesize to cause chronic orofacial pain: exchange protein activated by cAMP (Epac). Epac is a Rap guanine-nucleotide exchange factor that are linked to inflammation and nociception. Two forms of Epacs (Epac 1 and Epac 2) are upregulated in the dorsal root ganglion (DRG) during inflammation. (Noma et. al, 2008). In past studies, incision-induced inflammatory injury increases the expression of Epac1 and 2 in DRG neurons of rats (Noma et. al, 2008). Dr. Zhang's pilot studies suggest that an Epac inhibitors decreases the sensitivity to touch-evoked pain, termed allodynia,. In my study, I will further explore the use of an Epac inhibitor to reduce mechanical sensitization on the affected whisker pad.

I hope to continue this research not only during the gap period between my undergraduate career and my admission into Medical School, but also during medical school. This type of research reinforces the anatomy and different neuronal pathways that interest me being a Neuroscience major, and different biochemical reactions that also interest me as a Chemistry major.

Example 2: The topic of my thesis will be developmental programming. Developmental programming is a field of study that explores the correlation of maternal environment (i.e smoking, exercise, diet, environmental toxicant exposure) and offspring health. Specifically, this project will be exploring the effects of in utero polychlorinated biphenyl (PCB) exposure. Though PCBs were banned for industrial use in the 1970's, PCB exposure and pollution persists today. PCBs are classified as endocrine disrupting chemicals; thus, PCBs may contribute to the development of metabolic disease. In the past, our laboratory has shown that in utero PCB exposure can alter offspring glucose homeostasis and body composition in a mouse model.

In this project, we will be examining the changes in mRNA expression using NanoString in various tissues of fetuses and mothers exposed to in utero PCB in a mouse model. Specifically, we will be examining target metabolic genes that may contribute to the metabolic disease phenotype we observed in our in vivo experiments. Additionally, we will be confirming our NanoString mRNA expression results with real-time quanititative PCR. Thus, the overall goal of this project will be to make a reasonable hypothesis of a mechanism by which in utero PCB exposure leads to offspring metabolic diseases by examining any gene expression differences in the fetuses of mice exposed to PCB in utero vs. controls. Further, we will also examine if there is a similar pattern of perturbed gene expression in both fetal and maternal tissue to better understand how PCBs directly affect metabolic gene expression in both the fetus and the mother.

This project relates to my overall educational objectives by teaching me critical skills to succeed as a scientist in the future, including basic science techniques, data analysis, presentation skills, and scientific writing. In the future, I have aspirations to be a physician-scientist. It is key to have a high aptitude in all of these skills in this career. Thus, this project will directly benefit me by allowing me to sharpen and expand my scientific skillset.

Example 3: In 1925, Frederick Hisaw published a study on pubic bone re-absorption in mature female pocket gophers as an adaptation for being a subterranean (= tunneling) species. From this work, he eventually discovered two reproductive hormones, relaxin and oxytocin. Since this initial research, much work has been done on the relationship between hormones and bone re-absorption in humans, but almost nothing on rodents and other small mammals. From years of trapping, Dr. Krupa has observed that in other species of rodents and insectivorous mammals some females lack pubic bones as well. Some of these species are very different ecologically from pocket gophers. From this, the question arises why non-subterranean species of mammals exhibit this phenomenon as well. My research will explore what possible adaptations exist for female non-subterranean mammals to lack pubic bones. Are there certain ecological conditions that are associated with this phenomenon? My project will explore this by examining published literature and the skeletal materials available in the University of Kentucky Vertebrate Collection. This project will also involve field work collecting other small mammal species living in other ecological conditions to examine their pelvic bones.

Example 4: My capstone is focused on epigenetic causes of allergic diseases such as asthma, environmental allergies, and food allergies. As the incidence of these conditions has increased exponentially over the past 20-30 years, scientists' and clinicians' desire to determine their causes has increased as well. Prior studies have demonstrated that allergic conditions are not purely inherited nor attributable solely to environmental influences. Since epigenetics involves the intersection of genetic and environmental factors, it has been extensively studied in recent years as a possible explanation for the increase in allergic diseases.

My goal is to investigate how epigenetic factors may influence the onset of allergic disease, and present these first via a written assignment, and later by a public presentation. Members of both scientific and non-scientific backgrounds will be asked to attend the presentation and ask questions. This will be accomplished through advertising on social media and recruiting classmates and friends.

In addition, as someone who has been involved in the allergy community for many years, I have witnessed a significant amount of misinformation about allergic conditions. Emerging research on their causes has led to controversy; for example, the so-called "hygiene hypothesis" has led many to argue that allergic diseases are a result of excessive cleanliness. Additionally, websites purporting to have

discovered easy cures for allergic diseases are widespread. Thus, a second objective of mine is to assess the validity of claims regarding causes of and treatments for allergic conditions. I will accomplish this through review of primary literature.

This capstone relates directly to my desire to enter the medical field. I am currently applying to medical school and have always had a specific interest in allergy and immunology. Therefore, this project will not only allow me to explore that subject, but will also sharpen skills important for medical students (such as the ability to analyze primary literature).

Section B

Example 1:

- Student is able to interpret mRNA expression data in the larger context of phenotype. Student should be able to draw conclusions from NanoString and real-time quantitative polymerase chain reaction (RT-qPCR) data in regards to how mRNA expression may be related to phenotype.
- Student is able to independently execute RT-qPCR experiments in the lab.
- Student is able to write the results from this study in a formal and scientific style. Additionally, the student will be able to statistically analyze, graph, and discuss the results from the study.
- Student is able to analyze existing literature in the field in order to interpret the results of the study in the context of the previous experimental work that has been performed in this area of study.
- Student is able to reasonably hypothesize a potential mechanism of action based on experimental gene expression data by which in utero PCB exposure leads to metabolic disease in offspring.

Example 2:

At the end of this course, I should be able to:

- Understand how to conduct a thorough research review, taking care to analyze each paper for pertinent information.
- Understand the process of bone re-absorption in both humans and small mammals.
- Examine the pelvic girdle for evidence of re-absorption and/or loosening.
- Know the ecology of each organism I study and how it may or may not affect the process of re-absorption.
- Synthesize all my findings into a cohesive paper that explains the relationship between ecology and absorption of the pubic bone.

Example 3:

- To convey current and historical information about communication theory.
- To provide students with a knowledge of the scope and parameters of the field.
- To introduce students to the areas of the field.
- To help students understand the variety of ways in which communication has been viewed.
- To have students understand the powers and limits of perspectives.
- To help students see the values of using multiple perspectives in evaluating their communication experiences.
- To build an understanding of the ways in which communication inquiry occurs.
- To develop a sense of the place of theory in inquiry.
- To examine the products of different lines of inquiry.
- To inform students about what constitutes theories of communication.

- To inform students on the different types of theories.
- To provide insights into the similarities and differences among ways of making inferences and building theories in communication.
- To develop the students' ability to make well founded generalizations about communication.
- To develop student competencies in using theories to analyze actual events.
- To help students become more perceptive observers of communication.
- To help students be socialized into the "graduate" environment in the College of Communication and Information.
- To identify an area of communication research and a series of provocative theoretical questions appropriate for study.

Example 4:

- Explain the effects of epigenetic modification on allergic diseases (e.g. asthma, food allergy)
- Describe the influence of environmental factors on gene expression in these diseases
- Conduct a critical analysis of primary literature
- Compare popular beliefs about allergic disease with the perspectives of current scientific literature
- Present my findings through both oral and visual means (i.e. a final presentation and a written assignment)
- Effectively respond to questions from both lay and scientific audience members
- Discuss other prevailing hypotheses on the causes of allergic diseases
- Examine how epigenetics and other emerging fields may contribute to treatment for these diseases

Example 5:

Upon completion of this course, student will have:

- Developed an understanding of the role of the costume designer and the process of costume design
- Refined script and character analysis skills
- Understand the importance of and be able to do research for costume design
- Developed skills in sketching and rendering ideas
- Completed a costume design for the UK Department of Theatre and Dance's fall production of Little Shop of Horrors.

Section C

Example 1:

Over the course of this semester the student will work with the faculty to execute costume designs for the UK Theatre and Dance Department's fall production of Little Shop of Horrors. The duties of the student include (but are by no means limited to):

- Developing extensive research of the time period and production
- Using practical knowledge of costume design to create renderings of costumes for the cast of the show and progress in the production of the costumes for the show
- Attending rehearsals and work with the director to provide rehearsal materials
- Working with costume faculty to create and follow budgets provided for the show
- Working with students to lead and instruct the building of costume pieces
- Creating organizational documents, spreadsheets, charts, etc. for faculty and students

- Training and instructing backstage crew students on designs and the successful execution of all change that occur during the show
- Attending tech weeks and performances in order to ensure that the final design is executed to the fullest extent of the students abilities.

Example 2:

- Participate in the generation of an Experimental Design, animal and laboratory experimentation, and the collection and analyzation of data
- PowerPoint Presentation of experimental plan and experimental results to Dr. Taylor and our laboratory meetings
- Presentation at Undergraduate Research
- Showcase Summary of Experience in lab
- Final Paper of Project including Title, Introduction, Methods, Results, Discussion, and References

Example 3:

- 03/01/18: Complete any necessary experimental work necessary for this project, which will likely include RT-qPCR. Complete any statistical analysis on experimental data.
- 03/07/18: Complete figures and poster (turned into and reviewed by faculty mentor)
- 03/13/18: Present poster at Society of Toxicology Annual Meeting 2018 in San Antonio (Abstract Already Accepted)
- BY 04/25/18: Write a complete scientific manuscript of results from this study (4500+ words) and submit to a scientific journal (turned into faculty mentor)

Example 4:

- Research Review
- Research into bone absorption in both humans and rodents
- Examination of pelvic girdles
- Research into the ecology of these animals
- Synthesizing the influence of ecology on bone re-absorption into a cohesive paper
- Presentation at Showcase of Undergraduate Scholars

Example 5:

Schedule (at each stage, items will be submitted to Dr. Osterhage for grading and feedback.)

- By the end of September (~September 24th): Complete an outline of the written assignment, including a list of references to be used.
- By the end of October (~October 22nd): Complete a first draft of the written assignment.
- By mid-November (~November 12th): Edit draft of written assignment and submit a final copy.
- By the end of November (~November 26th): Complete a preliminary presentation, including visual aids.
- By the last day of class (December 8th): Present the project to a public audience.

Dr. Osterhage and I will meet on a monthly basis to discuss my progress on the capstone project. Deadlines and objectives may be adjusted slightly at these meetings (if necessary and approved by Dr. Osterhage.)

PRE-APPROVED GRADING SCALES

Example 1:

10% Email and Oral discussions with Dr. Taylor
40% Laboratory Research
10% Participation in laboratory meetings
10% PowerPoint presentation in laboratory meeting
30% Final paper

Example 2:

All Research Review- 33%
Examination and measurement of pelvic girdles- 33%
Final paper and presentation- 33%

Example 3:

10% Outline of written assignment
20% First draft of written assignment
10% Monthly meeting
60% Final project and presentation

Example 4:

30% Research
5% Attendance at meetings/rehearsals/performances
30% design work
35% finished costumes for use in theatre production

Example 5:

50%: Manuscript
40%: Poster and presentation
10%: Performance in lab