2016-2017 FYRE Research Project Descriptions

**Students:** Please use these project descriptions to determine which FYRE research projects interest you the most. Then complete the application form (located at [http://casb.mst.edu/forms/](http://casb.mst.edu/forms/)) and submit it to casb@mst.edu by Friday, November 11, 2016.

If you have any questions, please direct them to Dr. Kate Drowne at kdrowne@mst.edu.
Title of Research Project: The 2016 Presidential Campaign: Understanding Constructs of Gender and “Outsider” in a National Campaign

Faculty Mentor: Terry Robertson

Department: Speech and Media Studies (Department of Arts, Languages, and Philosophy)

Description of Research Project:
This research project will utilize quantitative content analysis to explore campaign advertisements from the Clinton and Trump campaigns. Differences in style, content, design, visual effects, aggressiveness, and character issues will be studied. The outcome of the analysis will facilitate both academics and practitioners as they study and design advertising campaigns for candidates.

This study will add to the literature concerning the effectiveness and impact of campaign advertising. Especially cogent in this campaign will be the fact that a woman is, for the first time, campaigning for the presidency and that a candidate that has never held political office is running as well. Thus, quantitatively measuring practices in campaign ads becomes important as a baseline for future campaigns involving similar candidates. Ad placement will also be explored in order to discern where candidates decided were the most effective venues and times for advertising. Finally, two aspects, negativity and humor, will be probed in order to determine the amount and type of negativity and humor that were in the ads.

Description of FYRE student’s responsibilities:
The first responsibility of the student will be to aid in the creation of an advertising database that will be used to review and code the ads.

Second, the student will assist in the creation of a content analysis coding instrument and coding book that will be utilized in performing the research. The student will then help with overseeing the coding.

Third, the student will help to compile the data set that will be used in the analysis and then be introduced to statistical processes that will point out advertising practices used by both candidates.

Finally, the student will be acclimated to the process of writing a social science research report. Included will be the introduction, literature review, methodology, results, and discussion portions of the paper.

Timeline:
Jan/Feb – gather ads and write coding instrument.
March – Code the ads
April/May – Write the report

The paper will be submitted to a conference and journal. The student’s name will appear as a co-author if he or she chooses to write or co-write a portion of the paper.

What skills will the FYRE student acquire or enhance as a result of participating in this project?
The student will learn the dynamics of quantitative social science research as well as the tools needed for content analysis of media artifacts. Further, the student’s technical writing skills will be enhanced by participating in the writing process of the research paper.
Title of Research Project: Monologues of Women in STEM prior to 1950

Faculty Mentor: Jeanne Stanley

Department: Theatre (Department of Arts, Languages and Philosophy)

Description of Research Project:

Discover and research at least five women who were active in each of the STEM fields prior to 1950. Recover little-known quotations and truths about these women’s lives. Write in the style of The S.T.E.M. Monologues, a section to be added to the play.

Timeline: January through mid-March: research and gather materials, (approval of women by end of February)- Mid-March to the end of April: blend the stories together in the style of the play. Meet weekly with the professor in person.

What skills will the FYRE student acquire or enhance as a result of participating in this project?

The student will learn to research women in history in each STEM area, discover the cogent material, edit and then write a part of a play to be performed in February, 2018. The student will learn to bring history to life, recreate the lives of STEM women, and elucidate this history within the context of The S.T.E.M. Monologues. Take-away: An appreciation for women’s contributions from an earlier generation, the ability to cull and edit appropriate materials, and playwriting skills. The joy of seeing the student’s work come to life on a stage.
Title of Research Project: Simultaneous Determination of 15 Pteridines Using Capillary Electrophoresis – Laser-Induced Fluorescence

Faculty Mentor: Yinfa Ma

Department: Chemistry

Description of Research Project:

This research project will involve the development and validation of an analytical method for the simultaneous determination of 15 pteridine derivatives using our proprietary P-Scan technology. Briefly, elevated levels of pteridine derivatives have been reported in the urine of women diagnosed with breast cancer as putative biomarkers for early risk screening. This project will expand upon our previous methods by increasing the number of pteridine derivatives that can be monitored by our technology. The resulting method will enable researchers and clinicians to more accurately characterize tumor biology in cancer patients by examining a greater panel of metabolic biomarkers.

Description of FYRE student’s responsibilities:

Weeks 1-2: The student will first be introduced to the P-Scan instrumentation and its fundamental operating principles. The student will gain a basic understanding of the how’s and why’s of biomarker research and the basis of capillary electrophoresis – laser-induced fluorescence.

Weeks 3-4: The student will work closely with a graduate student mentor to validate an existing method for the determination of 8 pteridine derivatives. This task is designed to provide the student hands-on familiarity with the instrumentation, the analytical technique, and an introduction to method validation aspects in analytical chemistry.

Weeks 5-9: Continuing to work closely with his or her graduate student mentor, the student will add 7 additional pteridine derivatives to the established method. This task will involve optimizing technique parameters, such as buffer type, buffer concentration, and separation voltage. As a result, the student is expected to gain a working knowledge of the analytical technique and an introduction to method development aspects. Finally, the new method will be validated again, employing the knowledge learned during Weeks 3-4.

Week 10-12: The student will be expected to prepare a short manuscript on his or her research project. This “workshop” is designed to teach the student the basics of scientific literature.

What skills will the FYRE student acquire or enhance as a result of participating in this project?

This research will offer the student a diverse range of experiential learning opportunities, ranging from cancer biomarker research to hands-on work with advanced research instrumentation to analytical method development. Although the project has significant intellectual merit and is anticipated to contribute to a peer-reviewed manuscript, the research will remain accessible to inexperienced students given the use of previously developed methods from which the student may learn the fundamentals of the technique. As a result, the student will gain an understanding of basic research, biomarker research, analytical method development, capillary electrophoresis – laser-induced fluorescence techniques and instrumentation, and scientific literature. The introduction of additional pteridine biomarkers to the established method will present a critical thinking opportunity to the student whereas the writing workshop will enhance their writing skills and abilities. The project has also been designed to capture the student’s interest in an exciting research program to lead to additional research experiences through the OURE program.
Title of Research Project:  Engineering Students’ Perceptions of Academic Integrity

Faculty Mentor:  Amber M. Henslee

Department:  Psychological Science

Description of Research Project:

As part of a larger study investigating academic integrity among FE 1100 students at Missouri University of Science and Technology, we have collected data on student perceptions of academic integrity. These data are currently being analyzed by the PI (Dr. Henslee), Dr. Gayla Olbricht, and one of her Master’s students in the Mathematics and Statistics Department. Upon completion of analyses, the results will be written in manuscript format and prepared for submission to a professional, peer-reviewed journal. Anticipated avenues for publication include the Journal of STEM Education and the Journal of Engineering Education. Results from this project will help to inform university instructors and administrators of student perceptions regarding academic integrity, and subsequently to establish educational programs designed to address integrity issues among college students.

Description of FYRE student’s responsibilities:

The FYRE student will conduct a literature search related to academic integrity among college students. Using the results of this search, the FYRE student will write components of the introduction section of a manuscript as well as components of the discussion section. The FYRE student will also learn how to format a manuscript in APA style, including the Reference section. After the manuscript is complete, the FYRE student will assist in submitting the paper to a professional, peer-reviewed journal. Depending on the outcome of the submission, the FYRE student will assist on revisions and resubmissions toward the end goal of a publication.

What skills will the FYRE student acquire or enhance as a result of participating in this project?

The following skills will be learned: 1. How to conduct a literature review of scientific psychological research, 2. How to begin technical writing of a professional manuscript, 3. How to format a manuscript per specific peer-reviewed journal guidelines, and 4. How to submit a manuscript to a professional, peer-reviewed journal.
Title of Research Project: Using Theatre to Improve Understanding of Diversity

Faculty Mentors: Jessica Cundiff and Susan Murray

Department: Psychological Science

Description of Research Project:

In February 2017, Professor Stanley will present a workshop production of her new play, *The STEM Monologues*. We want to research women’s and men’s knowledge and attitudes about gender bias in STEM fields before and after seeing the play. Research questions we will explore include:

- Does the play have a positive impact? Specifically, after seeing the play do people:
  - Report more empathic concern for women in STEM?
  - Demonstrate increased knowledge about gender bias in STEM?
  - Express less sexist attitudes?
  - Express more interest in learning about gender bias in STEM?

- Does the play have unintended negative effects? Specifically, after seeing the play do people:
  - React against the information presented (such as denying that the experiences are true)?
  - Feel like they may be stigmatized in STEM?
  - Feel a lower sense of belonging and fit in STEM?
  - Report lower self-efficacy to positively affect change in STEM?

- Do women and men react to the monologues differently?

Description of FYRE student’s responsibilities:

The student will see a psychology research project first-hand. The student will gain experience searching and summarizing journal articles in the field. The student will be able to participate in preparing a research proposal for external funding to extend this project the following year. Specifics of the FYRE project are:

- In January the student will help with a literature review and the development of the survey instruments.
- In February when the play is presented, the student will attend the performances and help administer the surveys.
- In March the student will help with data analysis which can include working in Excel and using SPSS to run statistical analysis. Knowledge of SPSS and statistics is not required but would be a plus.
- In April the student will help write up the results and help prepare a proposal for additional funding. The project will continue during the ’17-18 school year and the FYRE student could likely apply for OURE funding to continue this project or be funded by a grant if external funding is received.
- The student will present findings at the Undergraduate Research Conference.

A successful student can potentially continue participating in this research project beyond the spring 2017 semester.

What skills will the FYRE student acquire or enhance as a result of participating in this project?

The FYRE student will learn how to conduct a literature review and statistical analysis which will help him or her in future classes. The student will gain valuable skills in how to create and assess valid and reliable surveys – a skill that is in high demand in many business organizations. The student will also learn how to synthesize large amounts of data into a presentable format. The student will also get to experience the research process, with its ups and downs, to learn if research with human subjects is something he or she is interested in pursuing. If the student eventually applies to a psychology graduate program, this research experience will give him or her a leg up in the application process.
Title of Research Project: Construction of Scanning Tunneling Microscope

Faculty Mentor: Yew San Hor

Department: Physics

Description of Research Project:

The project is designed for first year undergraduate students in acquiring the experimental skill in constructing a home-built scanning tunneling microscope (STM) and performing surface morphology characterization of materials by using the STM for condensed matter physics research. A very sharp metallic needle with about one atomic size tip is needed for building a STM. Students will learn to sharpen the metallic needle by using reverse electrochemical etching. The tip is then brought near a surface of a conductive sample by a piezoelectric scanner. A small bias voltage is applied across the gap between the tip and the sample. If the gap is about a nanometer, electrons can flow across the gap via quantum tunneling. Depending on the gap size, the tunneling current is typically in the pA to nA range. This tunneling current can be amplified by an operational amplifier and then the amplified current will be measured. The amplified current is then fed into a feedback loop which controls the tip height or the z-axis of the piezoelectric scanner in order to maintain a constant gap between the tip and the sample surface by keeping the constant tunneling current. The piezoelectric scanner is capable of sub-angstrom motion in x, y and z directions. The x and y axes of the scanner are used to raster scan the tip across the sample. By measuring the z-axis voltage as a function of scan position, an image of the sample surface topography can be obtained.

Description of FYRE student’s responsibilities:

Jan 17 to Feb 16: Student who is conducting the project will first learn to produce a sharp metallic tip by using either a platinum iridium (PtIr) or a tungsten wire for the STM setup. The student will learn to sharpen the tip by utilizing an electrochemical etching process. Etchant such as 2N sodium hydroxide solution will be used for sharpening tungsten wire. For sharpening PtIr wire, calcium chloride solution will be used. The electrochemical etching setup uses a 12 volt DC power source. The student will perform the task in finding an optimum condition for obtaining the sharpest tip. The sharpness of the tip can be inspected under an optical microscope. The process will take a month to produce a sharp STM tip.

Feb 17 to March 16: The student will learn how to mount the STM tip on a piezoelectric scanner. A piezoelectric scanner and its controller can be purchased from Nanomagnetics Instruments. The controller has USB interface to a personal computer. The student will install the software, learn how to operate the controller and perform the STM experiment. The student will spend a month setting up the STM scanning tip and obtaining the first STM image on a known specimen, for example highly ordered pyrolytic graphic.

March 17 to May 3: The student will conduct an experiment to characterize a new sample, such as doped bismuth selenide. Bismuth selenide is one of the most widely studied topological insulators. Doping of a transition metal in the material is interesting for the studies of inducing superconductivity and magnetism in topological insulators. The surface characterization of the doped topological insulators is important in the research. The student will contribute his/her effort in the research. It is expected that the student will have a surface topography of a doped bismuth selenide within a month.

What skills will the FYRE student acquire or enhance as a result of participating in this project?

The student who participates in the project will acquire experimental skills of electrochemical etching, constructing experiment devices, computer interfacing, and STM technique. He/she will gain some research experience in obtaining surface topography, characterizing surface structure and analyzing experimental results.
**Title of Research Project:** Objective Detection of Sleepiness Using Physiologic Measures

**Faculty Mentor:** Matthew Thimgan

**Department:** Biological Sciences

**Description of Research Project:**

Inadequate sleep is a threat to the health of an individual and all of our public safety. Sleepiness can be as cognitively impairing as alcohol. Sleep-deprived decision making has led to such disasters such as the Exxon Valdez, the near meltdown at Three Mile Island, and the refinery explosion in Texas City. On a smaller scale, sleep deprivation also accounts for errors in truck drivers, pilots, and doctors. Unlike a breathalyzer for detecting alcohol, there is currently no method to assess how sleepy an individual is which is key to know if he or she is fit to drive or do other tasks. This project aims to develop a simple, objective, and inexpensive and 30 sec to 1 min metric to assess human sleepiness in real-world situations, such as factories, military environments, or other workplace settings. We have recruited 10 subjects for Fall 2016 and for Spring 2017 to complete a survey, cognitive tasks, and physiologic measures twice a day, twice a week. Data will be collected and analyzed by investigators in Biological Sciences, Psychology, Mathematics, and Engineering Management. In addition, we will evaluate the test takers’ attitudes toward the testing process and the results to improve the usability of tests.

**Description of FYRE student’s responsibilities:**

Initially, the participating student will help recruit subjects and administer tests to subjects participating in the study. The student will learn the background and rationale for these particular experiments. The student will be responsible for ushering other students through the protocol at the testing sites. The student will also participate in data handling as well as analyzing data to correlate sleepiness with physiologic measures.

**What skills will the FYRE student acquire or enhance as a result of participating in this project?**

The student will learn several aspects of conducting a human study and understanding how sleepiness affects human performance. These skills can directly translate to jobs that want experience in how to conduct one’s self with patient contact, design and execution of human experimentation, and analysis and variability of human data. Skills that will be developed include:

1) Coordinating and administering tasks in human studies.

2) Understanding the role that each test plays in understanding the role that sleepiness plays in human performance.

3) Participate in analyzing data and correlating objective and subjective tests with evidence of sleepiness.
Title of Research Project: Generic Mutation in the Eighteenth Century

Faculty Mentor: Rachel Schneider

Department: English and Technical Communication

Description of Research Project:

Close reading has been the basic tool of literary studies for a long time: to understand the meaning of a text, we must pay attention to individual words and phrases. However, recently critics have begun to practice distant reading, where scholars look at a large group of text to make different arguments. In *Graphs, Maps, and Trees*, Franco Moretti (2005) makes arguments about the development of the novel by comparing the titles of hundreds of them. He maps the locations of characters in Mary Mitford’s *Our Village* to make an argument about how labor is divided. This kind of work requires different critical tools: creating databases, using historical maps, and charting and graphing data.

For this research project, we will focus our investigation around a specific subgenre: the literary print fragment. To understand the fragment’s generic evolution over the eighteenth century, we will collaborate in building a database around these texts, generating mapping strategies, and potentially learning how to use TEI to encode our knowledge into the texts themselves.

Description of FYRE student’s responsibilities:

During the first month of the collaboration, the student will be reviewing research on literary fragments and the current existing database.

During the second and third month, the student will be processing the data and generating criteria for cataloging the fragments, based on existing work by the professor.

During the final month, the student will generate visuals (graphs, charts) to explain the data.

What skills will the FYRE student acquire or enhance as a result of participating in this project?

By doing this project, the FYRE student will learn about the intersection between literary studies and the broader field of digital humanities. The student will develop skills in analyzing and charting data, as well as reading and analyzing primary and secondary texts in literary studies. The student will assess arguments and learn to proficiently use Excel and Adobe to create infographics and track data. The student will learn how to differently discuss qualitative and quantitative data.
Title of Research Project: Cultural and Linguistic Variation on Campus: Developing a Language Attitudes Survey

Faculty Mentor: Dr. Sarah Hercula

Department: English and Technical Communication

Description of Research Project:

Missouri University of Science and Technology has seen a rapid increase in its international student population over recent years, which has led to an overall increase in cultural and linguistic diversity across campus. As an applied linguist whose work centers on language ideologies, I am interested in researching perceptions of this diversity among various campus populations (e.g., students, professors, staff, etc.). As a way to investigate these perceptions, specifically toward linguistic variation and diversity, I propose the development, implementation, and analysis of a language attitude survey to administer to volunteers across these various campus-related populations. Such a survey would measure language attitudes toward various linguistic features—phonological (pronunciation and sound patterning), grammatical, and lexical. To assess their perception of these particular features, survey participants would listen to audio examples of linguistic data and answer questions about their perceptions of the recorded speakers. The survey would also ask questions to assess participants’ general linguistics knowledge, including topics such as language variation, second language learning, etc. The survey would also ask participants to answer questions about their personal background (e.g., age, gender, race, linguistic background, etc.) to allow for the analysis of potential correlation of these factors with particular language attitudes. The results of the analysis of this study could provide important data for the campus community, particularly regarding cultural awareness, cross-cultural interaction, and opportunities for linguistic and cultural exchange and education.

Description of FYRE student’s responsibilities:

The student research participant would be involved chiefly in the development and implementation stages of the survey. The student would work with me to design and develop the survey, which would give the student experience with some of the important factors involved in the design of survey questions, including investigation of concepts including: structured/fixed response vs. non-structured/open-ended questions and avoiding biased/leading and double-barreled questions, among other factors. The student researcher would also be responsible for identifying participants and facilitating the recording of audio samples to be included as a part of the survey. I expect that the design and development of the survey would take the first 8-10 weeks of the spring semester. Once the survey had been completed and initially tested, the student researcher would use the remaining weeks in the semester to develop a plan for the dissemination of the survey to various campus-related populations. The student would be responsible for developing materials to advertise the survey so as to encourage participation among a large number of diverse survey participants. If time allows, the student could begin the implementation of his/her plan during the final weeks of the semester, and thus, the student would have the opportunity to be involved in some of the initial data collection, though I expect that the bulk of the data collection and all of the data analysis would occur after the conclusion of the spring semester.