

Academic Year 2019/20 MURI Research Projects

Below are the **MURI** projects to which full-time IUPUI undergraduate students pursuing their first degree can apply. If you want to be considered for one or more of the projects please update your CV/resumé and make sure it lists your contact email, current GPA, your major and minor, your year of study (first year, sophomore etc.), previous research experiences as well as your skill sets. Note, you are not expected to meet all the skills described for each project. When you have decided on the project(s) follow the application link below. You will be asked to enter some demographic information and to upload your CV. Your CV/resumé will then be forwarded to the corresponding project mentor(s).

To apply for a spot on a MURI team please [click here](#)

If you are accepted to a MURI team please know that you are required to work on the project for 25h/month from October 1 through April 30. In addition, you are **required** to attend the Student Research Orientation Day, which is tentatively scheduled for September 27, 2019 (time and location TBA).

Deadline for application is September 17, 2019. You can apply for a position on more than one project. However, you will be eligible to work on only one project. Once you have been accepted to a project please inform the mentors of other projects to which you have applied. Note that project mentors may decide to close applications for their respective project prior to that deadline once they have assembled their project team.

Project Title	Project Narrative
1. Reconstructing the Pre-Columbian History of Lead Pollution in the Midcontinental United States with Multi-Proxy Records from High-Resolution Lake Sediment Archives	This research project seeks to develop high-resolution geochemical records that span the last 2 to 3 thousand years in order to investigate the presence, timing, and spatial distribution of Pb pollution associated with pre-Columbian Native American galena use and processing. <u>For students majoring in:</u> Any discipline/majors <u>Required skill set:</u> None. Contact: Dr. Broxton Bird; Dr. Jeremy Wilson; Dr. William Gilhooly
2. Mapping the Oratory of Frederick Douglas	The goal of the project is to use history and spatial humanities methodology to analyze samples of the large body of speeches by F. Douglas, a runaway slave from Maryland who became one of the most influential African Americans of the 19th century. The research will be looking for geographical patterns, both chronologically and thematically, in Douglass's public speaking tours. <u>For students majoring in:</u> Geography, History, Communications, Political Sciences, Africana Studies <u>Required skill set:</u> Read and analyze nineteenth century letters, newspapers, and documents. Encode data to Excel files. Analyze encoded data results to determine significant spatial patterns. Contact: Dr. John R. Kaufman- McKivigan; Dr. Jeffery Duvall; Dr. Owen Dwyer
3. Developing Computational Model for Fabricating Coating Materials for Energy Applications	Advanced metallic and ceramic thin film and coating materials have been developed for energy and environmental applications. A major challenge is to develop a uniform coating on non-flat surface. This project's overarching goal is to develop a ray tracing base model for simulating the air plasma spray coating thickness, thus improving the coating uniformity in coating fabrication processes. <u>For students majoring in:</u> Mechanical Engineering, Electrical Engineering, Chemistry, Informatics, Computer Science <u>Required skill set:</u> materials science, chemistry, mechanical design, programming Contact: Dr. Jing Zhang; Dr. Jingzhi Pu
4. Development of a mobile phone app to facilitate linkage to skilled care during pregnancy and the postnatal period	The State of Indiana and Counties in Western Kenya are geographical regions which have high rates of maternal, newborn, and infant mortality, as compared to the overall rates of the United States and Kenya, respectively. The primary goal of this project is

to develop free, open-source, secure digital health tools by which to significantly improve health outcomes among women, infants, and children, regardless of geography. The MURI team is expected to develop a prototype for a new mobile phone app to facilitate linkage of pregnant and newly delivered women with evidence-based educational resources and skilled prenatal and postpartum care.

For students majoring in: Informatics and computing; public health

Required skill set:

General skills: Documentation and report writing; time-management skills; desire to work within a highly collaborative, fast-paced, interdisciplinary environment; willingness to learn basic principles related to achievement of project deadlines, benchmarks, and milestones.

Informatics/Computing students: Knowledge of Java, Java Script, and/or Python; interest in app development; willingness to utilize systematic processes by which to conduct user experience and user interface evaluations.

Public Health students: Literature review, ability to synthesize information, experience facilitating interviews; interest in how public health interventions can be applied in multiple geographical settings; writing skills are a plus.

Contact: Dr. Sherri Bucher; Dr. Saptarshi Purkayastha

5. Preparation and Modeling of Materials and Cells for 3D Bioprinting

Cell spheroids are microscopic aggregates of cells used as 'building blocks' for the creation of higher-order 3D structures, an extremely powerful approach to tissue engineering. The goal is the optimization of bioinks and cells for 3D bioprinting, by better understanding selected nutrient (glucose and lactate) diffusion, and impact on their post-printing assembling.

For students majoring in: Computer Sciences, Physics, Engineering, Biology, Pre-Medicine, Chemistry

Required skill set: General laboratory training; some computer programming

Contact: Dr. Nicanor I. Moldovar; Dr. Horia Petrache

6. Magnetic Field Orientation Control in Eye Surgery

Presbyopia is an age-related refractive condition, which results from impairment of accommodation of eye to focus on near objects. A method to remove the existing, defected lens without damaging the tissue around it uses nanoparticles and their plasmonic effect. The project objective is to design strong concentrated magnetic fields oriented to the nanoparticles as close as possible to the eye lens.

For students majoring in: ECE, ME, ECET, MET, Chemistry, Biology, Computer Science

Required skill set: Computer Proficiency, Electric Machines, Finite Element, Chemical Labs, Biology Labs

Contact: Dr. Afshin Izadian, Dr. Amir Reza Hajrasouliha

7. Supervisory Control of a Power Processor

Recently, a multilayer power electronics board that can provide various functionalities including charge and discharge of batteries on-demand, and has the ability to synchronize with the grid and injecting power was designed and built. In this project students will take advantage of the working hardware and design control systems to fully functionalize the power processing unit.

For students majoring in: ECE, ECET, ME, MET, Computer Science, Computer Engineering

Required skill set: Closed Loop Control System, Matlab

Contact: Dr. Afshin Izadian, Dr. Robert Weissbach

8. Developing low-cost real-time biomedical multichannel functional electrical stimulators by fusing traditional methods with audio tools and Musical Instrument Digital Interface (MIDI) controllers.

Functional electrical stimulators (FES), used in Biomedical Engineering to artificially activate muscles, is on the forefront of research involving treatment and rehabilitation of paralyzed individuals. However, tools for more complicated and “natural” muscle activation schemes are not available. This project aims to fuse the advantages of music and audio technologies with the multichannel FES to physically control signals used in multi-muscle stimulation.

For students majoring in: BME, MAT, ECE

Required skill set: experimental test and measurement experience

BME: disciplinary knowledge

MAT: music and audio software and hardware experience, particularly of MIDI controllers

ECE: understanding of programming (audio drivers development experience and C is preferred)

Contact: Dr. Timothy Hsu, Dr. Ken Yoshida

9. Recycling technologies for domestic mixed plastic waste

The environmental impact caused by plastic waste has created an important field dedicated to plastic recycling. The overall objective of this project is to optimize the use of additives to significantly improve the blending and recyclability of mixed plastic waste. The specific goals for this academic year are to develop a computational model to predict response based on properties including mechanical properties as well as melt flow index for use in injection molding and extrusion-based additive manufacturing.

10. Early Research in the Educational Efficacy of a Personalized Learning Tool

For students majoring in: Chemistry, Physics, Mechanical Engineering, Electrical Engineering, Motorsports Engineering, or any related major

Required skill set: Work in a laboratory environment and willing to learn how to operate equipment for plastic processing and testing.

Contact: Dr. Andres Tovar, Dr. Amanda Siegel

EASEL (Education through Application-Supported Experiential Learning) is a recently created platform that draws upon the theories of constructivism, self-directed learning, and experiential learning. With this platform, learners in experiential learning settings can use technology to reflect on their learning experiences. In this project student researchers will continue development and testing of the EASEL platform with a new focus on evaluating the early educational efficacy of EASEL in a personalized learning environment.

For students majoring in: Computer Science, Technical Communication, Computer Graphics Technology, Computer Information Technology, Informatics/New Media, Education

Required skill set:

Computer Information Technology & Computer Science students: Software development focused on Swift and Object-C, problem solving, Computer Programming (Javascript).

Computer Graphics Technology, Technical Communication, or Informatics/New Media

Students: Human-computer interface design or interaction, graphic design, UX or usability testing knowledge and/or experience. *Education students:* personalized learning, secondary education, STEM education

Contact: Dr. Christian Rogers, Dr. Corinne Renguet