Summer 2020 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. **New this year**: Please prepare a cover letter of at least 1 but no more than 2 pages that describes 1) why you are interested in participating in MURI, and 2) how engaging in undergraduate research aligns with your career goals. Note: even if you apply to more than one MURI project, you only need to compose one cover letter. Your letter should cover your interest in doing research in broad terms and not focused on a particular 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 and cover letter. Both documents 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 from June 1 to July 31, 2020. In addition, you are **required** to attend the Summer Student Orientation on June 1st and to present at the Summer Poster Symposium, which is scheduled for July 30, 2020, on the second floor of the University Tower.

Deadline for application is March 31, 2020. 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. Click-Chemistry Linkers for the Selective Trapping of Carbonyl VOCs	Volatile organic compounds (VOCs) are a diverse group of carbon-based small molecules that are present in exhaled breath and various biofluids such as blood, urine, feces, and sweat. Analysis of VOCs represents an interesting non-invasive approach to diagnosis with minimal inconvenience to the patient. In particular, the analysis of carbonyl (aldehyde and ketone) VOCs is of considerable importance. This project proposes to develop new bifunctional linkers that i) chemoselectively trap carbonyl VOCs using an aminooxy functional group, and ii) can be anchored at the surface of electrodes and other materials of interest for analysis. For students majoring in: Chemistry, Biology, Neuroscience Required skill set: General Chemistry Lab, Organic Chemistry 1 Lab, General Biology Lab, Contact: Dr. Sebastien Laulhe (slaulhe@iupui.edu); Dr. Balakrishnan (latabala@iupui.edu)
2. Late Holocene Midcontinental Flooding and its Role in Pre-Colombian Population Dynamics	This research project seeks to develop three high-resolution flood records that span the last2 to 3 thousand years in order to investigate the timing and spatial distribution of floods on the Missouri River and their impact on pre-Columbian Native American populations. ***To hear more about this project, check out this video:*** https://www.youtube.com/watch?v=eiIsF05HHn8 For students majoring in: Any. Required skill set: None. Contact: Dr. Broxton Bird (bwbird@iupui.edu); Dr. Jeremy Wilson (wilsojer@iupui.edu)

3. Research and Development of 3D Clay Printers

Clay has always been the most commonly used material when manufacturing ceramic materials since it is a natural ingredient that is easy to find in almost any environment. Additive manufacturing (3D printing) offers new opportunities when it comes to shaping techniques for ceramics. The objectives of this project are to (1) develop customized extrusion-based 3D ceramic printer with mechanical screw extrusion system, and to (2) understand the process-property-performance relations in 3D printed ceramic parts.
For students majoring in: Mechanical Engineering, Electrical Engineering, Chemistry, Informatics, Computer Science
Required skill set: materials science, chemistry, mechanical design, programming
Contact: Dr. Jing Zhang (jz29@iupui.edu); Dr. Jingzhi Pu (jpu@iupui.edu)

4. Great Marble Map of Rome Project

The Great Marble Map of Rome (GMMR) is one of the best known, yet least understood, artifacts from the ancient Roman world. Targeted studies of the map however, remain rare and sporadic due to the physicality of the map fragments themselves. Technological revolutions have improved access to the map by producing high quality, accurate, scalable 3D digital scans of all existing GMMR fragments. MURI students will pilot the design, construction, and population of the GMMR database and website, primarily through preparing 3D models of the scanned GMMR fragments.
For students majoring in: Computer Science, Informatics, Art History, Classical Studies
Required skill set: Familiarity with database management software or an ability to learn; familiarity with basic art historical research or an ability to learn
Contact: Dr. Elizabeth Thill (ethill@iupui.edu); Dr. Jenny Johnson (jennajoh@iupui.edu)

5. Experimental Analysis and Computer Simulations of Cellular Metabolism for 3D Bioprinting and Tissue Engineering

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 oxygen and selected nutrient (glucose and lactate) diffusion, and impact on their post-printing assembling.
For students majoring in: Biology or Pre-Medicine, Pre-Nursing, Biomedical or Electrical Engineering, Computer Science, Engineering Physics
Required skill set: Basic biological laboratory training OR basic chemical laboratory training OR general familiarity with computer modeling
Contact: Dr. Nicanor I. Moldovar (nimoldov@iupui.edu); Dr. Horia Petrache (hpetrach@iupui.edu); Dr. Rahmi Pak

6. Measurements and simulations of lipid membranes containing inositol headgroups

Biological membranes are complicated molecular mixtures that include lipids and proteins. Phosphatidylinositol (PI) is one of the three most abundant lipid classes in mammalian cells. The purpose of this project is to measure the effects of PI lipids on lipid membrane structure and its interaction with a representative membrane-bound protein domain.
For students majoring in: Physics, Biology, Chemistry, Engineering
Required skill set: Basic laboratory experience required.
Contact: Dr. Horia Petrache (hpetrach@iupui.edu), Dr. Anne Kimble-Hill (ankimble@iu.edu); Dr. Stephen Wassall (swassall@iupui.edu)

7. Identifying and Evaluating Educational Efficacy Features of EASEL

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 of the mobile application and the instructor portal and develop a mixed-methods study to evaluate the educational efficacy features of EASEL.

To hear more about this project, check out this video:
https://www.youtube.com/watch?v=zzfk4JXPu6I

For students majoring in: Computer Information Technology, Computer Science, Computer Graphics Technology, Technical Communication, and/or Informatics/New Media; Education
Required skill set: *Computer Information Technology & Computer Science*: Software development focused on Swift and Object-C, problem solving; Computer Programming (Javascript). *Computer Graphics Technology, Technical Communication, or Informatics/New Media*: Human-computer interface design or interaction, graphic design, UX or usability testing knowledge and/or experience. *Education*: personalized learning, secondary education, STEM education
Contact: Dr. Christian Rogers (rogerscb@iupui.edu); Dr. Corinne Renguette (crenguet@iupui.edu)

8. Retina Detachment Surgery

Retina detachment is a problem that causes blindness if not treated. In this disease, a part of the retina is peeled off the eye because of a hole in the retina or trauma. The process to fix the problem is to push the retina back to its place, making a scar around the detached retina and keep the retina in place for an extended period. A new approach is to create a magnetic field around the eye and use magnetic liquids to push the retina in place. The objective of this project is to characterize an adhesive that is biocompatible for the retina detachment and the use of suspended magnetic nanoparticles in silicon oil for a uniform external magnetic excitation.

For students majoring in: Physics, Biomedical Engineering, Chemistry, Electrical Engineering, Mechanical Engineering

Required skill set: Basic knowledge of physical property characterization; Use of basic measurement tools; Ability and willingness to learn new topics; Work on a tight schedule and deliver results.

Contact: Dr. Afshin Izadian (aizadian@iupui.edu); Dr. Amirreza Hajrasouliha (amhajras@iu.edu)

9. Determining viability of energy generation using piezoelectric materials

Finding alternative means of energy generation leads to researching techniques for energy harvesting from sources that are traditionally wasted. One of the newest methods of energy harvesting research is in the usage of piezoelectric devices. Piezoelectric devices generate a small amount of electrical energy when a force is applied to the device. A recent simulation model focused on the use of piezoelectric energy harvesting based on vibrations created by a liquid vortex. The goal of this project is to use the simulation model to build a hardware prototype to see if the same level of efficiency can be obtained.

For students majoring in: EE (EET), EN, CS (CpET), ME (MET), TCM (OLS)

Required skill set: EE (EET) - circuit design, simulation software, design process; EN - sustainable energy, energy storage; CS (CpET) – programming; ME (MET) - fluid dynamics, 3D printing, simulation software; TCM (OLS) - report writing, project management, research process

Contact: Dr. Andrew McNeely (andmcnee@iupui.edu), Dr. Andrew Gavrin (agavrin@iupui.edu)

10. Investigating the link between soundscape and noise levels of themed attractions to the experience of staff and customers

Themed attractions are carefully crafted experiences that aim to transport customers out of the local reality and into a world outside their normal day-to-day experiences. The goal of this project is to establish a body of research that will better inform the creation of attractions in the future by providing sound measurements. The MURI team will investigate overall noise levels across time, signal-to-noise ratios, and maximum peak levels, as well as the identification, spectrum, and rate of occurrence for noise sources. Additionally, room acoustics for indoor spaces will be measured.

To hear more about this project, check out this video:
https://www.youtube.com/watch?v=UQmH000UFpI

For students majoring in: Music Technology, Computer Graphics Technology
Required skill set: music technology / acoustics background for acoustic measurements, themed attraction / CGT background, design and statistics background, design and engineering background
Contact: Dr. Timothy Hsu (hsut@iu.edu), Dr. Christian Rogers (rogerscb@iupui.edu);

11. Image-based noninvasive evaluation of blood pressure in diseased human vessels with uncertainty quantification

One of the major cardiovascular diseases is the abnormal narrowing of an artery, called arterial stenosis (AS). A new computational modality, called *InVascular*, is being developed for non-invasive quantification of the hemodynamic abnormality caused by an AS. The project objective is to collect preliminary data for coronary, cerebral, and iliac stenoses in terms of computational results, experimental validation, and interpretation of flow features through visualization and collection of available medical data.
For students majoring in: Mechanical Engineering, Biomechanical engineering, Mathematics, Electrical and Computer Engineering, Biology, Medicine, and Computer Sciences
Required skill set: Programing skills of C/C++, Matlab, Excel; Laboratory skills of electrical circuit, Labview, 3D printing; Statistical analysis
Contact: Dr. Whitney Yu (whyu@iupui.edu), Dr. Alan Sawchuk (asawchuk@iupui.edu), Dr. Xiaoping Du

12. Tailoring Mechanical Properties of Compostable Bioplastic

The environmental impact caused by plastic waste has created an important field dedicated to plastic recycling. The overall goal of our work is to advance technologies to produce compostable bioplastic "at home" to eventually replace fossil-fuel based plastic in the production of some household items. We have discovered that all the risks involved in plastic recycling can be avoided by making bioplasticfrom scratch using natural ingredients. This summer the objective is to optimize the process of fabricating starch-based compostable bioplastic in a laboratory setting.

For students majoring in: Engineering & Technology and Science, Engineering/Technology,

Required skill set: Mechanical characterization, Chemical characterization, Processing optimization, Applications of bioplastics

Contact: Dr. Andres Tovar (tovara@iupui.edu), Dr. Amanda Siegel (apsiegel@iupui.edu)