Mark Legendre

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Undergraduate Researcher
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Education

University of Notre Dame — August 2017 - May 2021
B.S. Chemical and Biomolecular Engineering
Minor in Bioengineering

Stanford University — June 2018 – August 2018
Stanford Summer Session
Organic Chemistry of Carbonyl Containing Molecules

Research Experience

Undergraduate Researcher, University of Notre Dame — Fall 2019 - Present
Department of Biomolecular Engineering
Advisor: Matthew Webber, PhD

- Demonstrated charge-dependent preferential binding orientation in a cucurbit[7]uril macrocycle-guest complex
- Explored a range of cell-surface binding affinities on a 2-dimensional plane by altering a supramolecular guest conjugated to an RGD adhesion peptide

This work is still in progress.

Undergraduate Researcher, University of Notre Dame — Fall 2020 - Present
Department of Biomolecular Engineering
Advisor: William Phillip

- Analyzing the fluid dynamics of an osmotic separation module using COMSOL Multiphysics software
- Determining pressure limitation of continuous dialysate injection into lateral flow separation module

This work is still in progress

Undergraduate Researcher, Tulane University — Summer 2019 – Summer 2020
Department of Surgery, Division of Trauma and Acute Care
Advisor: Olan Jackson-Weaver

- Designed an *in vivo* rat model of hemorrhagic shock and resuscitation for supervisor to perform
- Demonstrated tissue dependency of glycocalyx shedding in response to hemorrhagic shock and resuscitation mediated by reactive oxygen species accumulation in cardiovascular endothelium

This work resulted in a poster presentation at the American Heart Association Resuscitation Science Symposium 2020. A manuscript is currently in preparation.

Undergraduate Researcher, University of Notre Dame — Fall 2018 – Fall 2019
Department of Biomolecular Engineering
Advisor: Jeremiah Zartman

- Used UAS-iRNA technology to knockdown genes coding for Ca^{2+} ion channels in *Drosophila*; genes were selected based on their conservation across the *Drosophila* and human genomes
- Interbred fly cultures and observed the phenological result in the wing domain of D*rosophila* via visible light microscopy

Projects

PCR Temperature Controller

Instructor: Jeffery Kantor

- Developed a PID controllor in Python to interface with a Temperature Control Lab-Arduino module
- Designed a user interface to specify user-designed PCR procedure (number of cycles, temperature ranges, etc.)

Biomedical Engineering Laboratory

Instructor: Tanyel Kiziltepe

- Conducted DNA fingerprinting using both PCR and RFLP analysis
- Identified Diabetes type and HIV infection via enzyme-linked immunosorbent assays
- Isolated and verified Green Fluorescent Protein in cultured *E. Coli*
- Performed a two-color microarray diagnostic on cancer biopsies

Nonlinear Regression and Error Propagation of Absorptive Nanoporous Membrane Data

Instructor: Alexander Dowling

- Used Python to fit a Langmuir isotherm to experimental data: used both linear and nonlinear regression
- Estimated batch times using numerical methods to integrate the isotherm
- Conducted error propagation on the model parameters as well as the estimated batch time result

Pilot Plant Operation at Imperial College, London

Instructor: Colin Hale

- Learned to remotely control a gas absorption pilot plant and diagnose malfunctions
- Designed a diagnostics test protocol and performed the procedure in the pilot plant
- Performed fluid dynamics, heat exchanger, and gas absorption experiments on small-scale modules

Honors & Awards

TBP SAP Grant, Indiana Gamma Chapter — Fall 2020
JP Kohn Scholarship, Department of Chemical and Biomolecular Engineering — Fall 2020
NDNano Undergraduate Research Fellowship, University of Notre Dame — Summer 2020
Dean's List, University of Notre Dame — Fall 2017 - Spring 2020
Tau Beta Phi Inductee, Indiana Gamma Chapter — Fall 2019

Publications

Manuscripts in preparation

1. Abdullah, S.[*1], Karim, M.[*2], **Legendre, M.[*3]**, Rodriguez, L.[1], Friedman, J.[1], Cotton-Betteridge, A.[2], Drury, R.[2], Packer, J.[2], Guidry, C.[1], Duschesne, J.[1], Taghavi, S.[1], Jackson-Weaver, O.[1] (2020). Hemorrhagic shack and resuscitation causes glycocalyx damage and endothelial oxidative stress preferentially in the lung and intestinal vasculature. *Submission to Shock*.
   *** These authors contributed equally to the work**

Teaching Experience

Teaching Assistant, Introduction to Physics I/II — Fall 2020
College of Engineering, University of Notre Dame

- Conducted individual and group help sessions for both physics courses
- Material covered included Mechanics, Electricity, and Magnetism

Instructional Tutor, Calculus I, II, and III — Fall 2018 - Spring 2020
Academic Services for Student-Athletes Department

- Conducted individual calculus help sessions for approximately 3 students per semester

Service & Outreach

Club Member, EnableND Prosthetic Design Spring 2020 - present
Notre Dame club 3-D prints prosthetics for community members

Judge, 2020 Northern Indiana Regional Science and Engineering Fair Spring 2020
Elementary Division on University of Notre Dame campus

Volunteer, St. Joseph Regional Hospital Fall 2018 - Spring 2020
Mishawaka, Indiana

Presentations

1. Abdullah, S., **Legendre, M.**, Karim, M., Rodriguez, L., Friedman, J., Taghavi, S., Guidry, C., Duchesne, J., Jackson-Weaver, O. (2020, December). *Endothelial Reactive Oxygen Species Mediate Glycocalyx Damage in Pulmonary and Intestine Vasculature in Hemorrhagic Shock in the Rat*. Resuscitation Science Symposium, Virtual.

Technical Skills

Coding Languages and Mathematical Packages: Python, MATLAB, Mathematica
Computer-Aided Design and Simulation Packages: AutoDesk AutoCAD, Comsol Multiphysics
Other: Linux (Ubuntu) OS, Mac OS, Windows OS, Microsoft Certification (Word, Power Point, and Excel)

References

Matthew Webber, Assistant Professor
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William Phillip, Associate Professor and Dean of Graduate Studies
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Mark McCready, Professor and Associate Dean of Research and Graduate Studies
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