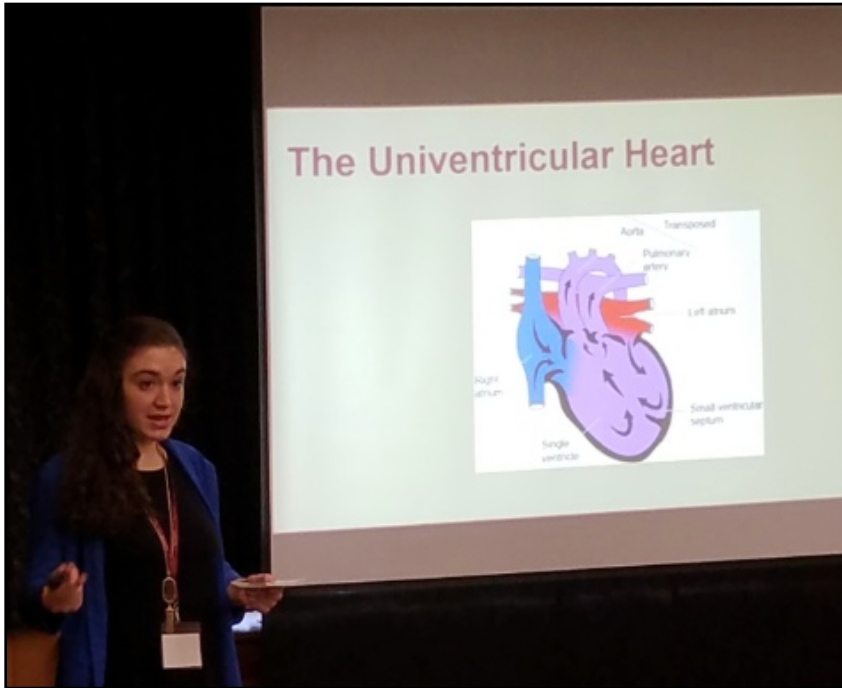


# KU BEARS

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## “UGR is Essential..

*..as I plan to pursue my PhD in Applied Mathematics.”*



Vanessa Maybruck, Mathematics Applied Track and Secondary Education, presents her work at the PASSHE STEM conference in fall 2019

**Inspiration:** “The project that I am working on, under the mentorship of Dr. Brooks Emerick, involves creating, modifying, and numerically solving differential equations that model blood flow after the Fontan surgical procedure. The Fontan procedure is the third step in a life-saving surgery in infants who are born with one ventricle in their hearts instead of two, resulting in the mixing of oxygenated and deoxygenated blood. When these patients reach their 40s, they often experience life-threatening complications as serious as ventricular failure and arrhythmia, which can ultimately lead to organ dysfunction and death. These complications have been linked specifically to the Fontan procedure and thus are collectively called Fontan failure. While some patients survive by being lucky enough to receive a heart transplant, Fontan failure is often not diagnosed until it is too late, and many patients die before they get their transplant.” *(continued on next page)*

### PURPOSE

“The purpose of the KU BEARS program is to support faculty/student research pairs over the summer. The goals are twofold: to develop the necessary skills set of undergraduate students to help them become student researchers and to provide faculty members with paid student research assistants.

Undergraduate students selected for the program will receive summer pay for research tasks assigned by a faculty supervisor. By assisting faculty members in their research, students selected for the program will learn the knowledge and skills necessary for conducting advanced research in their field.”

*-Grants and Sponsored Projects*



“IMPROVE THE PROCEDURE TO PREVENT FAILURE IN THE FUTURE”

Our project aims to provide insights that can be used to decrease diagnosis time for Fontan failure and improve the procedure to prevent the failure from occurring in the future. Specifically, we are extending on the work of mathematicians and engineers from the 2018 Mathematical Problems in Industry workshop, which Dr. Emerick attended, to provide increasingly accurate models for Fontan circulation. We have been working on this project for over a year now, but this summer we are focusing on numerically solving the partial differential equation model in 1-D and 2-D using the mathematical programming language MATLAB. Furthermore, we are incorporating these models with a dynamic vessel, which means we are simulating various cardiovascular conditions such as plaque buildup or weakening of vessel walls. These conditions can

lead to cardiovascular disease or events like heart attacks, strokes, and aneurysms. Eventually, probably after this summer, we plan to formulate and solve our own model for Fontan circulation that includes both upper body and lower body blood flows, which, we hope, will prove to be more accurate than the previous models we have studied.



WHAT UGR MEANS TO ME

For me, undergraduate research is essential, as I plan to pursue my Ph.D. in Applied Mathematics after graduating from Kutztown. Graduate schools almost always want to see that their applicants have previous research experience, and I am really

grateful that I’ve had the opportunity to do this project with Dr. Emerick because of that. Beyond that, research is challenging and extends your interests directly into a project that can really make a difference in the world. I love calculus and differential equations, and I also love science. This project is perfect for me because it combines theories from biology, electricity, fluid dynamics, differential equations, programming, and numerical analysis in an interesting and collaborative way, and I think that can be said for a lot of research projects. The opportunity to explore a topic that intersects with so many fields and challenges you in such a way that builds your skills is simply too good to pass up. Additionally, research is a really good opportunity to make connections with faculty who will support you and guide you to take courses that will prepare you for what comes next, whatever that may be.

