CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
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Project Number
38185

Project Title
Artificial Pancreas for Continuous High Blood Glucose Levels

Abstract

Objectives/Goals
To recreate the pancreas and its function in the body in an artificial way to mimic the delivery of insulin for continuous high glucose levels without the need to monitor levels, making an integrated pump with a conductivity sensor that will detect changes in pH and immediately act to neutralize it.

Methods/Materials
I built a closed-loop circuit that would turn on and off a pump according to pH levels sensed by a homemade conductivity sensor. I represented the process of an actual insulin pump by using an acid/base reaction. First, I normalized the pump to stop in a neutral solution. My first test was to see if the pump would turn on in the basic solution and add in the vinegar, causing the pump to turn off. I did the same test two more times but instead added increments of baking soda to the solution, representing continuous high blood glucose levels.

Results
Applying it to the real situation, the baking soda solution representing the high glucose levels and the vinegar representing the insulin shows that this basic prototype is partially successful. The first test was not very reliable as the sensor didn#t detect the minor change in pH due to its logarithmic measurements. The second test, it took time for the sensor to detect the change and turn on; an average of 3 mL of vinegar pumped in every time.

Conclusions/Discussion
The experiment proved to be partially successful and did accomplish my goal although with some minor errors. By comparing my observations and results from the continuous high glucose levels test to that of the control, I understood that there are many difficulties in ensuring the accuracy of the conductivity sensor and the pump to work together. This experiment serves as one step forward in approaching the great range of diabetic issues, being a macro-scale prototype of the artificial pancreas.

Summary Statement
To understand the difficulties behind the artificial pancreas, this project will be conducted to prototype a successful artificial pancreas, focusing on continuous high blood glucose levels.

Help Received
I created the circuit design and the method of testing and was given an explanation of the circuit by the physics teacher.