



CALIFORNIA STATE SCIENCE FAIR 2015 PROJECT SUMMARY

Name(s) Jasmeet S. Dhaliwal	Project Number 35336
Project Title The Diabetes Dilemma: A Simulation of the Homeostatic Nature of the Pancreas Using Electrical Circuitry	
Objectives/Goals The objective is to build and test a simplified model of an artificial pancreas to demonstrate functioning of the human pancreas to balance glucose level in the blood. My hypothesis is that a simplified model of the human pancreas constructed from electrical circuitry would effectively mimic the homeostatic nature of the pancreas to balance glucose level in the blood. Abstract Methods/Materials Instead of blood, glucose and insulin, baking soda solution and distilled white vinegar (5% acidity, 0.841 Molar) were used. An electrical circuit was created using a solderless breadboard and other materials. Baking soda solution was prepared by mixing 28.3 g with 400 mL of distilled water. A 12V peristaltic pump was connected to the electrical circuit through the distilled white vinegar and baking soda solution after measuring their pH. A conductivity sensor (acting as glucose sensor) was also built. When the solution was very acidic, the conductivity sensor made the electrical circuit run the pump, moving the basic solution into the acidic solution to neutralize it. This represented high blood glucose levels being lowered by the addition of insulin, until the glucose levels were normal. As the acidic solution became more neutralized, the conductivity sensor made the circuit stop powering the pump. pH of the neutralized solution was measured and quantity of the basic solution added was recorded. Results The artificial pancreas model was successful to some extent in simulating the pancreas and supporting the hypothesis. There were 300 mL of baking soda solution in the Baking Soda bowl and 200 mL of vinegar in the Vinegar bowl at the start of pumping. Since the molarities of the vinegar and baking soda solutions were theoretically the same (0.841 M), the volume of baking soda solution remaining in the Baking Soda bowl should have been 100 mL, while the volume of the neutralized solution in the Vinegar bowl should have been 400 mL (ratio of 1 to 4) at the end of each trial. However, the volume of the baking soda solution remaining in the Baking Soda bowl was 238 mL, 212 mL, and 125 mL compared to the 262 mL, 288 mL, and 375 mL of volume remaining in the Vinegar bowl, respectively. Conclusions/Discussion A simplified model of the human pancreas can be built, but such a device requires further research, additional trials, and certain adjustments before it can perform as consistently and accurately as the human pancreas.	
Summary Statement In this project, I built a model of the human pancreas using electrical circuitry, and I tested the effectiveness and functionality of this model to mimic the homeostatic nature of the pancreas to balance glucose levels.	
Help Received My parents ordered materials for the project, supervised the experiment to ensure safety, and helped print the board.	