



Colorado Science and Engineering Fair

2025 Individual Project Abstract Form

Please print 2 copies of the completed form. Sign both copies, keep 1 for your notebook and submit 1 copy to your Regional Fair Director with your other paperwork.

Title of Project: Dealing with Diabetes: The road to developing an Artificial pancreas

Finalist's Name: Zayn Rana

School and City: Crescent View Academy, Aroura CO

Sponsor's Name: Hajra Khan

Category: Engineering

Division: Junior (grades 6 - 8)

Abstract (250 words or less):

People with diabetes need to figure out how much insulin they need to take on a daily basis in order to keep their blood glucose levels maintained. Finger sticks and blood glucose meters or a continuous glucose sensor are some ways diabetics can monitor their blood glucose throughout the day and take insulin to keep blood glucose within safe levels. Improvements in insulin pump and glucose sensor technology have led to smarter “hybrid loop systems.”

In this project I researched how hybrid loop systems work by building a circuit that acted as a model of an artificial pancreas, to mimic the automatic adjustment and administration of insulin in response to changes in blood glucose levels, similar to the way the human pancreas works to regulate blood glucose. Instead of insulin and blood, I used tap water and distilled water and measured their electrical conductivity by building a circuit that outputs a voltage. I also tried to fine-tune the circuit so it can quickly and safely adjust "blood sugar" to the right levels.

Using an Arduino programming system, I built a model of an artificial pancreas to model an automatic feedback system, similar to the feedback system used by the human body to adjust blood glucose levels using insulin. The distilled water had a much higher conductivity, or voltage, which represented blood with a high glucose level. The tap water represented insulin. The addition of tap water into the distilled water caused the voltage to drop. By fine-tuning the pump through editing the Arduino's programming code, the pump automatically shut off at a target level, as would be the case in a feedback system in the human body. It took approximately 2.5 minutes for my artificial pump model to reach the threshold value at which point the artificial pump ‘shut off’ and stopped releasing “insulin” into the “blood”.

The sensor reading (voltage) represents blood glucose levels and the time, which is the time it takes for the pump to bring the blood glucose levels back down to a threshold level once the pump starts working. Once the threshold value is reached, the pump turns off. My results showed that it took about 2 and a half minutes using the hybrid loop system in my artificial pump model for the “blood glucose” levels to stabilize and for the pump to turn off.

I hereby certify that the above statements are correct and the information provided in the Abstract is the result of one year's research. I also attest that the above properly reflects my own work.

Finalist's Signature:

Date:

In addition, all students must complete the ISEF Student Checklist (1A), Research Plan, Approval Form (1B), and Checklist for Adult Sponsor (1), and any other ISEF forms required for this type of project. See the International Rules and Guidelines for form requirements. Return COPIES of all of these forms to your Regional Fair Director with you Finalist Verification/Permission Form. **A signed copy of this form must be included in your notebook.**