Log Book

On October 20, 2023 I started to think about my project. After watching an article about a pancreas simulator on Science buddies I wanted to do that topic.

October 23, 2023 I decided to have two parts of my experiment the simulator and doing it on people. This would add depth to my project.

On October 25, 2023 I made that testing how the blood glucose levels effect people my main project and idea. The simulator would be the second and not that important part.

By November 1, 2023 I decided my final topic which was

When testing how a mango, milk chocolate and coke would increase the blood glucose levels using a blood glucose monitoring watch then which food will increase the blood glucose levels the most?

By November 24 I finished by hypothesis, Variables and most of my background research.

Hypothesis=

If we test for the amount of glucose in a medium sized raw mango, 1 bar of milk chocolate (100 grams) and 1 can of coke using a glucose monitoring watch then, milk chocolate would raise the blood glucose levels the most. Milk chocolate has a whopping 52 grams of sugar (glucose and sucrose) whereas an average sized raw mango has 8.98 grams and a 12 oz can of coke has 39 grams of sugar. This is only estimated as many factors apply such as carbohydrates and fats.

Background Research number 1:

Glucose is engendered through the metabolism of the body, acting as the fuel of the body. A variety of foods that we consume contain glucose. Whether we consume sucrose (table sugar) or foods containing carbohydrates such as starches our body breaks these resources down to glucose. When the body breaks these foods down, insulin is produced by the pancreas. The pancreas plays a crucial role in the body by regulating the breakdown of carbohydrates, fats and proteins. Additionally it releases the enzymes into the small intestines to aid in the absorption of nutrients from victims. The pancreas releases insulin as it corresponds with the body.

Background Research number 2:

The insulin let's glucose reach the bloodstream. It then lets the cells in the body utilize the glucose. They may utilize the glucose as energy or store the glucose for other times. The body releases glucose when we consume it. For example the amount of glucose in the body is higher at lunch than in the middle of the night. The amount of glucose is referred to as the blood glucose level. When the glucose is utilized in cells the blood glucose level drops meaning the pancreas stops injecting insulin to the body. With diabetes, the basic definition for it is the pancreas doesn't respond with the body. The pancreas either doesn't inject insulin at all or injects insulin at the wrong times.

Background Research number 3:

Due to this the blood glucose level may ascend or decline to hazardous levels. Due to this diabetes are perilous symptoms of diabetes may range from mild to severe. Some symptoms of diabetes include weakness, urinating more frequently, feeling very thirsty and hungry, feeling very energetic and then followed by tiredness (mood swings), and losing large amounts of weight in a short period of time.

Background Research number 4:

Prediabetes - Diabetes doesn't just appear in a few days. Diabetes gives an abundance of signals before they genuinely appear in a few days. These signals could take up to 10 years. During this period a person has prediabetes. Prediabetes is when you have a higher blood glucose level than a normal person but not as dangerously high to be relegated as diabetes. A person with prediabetes has a more preponderant chance of developing a heart disease than an average person.

Background Research number 5:

Type 1 diabetes - In type 1 diabetes the pancreas either makes very little insulin or engenders no insulin at all. Insulin is very important as it allows glucose to be stored or utilized for energy by the cells. Unfortunately there is no cure for type 1 diabetes. 1.25 million people have to deal with type 1 diabetes in the United States alone. Treatment of type 1 diabetes is a lifelong insulin pump and a continuous glucose monitor.

Background Research number 5:

Type 2 diabetes - During type 2 diabetes the pancreas doesn't properly correspond with the body. This is when the body doesn't make enough insulin or injects it at the wrong time. In the United States 38 million people have type 2 diabetes! However there is no treatment of type two diabetes. Diseases such as heart diseases, strokes, foot problems, eye and kidney disease have an increased chance of happening.

Background research number 6:

In this experiment we will be making a simulation of the human body. In an adult human body there is 1.2 - 1.5 gallons of blood, making an average of 1.3 gallons. Liters will be used here as it is a whole number. 1.3 gallons = 5 liters. The normal blood glucose levels are approximately 90 mg/dl the same as 5mm (mmol/l.) Glucose is $C_6H_{12}O_6$. In 5 liters of blood there is about 3.3 - 7 grams of glucose in an adult human body which is an average of 5.1 grams. This experiment will be done at a much smaller scale at 200 ml. Which means everything will be divided by 25. Scale 1:25. This means the amount of glucose in the experiment will be 0.204 grams.

Background research number 7:

The blood will be represented by milk as it is not a conductor of electricity unlike water. To the milk salt will be added as it is a conductor of electricity. The voltage of the milk is 0. In this model the average blood glucose level is 0.9 volts. 0.9 volts represent the average blood glucose level which is about 4.75 mmol/l.

Variables Glucose monitering Part A

Manipulated variable: My manipulated variable is the type of food being tested on a person.

Controlled variable: My controlled variable is the watch that is being used, the type of food being eaten, the time the food is eaten at, how constantly the watch measures, and how long the experiment lasts.

Responding variable: The blood glucose levels graph that appears for each person after eating the different foods.

Variables pancreas simulator Part B

Manipulated variable: My manipulated variable is the type of food being tested on a person.

Controlled variable: My controlled variable is the watch that is being used, the type of food being eaten, the time the food is eaten at, how constantly the watch measures, and how long the experiment lasts.

Responding variable: The blood glucose levels graph that appears for each person after eating the different foods.

On December 17, 2023 I started my experiment. Participant 1 did as he was instructed to. Next day we relized we forgot to connect the watch to a phone.

On December 19, 20 and 21/2023 participant one completed 2 trial for each food.

On December 25 I went to British Columbia where the other participants were.

From December 26-31, 2023 participant 2 and 3 completed part A for my experiment

Mango:

For person 1 the highest point in the blood glucose graph was 8.07 mmol/l or 145.3 mg/dl.

8.09 mmol/l or 145.6 mg/dl was the highest blood glucose level for person 2 after consuming a mango.

Person 3's highest blood glucose levels was 8.02 mmol/l or 144.4 mg/dl.

The average for all the participants was 8.06 mmol/l 145.1 mg/dl.

Chocolate:

Person 1's highest blood glucose levels was 8.38 mmol/l or 150.8 mg/dl

For person 2 the highest point in the blood glucose graph was 8.09 mmol/l or 145.6 mg/dl.

8.22 mmol/l or 148 mg/dl was the highest blood glucose level for person 3 after consuming milk chocolate.

The average for all the participants was 8.23 mmol/l 148.1 mg/dl.

Coke

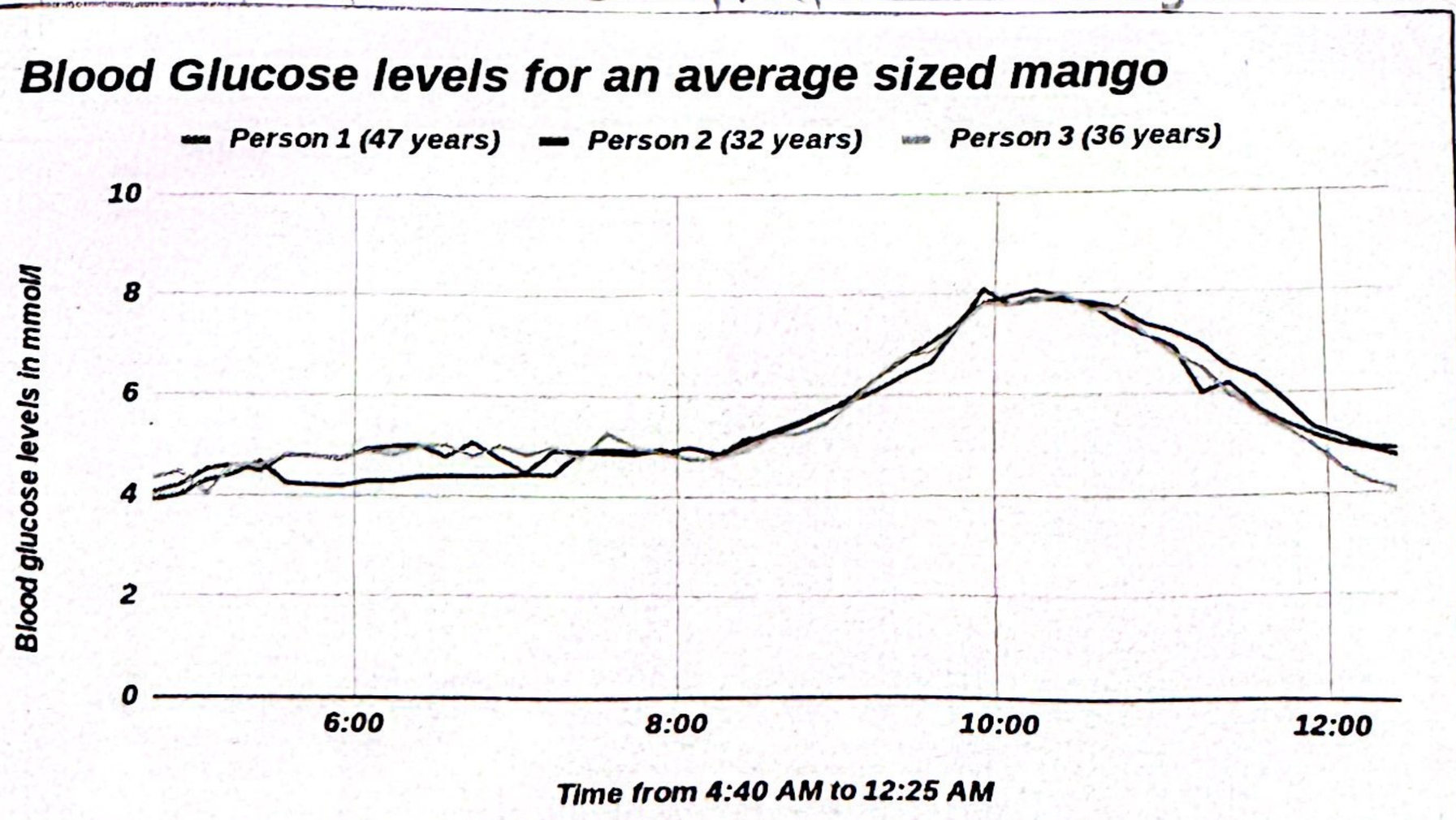
8.3 mmol/l or 149.4 mg/dl was the highest blood glucose level for person 1 after consuming milk chocolate.

For person 2 the highest point in the blood glucose graph was 8.02 mmol/l or 144.4 mg/dl.

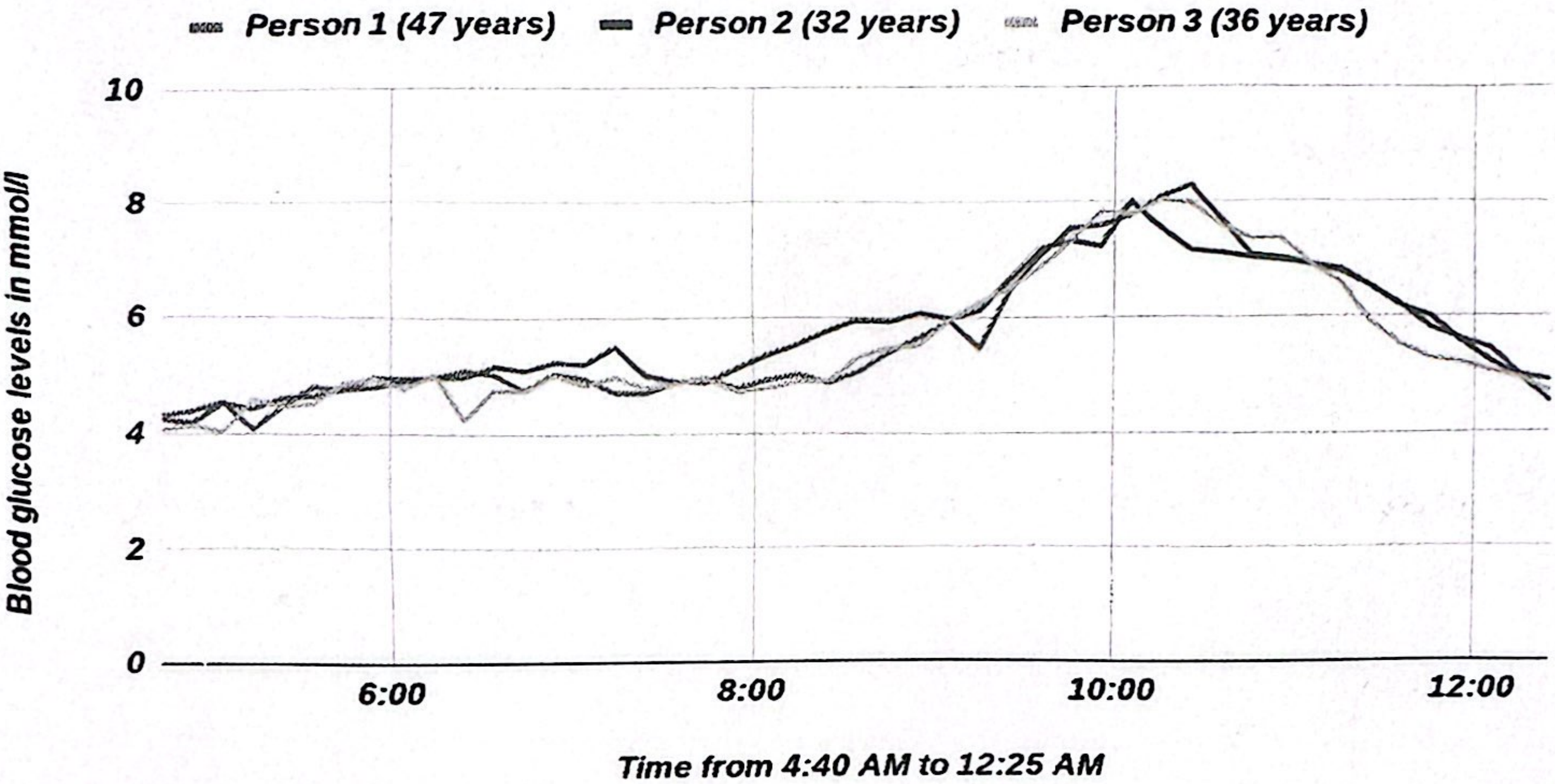
Person 3's highest blood glucose levels was 8.05 mmol/l or 144.9 mg/dl.

The average for all the participants was 8.12 mmol/l 146.2 mg/dl.

The proper line graphs mango:

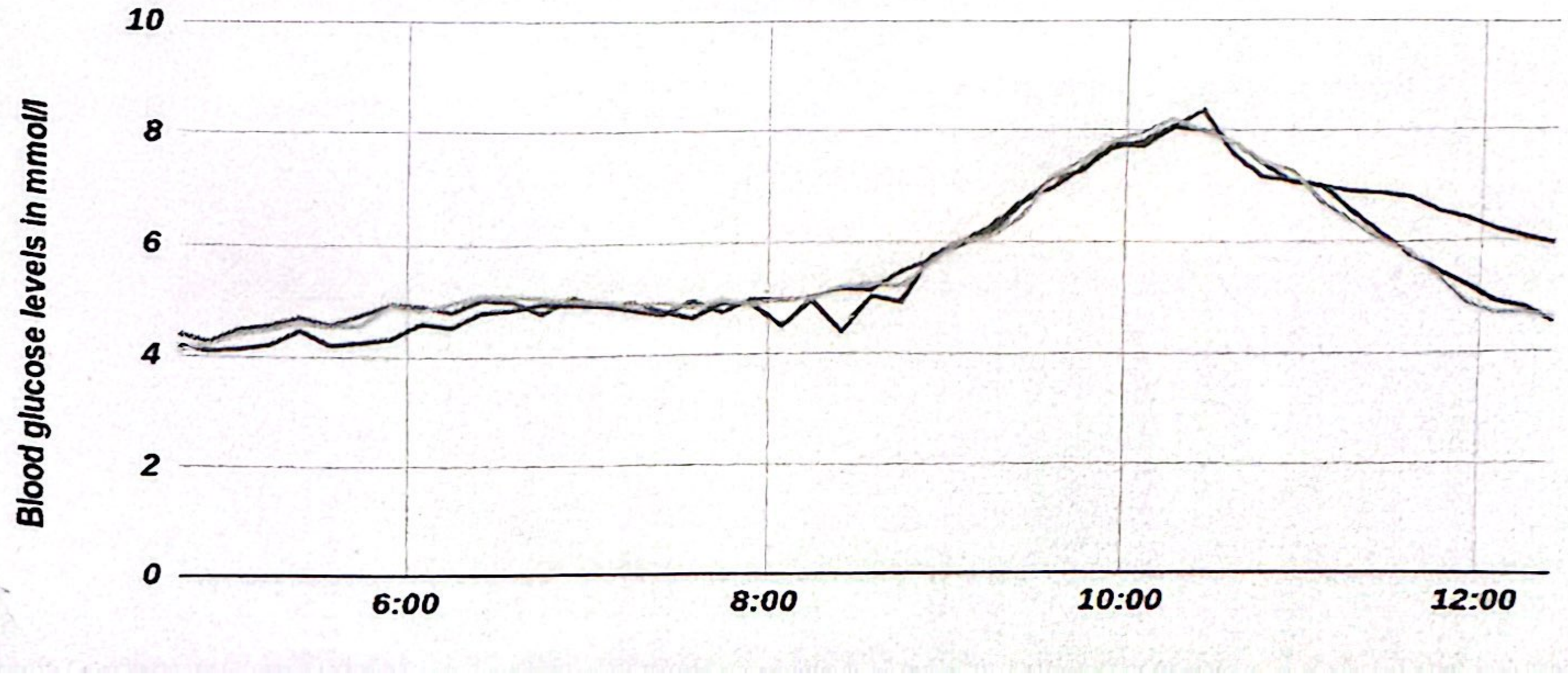


Blood Glucose levels for 50 grams of milk chocolate



Coke

Blood Glucose levels for 222 ml of Coke



On January 1, 2024 I began making the pancreas simulator. I made the model as instructed by Science buddies with a few changes. For both the diabetics simulator a code was uploaded. For type 1 diabeter to represent a mango 112 ml of a 1 molar NaCl solution was added. 132.1 ml for milk chocolate and 136.2 ml for coke. Here are the results Type 1 Diebeteis

The multimeter read 1.43 volts ten minutes later after adding 122 ml of the 1 molar salt solution to represent a mango.

Ten minutes after adding 132.1 ml of the 1 molar salt solution to represent milk chocolate the voltage on the multimeter read 2.03 volts.

For type 1 diabetes after 136.2 ml of a 1 molar NaCl solution was added to represent coke, after 10 minutes the multimeter read 2.27 volts.

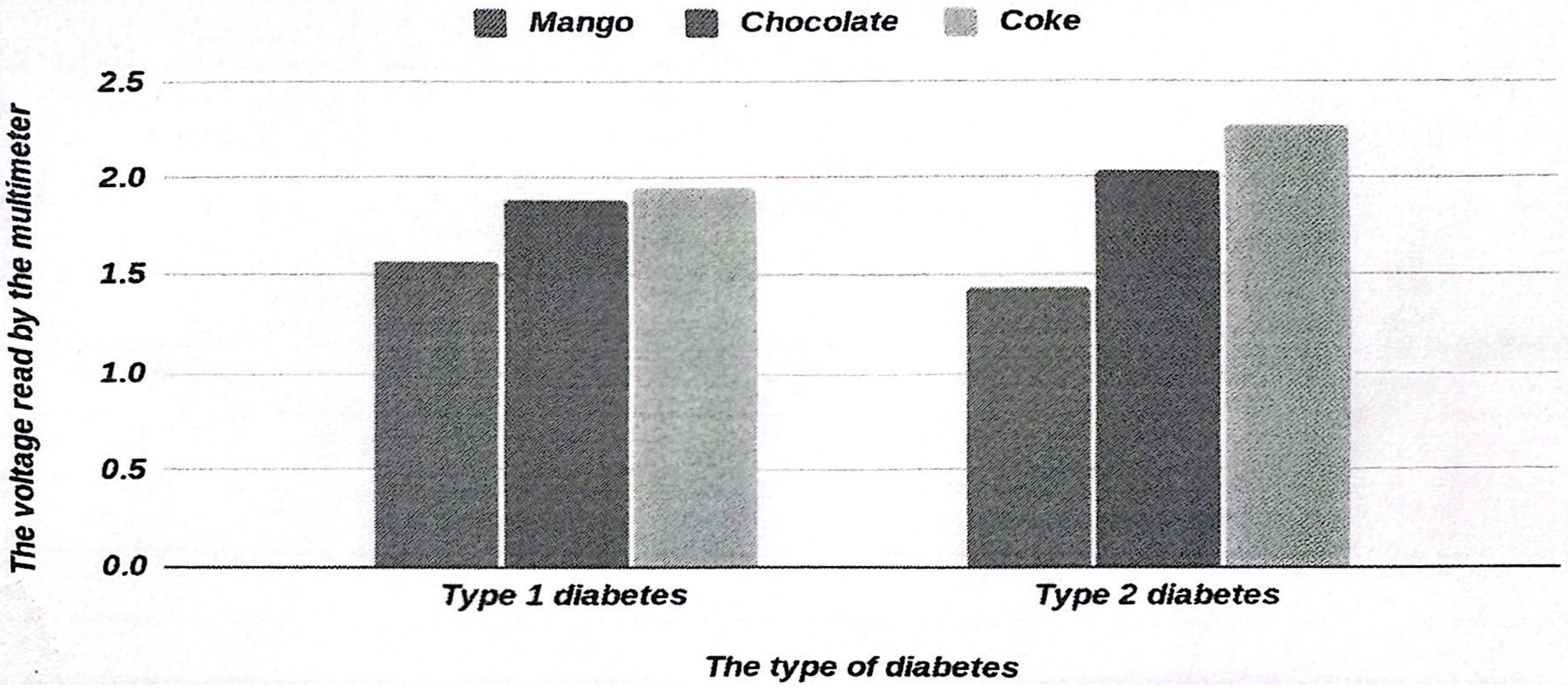
Type 2 diabetes

For type 1 diabetes after 112 ml of a 1 molar NaCl solution was added to represent a mango, after 10 minutes the multimeter read 1.57 volts.

The multimeter read 1.89 volts ten minutes later after adding 132.1 ml of the 1 molar salt solution to represent milk chocolate.

Ten minutes after adding 136.2 ml of the 1 molar salt solution to represent coke the voltage on the multimeter read 1.95 volts.

How consuming a mango, milk chocolate and coke would affect someone if they had type 1 or 2 diabetes.



Conclusion:

The focus of this experiment was to investigate how consuming an average sized mango, 100 grams of milk chocolate and 222 ml of coke would affect the blood glucose levels. It was hypothesized that the result of this experiment would be that consuming milk chocolate would raise the blood glucose levels the most. This was proved wrong because coke increased the blood glucose levels the most. The results of this experiment showed that the highest average point in the graph after consuming a mango was 8.06 mmol/l or 145.1 mg/dl, for milk chocolate it was 8.12 mmol/l or 146.2 mg/dl and lastly for coke it was 8.23 mmol/l or 148.1 mg/dl. This experiment can be supported by the following research. Glucose is fuel for the body which is obtained from the foods we consume. Our body breaks them down to glucose. When we eat our blood glucose levels increase. To lower them back down a fluid is produced by the pancreas called insulin. The pancreas releases insulin as it corresponds with the body. This helps lower the blood glucose levels and allow the cells to use the glucose. When the insulin doesn't properly respond with the body a medical condition known as diabetes is formed. There are different types of diabetes but there is no known cure. If a diabetic person consumes food containing high amounts of glucose it can increase their blood glucose levels to a dangerous level which can harm them.

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```
1 /*
2  * Artificial Pancreas model code
3  *
4  */
5
6  int pumpPin = 11; // pin used to control pump
7  int pumpSpeed = 255; // pump speed, value between 0-255
8  int conductivity;    // conductivity value, this will be 0-1023 from analogRead
9  int threshold = 210; // conductivity threshold at which pump should turn off
10
11 void setup() {
12   // put your setup code here, to run once:
13   pinMode(pumpPin,OUTPUT); // set pump pin as output
14   Serial.begin(9600);      // initialize serial communication
15
16 }
17
18 void loop() {
19   // put your main code here, to run repeatedly:
20   conductivity = analogRead(A0);  // get conductivity reading
21   Serial.println(conductivity);
22   if(conductivity>threshold){
23     analogWrite(pumpPin,pumpSpeed); // turn pump on if threshold has not been reached yet
24   }
25   else{
26     digitalWrite(pumpPin,LOW); // turn pump off if threshold has been reached
27   }
28
29 }
30
```