

DRAFT

Georgia Performance Standards

Biology

The task

Students were given a data table showing a high school student's blood glucose levels as measured hourly over a 24-hour period. They were asked to graph the data; to draw conclusions about regulatory response from the data; and to use their conclusions to make inferences about the effects of injected insulin on diabetes.

Circumstances of performance

Students were expected to work in alone and outside of class with teacher feedback.

Prior Learning

This task requires that students have studied the basic functions of cells, homeostasis, and the role of insulin in the body.

What the work shows

Characteristics of Science

Habits of Mind

SCSh1. Students will be able to use tools and instruments for observing, measuring, and manipulating objects in scientific activities.

- b. Develop and use systematic procedures for recording and organizing information.

SCSh2. Students will be able to use the ideas of system, model, change, and scale in exploring scientific and technological matters.

- a. Apply the concept of a system to the analysis of how things work and the design of solutions to problems. Specify the system's boundaries and subsystems, its relation to other systems, and its input and output.
- b. Understand that computers are used to develop, test, and revise models, including mathematical models that involve long, complicated, or repetitive computations, and graphic models that simulate complicated processes or make it possible to design and test devices and structures.
- c. Explain how systems in equilibrium may return to the same state of equilibrium when the disturbances are small and how large disturbances may destroy a system's equilibrium and eventually result in a different state of equilibrium.
- d. Understand how large changes in scale typically change the way things work in physical, biological, or social systems because the changes in scale affect various properties of those systems in different degrees.

SCSh5. Students will be able to communicate scientific ideas and activities clearly.

- a. Write clear, coherent accounts of scientific activities, including possible analyses and alternative interpretations of the results.
- c. Make and use tables, charts, graphs, and scale drawings to make scientific arguments and claims in oral and written presentations.

Content

SB1. Students will be familiar with the structures and functions of living cells.

- a. Students will analyze the basic relationships between living and non-living things as they relate to absorption, storage, and release of energy in cells.
- b. Students will describe the structure, function, and how they regulate homeostasis as they pertain to cell organelles.

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Student Work

Sample 1

Endocrine Feedback Exercise

Introduction:

The Endocrine System consists of a group of glands located all around the body that produce and secrete chemical messengers. These messengers, or **hormones**, travel through the blood stream causing effects in specific **target** tissues. The endocrine system serves as a fine tuner for maintaining homeostasis in the body. This system, combined with the nervous system, serves to control all body reactions and behaviors.

Hormone secretion by the various endocrine glands is controlled by delicate series of actions known as **feedback**. In this process the production and/or secretion of hormones is regulated by the presence or absence of a second blood chemical. For instance, the secretion of both glucagon and insulin, by the pancreas, is regulated by the presence or absence of glucose in the blood.

In this exercise you will examine the body's response to the normal change in blood glucose during a typical day.

Directions:

Use the information on the chart below to construct a line graph of the % blood glucose over the course of a high school student's day. This student generally eats 3 meals a day, and is a member of the school's football team.

Time of Day	% Blood Glucose	Time of Day	% Blood Glucose
7AM	45	7PM	45
8AM	30	8PM	43
9AM	28	9PM	30
10AM	30	10PM	28
11AM	30	11PM	30
12 NOON	48	12 MIDNIGHT	29
1PM	43	1AM	29
2PM	30	2AM	28
3PM	30	3AM	30
4PM	24	4AM	28
5PM	28	5AM	30
6PM	30	6AM	30

Breakfast is at 6:30AM
Lunch is at 11:30AM
Dinner is at 6PM

Football Practice is from
3:30PM - 6:30PM

Analysis Questions

- In your own words, describe what is happening to the blood glucose levels throughout the day.
The glucose levels increase shortly after each meal is eaten. During practice, the level of glucose decreases.
- What effect did eating have on the blood glucose level?
Eating increases the blood glucose levels.
- Why do you think there is a slight delay in the change of blood glucose levels after eating?
The delay is due to the fact that the food must be digested so that it can break down into glucose.

Sample 2

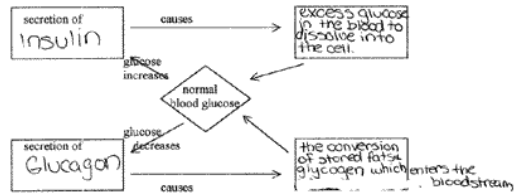
- What happens to the amount of glucose in the blood between:
lunch and football practice: *The amount of glucose gradually decreases*
during football practice: *The amount slowly increases*
- Which hormone is responsible for the change in blood glucose levels between:
7:00AM and 11:00AM *Insulin*
3:00PM and 5:00PM *Glucagon*
- Diabetes is a condition where the pancreas no longer produces any (or enough) insulin. If this student was a diabetic and did not know it, how would his blood sugar graph be different?
The glucose levels in the blood would be higher than that of a person without diabetes.
What problems should this create for the student?
The cells would not absorb enough glucose & would lack the energy to properly function. The person could pass out or produce new hormones when needed.
- Hormones do not last in the blood stream indefinitely. For this reason your glands must constantly produce new hormones when needed. Using this information - why would a diabetic person require injections of insulin two or even three times a day?
Insulin injections would need to be given 2 or 3 times a day because when the insulin is injected into the bloodstream, it will only last for a period of time. Since the body cannot elevate the insulin levels sufficiently on its own, more insulin must be injected.

Insulin works to decrease the blood glucose levels by:

- allowing glucose to diffuse into cells
- stimulating cell respiration to occur
- stimulating the formation of storage glycogen in the liver and fat cells around the body

Glucagon works to increase the blood glucose levels by:

- increasing the conversion of stored fats and glycogen into glucose which is placed into the blood



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Analysis Questions

- In your own words, describe what is happening to the blood glucose levels throughout the day.
Throughout the day, blood glucose levels fluctuate. During physical exercise, the glucose levels are at their lowest. And during lunch, glucose levels in the blood are at their highest.
- What effect did eating have on the blood glucose level?
It raised it significantly.
- Why do you think there is a slight delay in the change of blood glucose levels after eating?
There is a slight delay in the change of blood glucose levels after eating because the food needs to be digested and the sugar must be circulated throughout the bloodstream.

4. What happens to the amount of glucose in the blood between:

J lunch and football practice: *during lunch, glucose is at its highest and during football practice glucose levels drop to their lowest. The glucose levels drop significantly.*

5. Which hormone is responsible for the change in blood glucose levels between:

K 7:00AM and 11:00AM *Insulin*
3:00PM and 5:00PM *Glucagon*

6. Diabetes is a condition where the pancreas no longer produces any (or enough) insulin. If this student was a diabetic and did not know it, how would his blood sugar graph be different?

His blood sugar would be high and off the charts.

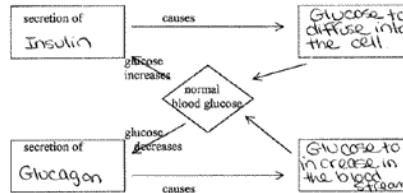
What problems should this create for the student?

He would probably pass out, dehydrated, maybe there would be a possible death.

R 7. Hormones do not last in the blood stream indefinitely. For this reason your glands must constantly produce new hormones when needed. Using this information - why would a diabetic person require injections of insulin two or even three times a day? *A diabetic person would require injections of insulin two or even three times a day because since insulin works to decrease the blood glucose levels by allowing glucose to diffuse into cells, stimulating cell respiration to occur and stimulating the formation of storage glycogen in the liver and fat cells around the body since a diabetic person does not produce enough insulin, they would need to receive two to three shots a day to prevent their glucose levels from rising to high.*

Use the following information to complete the concept map below:

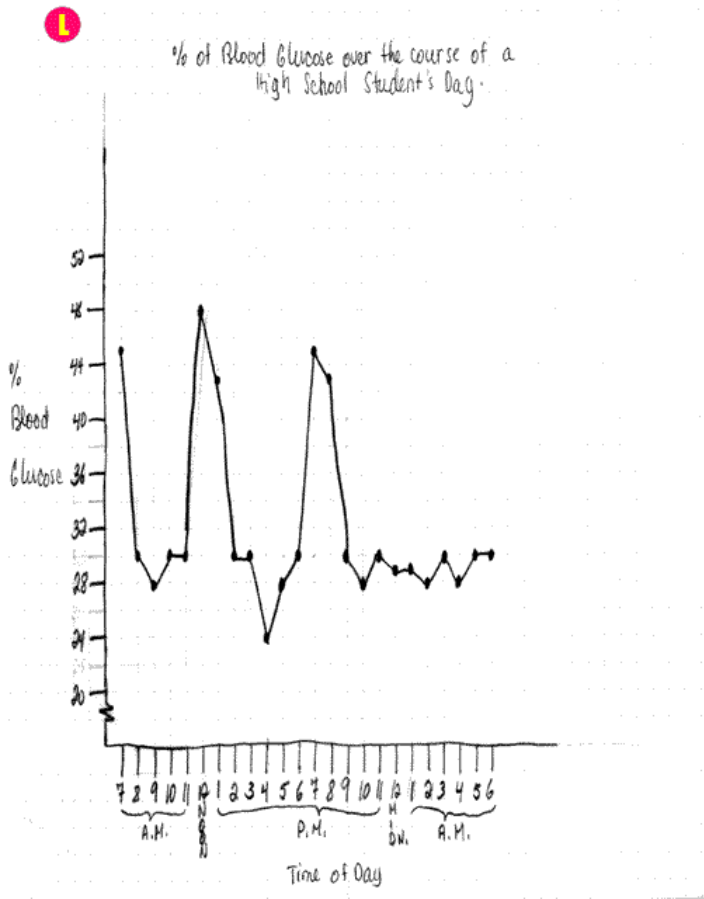
- Insulin works to decrease the blood glucose levels by:
- allowing glucose to diffuse into cells
 - stimulating cell respiration to occur
 - stimulating the formation of storage glycogen in the liver and fat cells around the body
- Glucagon works to increase the blood glucose levels by:
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A The student understands that substances within the blood last for a finite time, and used this information to explain why regular injections of insulin are required to regulate diabetes.

B This answer accurately explains what happens to sugar in the blood after a meal. It also points out that insulin is involved in the entry of glucose into various cells.

C D The answers demonstrate an understanding that eating as well as normal and strenuous metabolic demands cause changes in blood sugar levels, and that the effects of those changes are regulatory responses to maintain homeostasis.

A E In the discussion of diabetes, the connection between the presence of insulin and the ability of the body to absorb glucose into cells is clearly stated.

B The student accurately correlates the regulatory effect of injected insulin with the production of glycogen.

B E Concepts related to cell function and regulation is accurately applied in making inferences about the regulatory effects of injected insulin.

F G H I J K Concepts related to cell function and regulation is accurately applied in making inferences about the data in the table.

L The points on the graph are correctly plotted. The student chose appropriate scales and intervals for the graph, and the axes are correctly labeled. The use of a ruler or straight edge for drawing the axes and connecting lines would be recommended in a revision.

A B E The students correctly interpret the data presented in the table, and use their conclusions to make inferences about the effects of injected insulin.