Activity 2.1.3: Feedback (Place in your lab journal after corrected)

Introduction

So far in this lesson, you have studied the connection between insulin and glucose and how the interaction of the two is related to diabetes. But how does your body monitor and control the level of sugar in your blood? The human body maintains homeostasis, a steady state, by monitoring changes in the internal and external environment and feeding this information back to the body so that it can make necessary change. The control of body temperature, heart rate, and the concentration of sugar in the blood are all regulated by these feedback mechanisms or feedback loops. There are actually two types of feedback mechanisms: negative feedback and positive feedback. In this instance, the terms positive and negative do not infer good or bad. Instead, the terms refer to the effect the input of information (feedback) has on the output (action) of the system. Positive feedback causes a reinforcement of the original action, so the input causes the reaction to increase. Negative feedback causes the system to stop doing the original action and to either take no action or to perform an opposite action.

While our nervous system communicates using electrical signals, the body's endocrine system uses chemical signals, called hormones, to regulate body functioning. Hormones are proteins involved in maintaining the body's homeostasis. These chemical messengers carry signals from one cell to another and regulate many of the body's functions, including growth and development, metabolism, and reproduction. Hormones are secreted by tissues in the body referred to as glands. Each hormone has a specific list of target tissues, and in many cases these include other endocrine glands. Hormones are a vital component of the body's feedback system. Insulin is one of the key hormones that helps maintain a healthy blood sugar level.

In this activity you will investigate feedback and feedback loops. Using knowledge of the insulin/glucose connection, diagram the specific steps in the body that function to keep blood sugar in balance.

Equipment

- Computer with Internet access and Inspiration® software
- Markers
- Laboratory journal or notebook

Procedure

1. Watch the Penn Medicine video – Negative Feedback and Insulin Production to learn more about feedback in the body
   http://www.pennmedicine.org/health_info/diabetes2/000272.html
2. Define feedback or feedback mechanism. This definition should include an example that shows you understand the concept.

Feedback is a response from the body to an abnormal change in homeostasis in order to bring the body back to normal. For example, if the body is low on fluids, the glands in the body will create a sensation of thirst in the brain which will cause the person to seek out water, which once consumed will help the body to return homeostasis.

3. Research how the body regulates body temperature. Think about the organs, tissues, or functions involved in warming and cooling the body. Use the Internet or other resources to find information. Take notes in your laboratory journal or notebook.

4. Open Inspiration® software.

5. Construct a feedback diagram depicting the regulation of body temperature. A basic template of a loop is shown below. You can use this basic template or design another visual using the software. Add or delete bubbles or boxes as needed. Fill in the steps to show how the body restores normal temperature. Indicate whether the feedback loop you have drawn represents a positive or a negative feedback mechanism.

![Feedback Diagram](image)

6. Print and attach to this assignment.

7. Think about the insulin/glucose connection. Insulin is a key hormone that communicates with the body to control the level of sugar in your blood.

8. Imagine you just ate a candy bar. What are the steps your body goes through to control this increase? Make sure to mention the glands involved, the hormones released, and the response of target organs. Refer to the video you watched in Step 1 if needed.

   The pancreas produces insulin when the raise in blood sugar is detected, which lets the glucose into the cell. Additionally, the liver will produce glycogen from the excess glucose for later use, the glycogen is then stored in fat and muscle cells.
9. Imagine your candy bar has long since worn off and your blood sugar is beginning to drop. What is the role of the hormone glucagon in getting your blood sugar back to normal. Make sure to mention the glands involved, the hormones released, and the response of target organs. Take notes in your laboratory journal.

Once the blood sugar has begun to drop, the pancreas makes glucagon to break up the stored up glycogen in fat and muscles. This causes glucose to be released and thus restore the blood sugar to a normal state.

10. Use your findings to create a feedback loop diagram that describes how your body maintains the proper level of sugar in the blood. Combine your findings about how insulin and glucagon work and think about the sequence of events that occurs to restore balance in the body. Complete this loop using Inspiration® software. A sample diagram is shown below:

11. Depending on how you set up your loop, consider adding additional boxes or deleting unnecessary ones. Be specific, detailing glands and organs as necessary, and make sure your progression makes sense.

12. Add additional information to your completed diagram to show what happens to this loop in the case of diabetes. Be sure to address both Type 1 and Type 2 diabetes.
13. Compare your feedback loop with another group. Discuss any discrepancies you may find and modify your information if needed.

14. Attach a copy of your completed feedback loop to this assignment.

15. Update the classroom evidence board with information from Lesson 2.1.

16. Answer the Conclusion questions.

Conclusion

1. Is blood sugar regulated by negative or positive feedback? Explain your answer.

   Blood sugar is regulated by negative feedback. If it is too high, the body takes the opposite action of bringing glucose into cells via insulin and turning the excess into glycogen for storage and later use. If it is too low, the body produces glucagon to break down the stored up glucose, an opposite reaction.

2. Explain how a problem with insulin receptors would affect the ability to achieve homeostasis.

   If insulin receptors did not function properly, the glucose could not enter the cells, which would cause prolonged periods of high blood sugar, much as in type 2 diabetes. This would make the body unable to achieve homeostasis without great effort.

3. Explain how it is possible that a problem with hormones and feedback led to Anna Garcia’s untimely death.

   Since Anna Garcia’s body did not produce insulin properly due to type 1 diabetes, it is possible that an issue of too great an amount of glucose in her bloodstream (and thus not in her cells) caused her to have very low energy, causing her to black out and hit her head on the desk, which led to her death.
In Type 2 Diabetes, the pancreas does not produce insulin

Insulin helps glucose into cells

Glycogen is stored in fat and muscle cells

Liver detects increase, makes glycogen

Blood sugar rises

Glucagon breaks down glycogen in fat and muscle cells.

Normal level of blood glucose

Blood sugar drops

Pancreas produces glucagon

Pancreas detects decrease

In Type 1 Diabetes, the pancreas cannot produce insulin