



# Diagnosing Diabetes

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## The Case:

Your patient reports problems with fatigue and increased urination. You suspect that she might have diabetes. The results of her blood tests indicate that her blood glucose level is slightly above the normal range. You schedule the patient for a glucose tolerance test which is a medical test to check how the body metabolizes blood sugar.

## Your Tasks:

- Organize pictures to illustrate a patient information sheet
- Test and graph the glucose levels in blood plasma samples collected during the patient's glucose tolerance test.
- Test and graph the insulin levels in blood plasma samples collected during the patient's glucose tolerance test.
- Analyze the test results to determine if the patient has Type 1 or Type 2 diabetes.

## PART 1:

### What you should know about diabetes and the glucose tolerance test

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You have a patient information sheet called *What You Should Know About Diabetes and the Glucose Tolerance Test*, that explains diabetes and the glucose tolerance test. However, many of your patients have difficulty reading this information sheet. You would like to add some pictures that you have collected to illustrate the information in the brochure.

1. Read the patient information sheet on the next three pages—*What You Should Know About Diabetes and the Glucose Tolerance Test*. For each paragraph, select the color graphic on the separate handout that illustrates the information. Cut and paste the graphics in the appropriate boxes on the information sheet.

## What You Should Know About Diabetes and the Glucose Tolerance Test

<p>1. Key to the Diagrams</p>	
<p>2. Most of the food you eat is turned into glucose, or sugar, for your body to use for energy. Your blood carries the glucose to all the cells in your body. Your blood always has some glucose in it because your body needs glucose for energy to keep you going. But too much glucose in the blood isn't good for your health. To maintain homeostasis, you need to keep a normal level of glucose in your blood.</p>	
<p>3. Healthy people have a <b>feedback (control) mechanism</b> that maintains homeostasis by keeping blood glucose levels relatively constant and within a normal range. A high blood glucose level acts as a stimulus for the pancreas. The pancreas responds to this stimulus by secreting <b>insulin</b>, a chemical messenger (hormone). Insulin helps the glucose from food diffuse out of the blood and into your cells. This lowers blood sugar levels.</p>	

4. Most of the cells in the body carry **receptors** for the insulin hormone on their cell membranes. Once the insulin binds to one of these receptors, the receptor gives a signal to the cell's interior. This signal causes glucose transport proteins in the cell membrane to open and allow glucose to diffuse out of the blood and into body cells.

5. **Diabetes** means that your blood glucose (often called blood sugar) is too high because glucose can't get into your cells. When glucose can't get into your cells, it stays in your blood.

6. **Type 1 diabetes** accounts for 5% to 10% of all diagnosed cases of diabetes. Type 1 diabetes is called an autoimmune disease, because the immune system attacks the person's own pancreas cells. The cells in the pancreas that produce insulin are destroyed. Most people with Type 1 diabetes produce no insulin at all. Without insulin, glucose cannot get into the cells and accumulates in the blood.

<p>7. <b>Type 2 diabetes</b> accounts for about 90% to 95% of all diagnosed cases of diabetes. People can develop Type 2 diabetes at any age - even during childhood, although most people with Type 2 diabetes are adults. People with Type 2 diabetes produce insulin but the insulin receptors on their cells do not respond properly to the insulin message. Being overweight and inactive increases the chances of developing type 2 diabetes.</p>	
<p>8. Treatments for both types of diabetes include making wise food choices, being physically active, and controlling blood pressure and cholesterol levels. People with Type 1 diabetes must take insulin injections. People with Type 2 diabetes use oral medicines to lower blood glucose levels.</p> <p>If diabetes is not properly treated, the high blood glucose levels can cause serious health complications including heart disease, blindness, kidney failure and leg amputation. Diabetes is the sixth leading cause of death in the United States.</p>	
<p>9. A <b>Glucose Tolerance Test</b> is a diagnostic blood test for diabetes. After fasting (not eating) overnight, you are given a concentrated sugar solution (50 to 100 grams of glucose) to drink. Your blood is sampled periodically over the next several hours to test its glucose levels.</p> <p>Normally, blood glucose does not rise very much and returns to normal within two to three hours. If you have diabetes, the blood glucose level is usually higher after fasting, rises more after drinking the glucose solution and takes from four to six hours to come down to normal levels.</p>	

**Answer the following questions. Refer to the information and diagrams in *What You Should Know About Diabetes and the Glucose Tolerance Test*:**

1. What is insulin? What does it do in your body?

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2. What do the insulin receptor molecules on the cells in your body do?

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3. List two similarities between Type 1 and Type 2 diabetes.

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4. List two differences between Type 1 and Type 2 diabetes.

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5. What health problems may result if a patient's diabetes is not properly treated to maintain normal blood glucose levels?

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**PART 2:  
Analyzing Blood Glucose Levels**

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To prepare for the glucose tolerance test, your patient fasted for 12 hours. To begin the test she drank a solution that contained a measured amount of glucose. Blood samples were collected immediately before she drank the glucose solution and every half hour after she drank the glucose solution. The blood sample was centrifuged to separate it into blood cells and blood plasma (the liquid part of blood). You will test the concentration of glucose in the patient's blood plasma to determine if she has diabetes.

1. Your lab kit has 5 samples of the patient's blood plasma that were collected at various time intervals during the patient's glucose tolerance test.

- Use Column 1 on the "Glucose Tolerance Testing Sheet." Place 1 drop of the appropriate plasma samples to be tested in the appropriate circles in Column 1. Save the samples of patient blood plasma for use in Part 3.
- Place a strip of glucose test paper into each of the circles in Column 1 of the "Glucose Tolerance Testing Sheet" that contain the plasma samples that you are testing. Immediately compare the color of the test paper with the color on the Glucose Test Paper Color Chart. Record the results of the glucose tests in Table 1 below.

**TABLE 1**

<b>Time of Blood Collection Minutes After Drinking Glucose Solution</b>	<b>Glucose Level in Blood (milligrams/deciliter)</b>
<b>0 (after fasting)</b>	
<b>30</b>	
<b>60</b>	
<b>90</b>	
<b>120</b>	

- The graph below shows the blood plasma glucose levels for a healthy person who does not have diabetes. Plot the data from the patient's glucose test results (from Table 1) on the graph.

Key: **- - - -** = Healthy person who does not have diabetes  
**————** = The patient

**Glucose Concentration During Glucose Tolerance Test**



Use the information in the *What You Should Know About Diabetes and the Glucose Tolerance Test* fact sheet to help you interpret the results of the patient's glucose tolerance test.

5. Explain why the blood glucose level for the healthy person was low (70 mg/dL) at the beginning of the glucose tolerance test.

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6. Explain why the blood glucose level for the healthy person rises after drinking the glucose solution.

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7. Explain what causes the healthy person's blood glucose levels to decrease after 30 minutes.

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8. Explain what might cause the patient's blood glucose levels to remain high after 30 minutes.

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9. Based on the information in this graph, do you think the patient has diabetes? Support your answer with evidence from the graph.

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10. Do you have enough information to determine if the patient has Type 1 or Type 2 diabetes? If not, how would you go about figuring this out?

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### **PART 3:** **Analyzing Blood Insulin Levels**

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There are two types of diabetes that result in higher than normal blood glucose levels - called Type 1 and Type 2 diabetes. A person with Type 1 diabetes does not produce insulin. A person with Type 2 diabetes does produce insulin but their cells are unable to respond to the insulin message.

To determine whether the patient has Type 1 or Type 2 diabetes, you need to test the concentration of insulin in the patient's blood plasma.

1. Use Column 2 on the "Glucose Tolerance Testing Sheet." Place 1 drop of the appropriate plasma samples to be tested in the appropriate circles in **Column 2 – Insulin Level in Blood**.
2. Add 1 drop of the Insulin Indicator Solution to the plasma in each of the circles. After 10 seconds, compare the color of the fluid in each circle with the Insulin Test Indicator Color Chart.
3. Record the results of the insulin tests in Table 2 on the next page.
4. The graph on the next page shows the blood plasma insulin levels for healthy person who does not have diabetes. Plot the data from the patient's insulin test results on the graph.

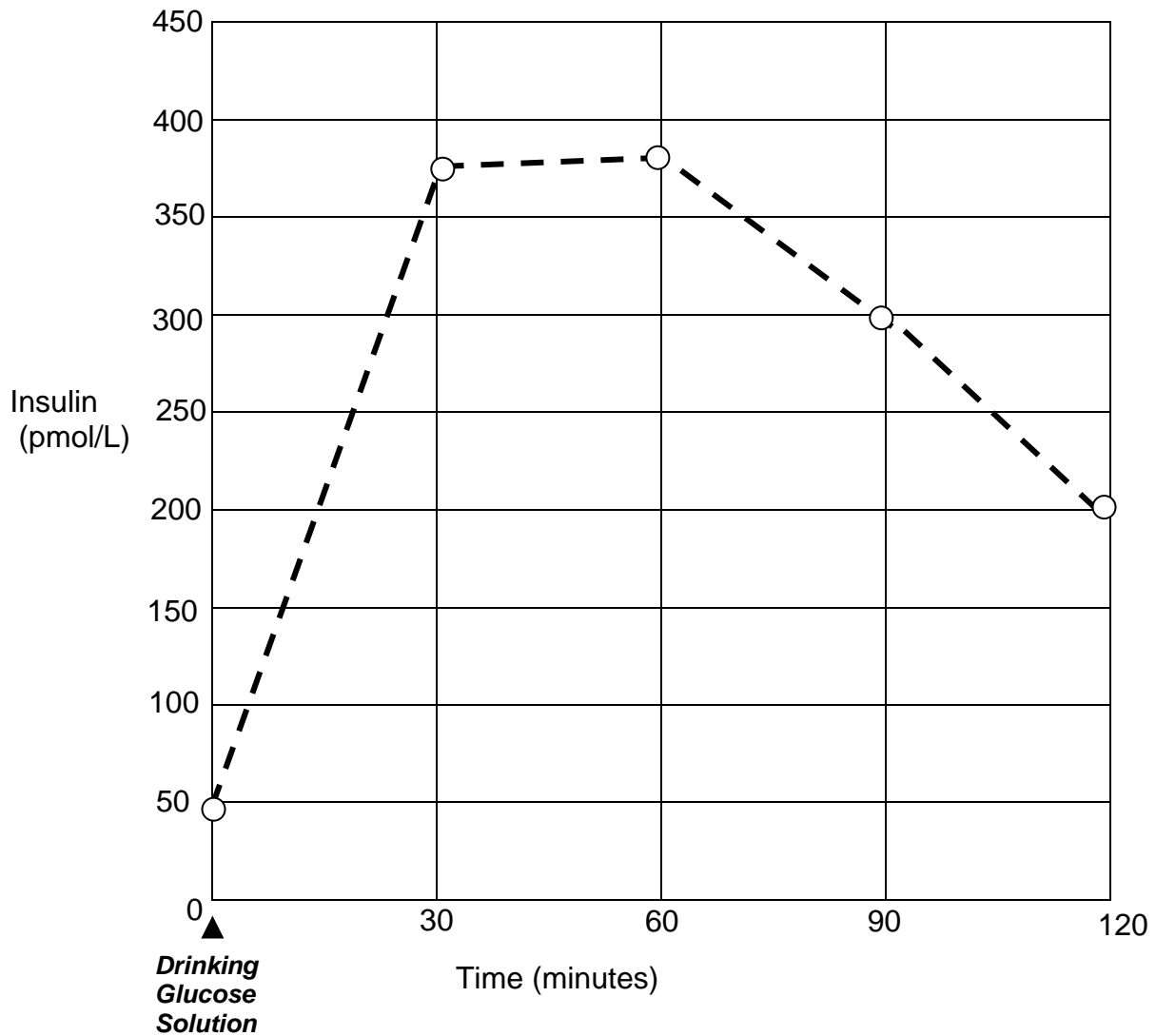


**TABLE 2**

<b>Time for Blood Collection Minutes After Drinking Glucose Solution</b>	<b>Insulin Level in Blood (picomole/liter)</b>
<b>0 (after fasting)</b>	
<b>30</b>	
<b>60</b>	
<b>90</b>	
<b>120</b>	

Key :   
 - - - - = Healthy person who does not have diabetes  
 ————— = The patient

**Insulin Concentration During Glucose Tolerance Test**



Use the information in the *What You Should Know About Diabetes and the Glucose Tolerance Test* factsheet to help you interpret the results of the patient's glucose tolerance test.

5. Compare the insulin levels in a healthy person with the insulin levels in the patient.

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6. Based on the information in the graph, do you think the patient has **Type 1** or **Type 2** diabetes? Support your answer with information from the graph.

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7. Why would insulin injections typically not be used to treat the patient's diabetes?

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8. What treatment plan would you suggest to keep the patient's glucose levels within normal range?

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9. What health problems may result if the patient does not follow the treatment plan suggested to keep her blood glucose levels within normal range?

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