

# Blood Glucose Metabolism

## Model 1: The Oral Glucose Tolerance Test (OGTT)

The Oral Glucose Tolerance Test is often used to detect diabetes mellitus. The following procedure is used to conduct an OGTT:

- Patient is instructed to eat a normal diet during the days leading up to the test.
- Patient is instructed to fast (no eating or drinking) for 8 to 10 hours prior to the test (usually overnight).
- At the lab, the patient drinks a prepared glucose solution (the volume and concentration of the solution varies according to the patient's body weight).
- Measurements of the patient's blood glucose levels are taken every 30 minutes or every hour for 2 hours (*no additional food or drink is consumed during the administration of the OGTT*). In most clinical settings, readings for blood glucose are taken at time zero and at two hours. In research studies using the OGTT, glucose levels are recorded more frequently and for longer durations of time.

The following data table shows acceptable minimum and maximum values for the OGTT.

<b>Time (minutes)</b>	<b>0</b>	<b>30</b>	<b>60</b>	<b>90</b>	<b>120</b>
<b>Maximum Blood Glucose (mg/dL)</b>	100	170	160	130	105
<b>Minumum Blood Glucose (mg/dL)</b>	80	150	140	110	85

## QUESTIONS:

1. What do people consume at the start of the Oral Glucose Tolerance Test? How is the volume and concentration determined?

2. What is the time duration of the OGTT?
3. What is the range of normal values of blood glucose at the beginning (time zero) of the test?
4. What are the highest acceptable blood glucose levels during the test? At what time in the test do these values occur?
5. What is the range of normal values of blood glucose at the end of the OGTT?
6. Two individuals (Maria and Laura) both complain to their doctor of frequent thirst and frequent urination. Maria has the additional symptom of blurry vision and a “tingling sensation” in her fingers and toes. The doctor suspects diabetes mellitus, a disease in which blood glucose metabolism does not stay within normal ranges. The doctor orders both to undergo an Oral Glucose Tolerance Test to test this prediction. Below are the results of the OGTT.

### Measurements recorded during OGTT

<b>Time (minutes)</b>	<b>0</b>	<b>30</b>	<b>60</b>	<b>90</b>	<b>120</b>
<b><u>Maria:</u> Blood Glucose (mg/dL)</b>	90	140	150	135	110
<b><u>Laura:</u> Blood Glucose (mg/dL)</b>	110	170	220	270	300

- a) Which individual is more suspect of having diabetes mellitus?
- b) Justify your answer comparing each person’s OGTT data to data found in Model 1.

## Model 2: Blood Glucose and Blood Insulin Levels

Insulin is a protein hormone that is secreted into the blood by the pancreas. Clinicians rarely measure insulin levels, but the procedure is regularly done in research labs studying diabetes.

The following data show blood insulin levels that correspond to the blood glucose levels in the OGTT used in Model 1.

### Measurements recorded during OGTT

Time (minutes)	0	30	60	90	120
<b>Maria:</b> Blood Glucose (mg/dL)	90	140	150	135	110
<b>Maria:</b> Blood Insulin (pmol / L)	45	140	200	220	150
<b>Laura:</b> Blood Glucose (mg/dL)	110	170	220	270	300
<b>Laura:</b> Blood Insulin (pmol / L)	25	60	80	85	90

### QUESTIONS:

7. What units are used to measure blood glucose? What units are used to measure blood insulin?
8. On your own, draw two graphs-- one showing Maria's glucose and insulin levels vs. time, and the second showing Laura's glucose and insulin levels vs. time. After all individuals have completed drawing graphs, compare them with your group members. *(Use a separate piece of paper if you choose)*

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9. Which individual above (Maria or Laura) had the greater pancreatic response to the OGTT? How do you know?
  
10. On your own, write a grammatically correct sentence describing the relationship between blood glucose and blood insulin levels. After each individual is finished, compare sentences and, as a group, decide on the most accurate sentence.
  
  
  
  
  
  
  
  
  
  
11. Diabetics are often required to monitor their blood glucose levels to determine if/when they require a shot of insulin. Under what conditions should diabetic individuals give themselves a shot of insulin?



### Model 3: Glycemic index and changes in blood glucose

Three college students (Carter, Linden, and Miriam) have their blood glucose levels measured for six hours. All three recorded what they ate for breakfast at 7:30 am, but did not record any other intake of food.

*Carter’s Breakfast:* Orange juice, high fiber regular oatmeal, and a banana.

*Linden’s breakfast:* Sugar soda pop, Chocolate Frosted Sugar bombs, and two cups of coffee (with sugar).

*Miriam’s breakfast:* Bacon, eggs, and two cups of black coffee.

#### Student Blood Glucose Levels

Time (minutes)	7am	8am	9am	10am	11am	Noon	1pm
<b><u>Carter:</u></b> Blood Glucose (mg/dL)	70	140	140	80	80	80	115
<b><u>Linden:</u></b> Blood Glucose (mg/dL)	70	170	55	170	55	160	55
<b><u>Miriam:</u></b> Blood Glucose (mg/dL)	70	80	80	80	70	70	90

#### QUESTIONS:

- Construct one graph that documents how each student’s blood glucose levels changed over the time period shown. (*You may choose to use a separate piece of paper*)

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13. How many times do you think each person ate during the 6-hour span? How do you know?
  
14. What types of foods are associated with the most rapid changes in blood glucose levels?
  
15. Glycemic Index (GI) is a numeric scale (ranging from 1 to 100) that serves as an indicator of how rapidly a food causes an increase in blood glucose levels. Carbohydrates that cause a rapid increase in blood glucose have high numbers, whereas carbohydrates that cause a gradual increase in blood glucose have lower numbers.
  - a) Using the term “glycemic index,” describe Carter, Linden, and Miriam’s breakfasts.
  
  - b) Which breakfast had the highest glycemic index?
  
  - c) Which breakfast had the lowest glycemic index?
  
16. Using the term “glycemic index,” write one or two sentences that describe the components of a healthy breakfast; one that would not cause a rapid change in blood glucose.

