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TEACHER NOTES

S3. Controlling the level of glucose in the blood

KS4 science

In this text-based activity pupils compare glucose and insulin levels recorded for a diabetic and a non-diabetic.

Timing - 20-25 minutes;
possible homework exercise

Two pupil activity sheets S3 accompany this activity.

Graph paper is needed

Answers to questions on pupil

sheet S3: Task 1

1. Graph
2. Rapidly reduces the level of blood glucose.

Task 2

1. Rises steeply/quickly.
2. Eating a meal involves the digestion of food; this will increase the amount of glucose in the blood; this stimulates the production of
3. Returns to the original level (*not* to zero); it is important to note that there is a 'background' level of insulin in the bloodstream.
4. This is zero; this is not so in a 'normal' person.
5. It rises (but not as rapidly or to the same level as the 'normal' graph).
6. After an injection of insulin, there is a delay before it becomes 'actively' present in the blood. Insulin is normally injected about half an hour before a meal. (There are now types available which can be injected just before eating.)
7. Zero; insulin-dependent diabetics cannot make their own insulin.

   'Normal' people can make insulin and there is always some present in the bloodstream.

CONTROLLING THE LEVEL OF GLUCOSE IN THE BLOOD

The level of glucose in the blood is normally controlled by two hormones. These are called insulin and glucagon. Both of these are produced in the pancreas. This means that the pancreas has two different but very important functions. These are the production of digestive **enzymes** and the production of hormones.

The parts of the pancreas that produce the hormones are called the Islets of Langerhans (islets - the tissue looked liked small islands; Langerhans- Paul Langerhans discovered this tissue).

The control of blood sugar is an example of homeostasis (maintenance of a constant internal environment). Insulin and glucagon work in opposition to one another. Insulin works to remove excess glucose from the blood. Glucagon adds glucose to the blood in times of shortage.

Insulin stimulates the conversion of glucose into a substance called glycogen. Glycogen is a storage **carbohydrate**. It is stored in the liver and muscles. Insulin also stimulates the uptake of glucose by the cells of the body. Glucose is used in the process that produces energy, i.e. respiration. Insulin stimulates processes which have the effect of lowering the amount of glucose in the blood.

Glucagon stimulates the conversion of glycogen from the liver into glucose. This has the opposite effect to insulin. This will increase the amount of glucose in the blood. Early onset diabetes (Insulin Dependant Diabetes, IDD) is a severe form of the condition diabetes mellitus. In this condition there is a complete failure of the pancreas to produce insulin. If this is left entirely untreated it will be fatal. Patients suffering from this form of the disease have to regularly monitor the level of glucose in their blood. (The level of glucose in the blood is measured in millimoles per cubic decimetre ($mmol/dm^3$)). In response to this patients have to have regular injections of insulin.

Task 1

The following questions show the effect that insulin has on the level of glucose in the blood of a 'normal' person.

A person's level of blood glucose was measured. They were then given an injection of insulin. The level of blood glucose was remeasured over time. The results are shown below.

	TIME (minutes)	LEVEL OF BLOOD GLUCOSE ($mmol/dm^3$)
	0	4.1
insulin injection	15	4.1
	30	1.9
	40	3.8
	60	3.8
	90	3.9
	120	4.2

1. Plot a line graph of these results. Put time along the bottom (x axis). Put the level of glucose ($mmol/dm^3$) up the side (y axis).

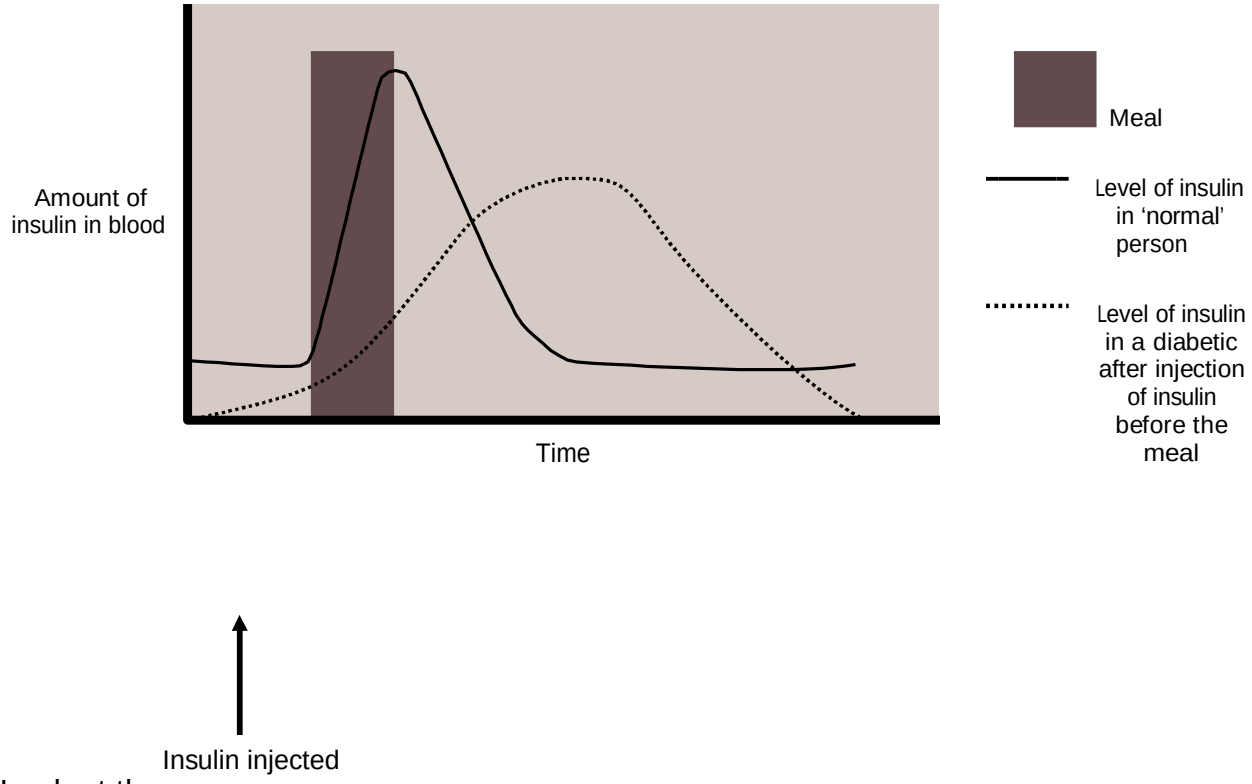
   Remember to give your graph a title. Label the axes. Show where the injection of insulin was given.

2. What effect does insulin have on the level of glucose in the blood?

Task 2

The following sketch graph shows the level of insulin (not glucose) in a 'normal' person. The graph shows what happens to this level after a meal has been eaten.

The graph also shows the level of insulin in a diabetic in the same situation. The diabetic has been given an injection of insulin before the meal.



Look at th

1. What happens to the amount of insulin in the blood when the meal is being eaten?
2. Why does eating a meal bring about this change?
3. What eventually happens to the amount of insulin?

Look at the 'diabetic' line.

4. What is the level of insulin in the blood before the injection is given? In what way is this different to the 'normal' graph?
5. Describe what happens to the level of insulin in the blood following the injection.
6. Why should an injection of insulin be given about half an hour before a meal is eaten?
7. What is the level of insulin in the blood at the end of the graph? Explain this level. In what way is this different to the 'normal' graph?