Sourcing Sugars

Sourcing Sugars I

Aim: This hands-on workshop is designed to help students to investigate which foods and drinks contain glucose.

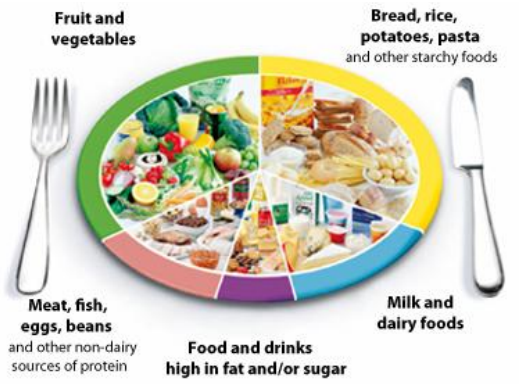
Curriculum Links:

By investigating some body systems and potential problems which they may develop, I can make informed decisions to help me to maintain my health and wellbeing. ***SCN 2-12a***

I have collaborated in activities which safely demonstrate simple chemical reactions using everyday chemicals. I can show an appreciation of a chemical reaction as being a change in which different materials are made. ***SCN 2-19a***

Background Info

There are many different kinds of nutrients our bodies need to stay healthy. These include vitamins, proteins, fats and carbohydrates. We get these from eating a variety of different foods.



In order for our body to operate efficiently we have to give it energy and **carbohydrates** supply this. There are two types of carbohydrates – simple carbohydrates and complex carbohydrates.

Simple carbohydrates are sugars including glucose (see further details later), fructose (the sugar found in fruits), sucrose (table sugar) and lactose (the sugar found in milk). These carbohydrates are easy to digest and provide a quick energy source. Simple carbohydrates are single-chain sugars.

Complex carbohydrates are also sugars but are long chains of simple sugar molecules joined together to form complex chemical structures. Complex carbohydrates are things like starches found in grains, some vegetables and legumes. They require more digestion than simple carbohydrates and are the body's best source of energy because they are burned in a constant, time-release manner. They provide sustained energy for athletic events and can help keep blood sugar levels steady.

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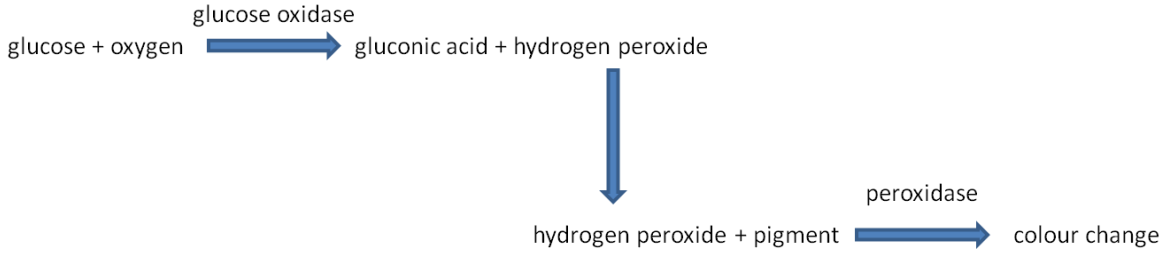
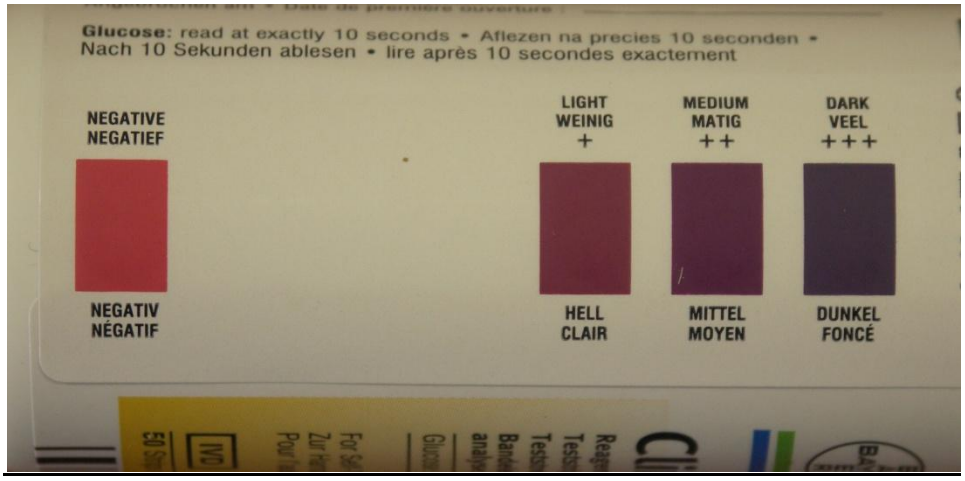
When carbohydrates, both simple and complex, are eaten, the digestive process transforms these into **glucose**. This is the fuel for all the body's cells. The body will either use the glucose immediately or, if there is too much, store it in the body as fat. The liver converts glucose to fat.

In this experiment we are going to look at some everyday food and drinks to see if we can find out which, if any, contain a high amount of glucose.

We can use a special test sticks called **Clinistix** to test for glucose. The sticks contain two enzymes. The first of these, glucose oxidase, speeds the reaction between glucose (in the test liquid) and oxygen (in the air). This reaction produces gluconic acid and hydrogen peroxide. The second enzyme, peroxidase, catalyses the reaction between the hydrogen peroxide and a pigment in the stick, causing it to change colour.



The colour produced is proportional to the amount of glucose present. The darker the colour, the more glucose is present.



Setting up the workspace for the experiment

Because this experiment involves a lot of liquids, spillages may occur so consider covering the tables or conducting the experiment on trays.

Participants should wear personal protective equipment of some sort to protect clothes and skin. For example, disposable aprons or lab coats, gloves (if available) and eye protection (if available). Students with long hair should tie it back.

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Equipment Required

- Clinistix
- Test tubes (as many as you have samples)
- Test tube rack
- 5ml droppers / plastic pipettes (**NB** droppers must allow you to measure the volume of sample)
- Food and drink samples
  e.g. Tap water, flavoured water, Fruit Shoot, lemon juice, Irn Bru, Lucozade, Red Bull, Capri-sun, fresh orange juice, honey, fresh apple juice, Oasis, Fanta, Sprite, flavoured yoghurt, natural yoghurt, Ribena, Coke, Diet Coke, whole milk, semi-skimmed milk, flavoured milk orange squash.

What to do

Setting up the tubes (1 set per group of students);

1. Label each of the test tubes with a number.
2. Place 1ml of each sample into a separate test-tube using a new dropper each time. Note in the table overleaf which sample is in which numbered tube.
3. Place the tubes in the test-tube rack when complete.

Testing the samples;

The samples will be tested one by one with a Clinistix test strip (use a new strip for each sample).

4. Dip the test strip into the liquid and remove immediately.
5. Remove any excess liquid by tapping the strip on the side of the test tube.
6. After 10 seconds, compare the colour of the strip to the colour chart. Disregard any further colour change that happens after this time.
7. Record the colour of the strip (and therefore the level of glucose) in the table overleaf by ticking the appropriate box.

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Results

The results below may vary depending on the type of products and the brands you use but these should give you an idea of what to expect.

Test-tube number	Sample	Clinistix Result			
		Negative	Light	Medium	Dark
1	Tap water	✓			
2	Mineral Water	✓			
3	Flavoured Mineral Water				✓
4	Orange squash			✓	
5	Fresh orange juice		✓		
6	Natural yoghurt	✓			
7	Flavoured yoghurt				✓
8	Coke				✓
9	Diet Coke	✓			
10	Whole Milk	✓			
11	Semi-skimmed milk	✓			
12	Flavoured milk (chocolate)		✓		

Conclusions

Which solutions did not cause the test stick to change colour?

Tap water, mineral water, natural yoghurt, diet coke, whole milk, semi-skimmed milk.

Why was there no colour change with these liquids?

If the test solution contained no glucose the colour of the stick would stay the same.

Which test solutions contained the highest amount of glucose? How could you tell?

Flavoured water, flavoured yoghurt and coke – the stick went a dark colour.

Which test solutions contained the lowest amount of glucose? How could you tell?

Fresh orange juice and flavoured milk – the stick went a light colour.
NB Not the solutions that contained no glucose.

Encourage the students to compare solutions that are similar e.g. – mineral water vs. flavoured mineral water and Coke vs. Diet Coke.

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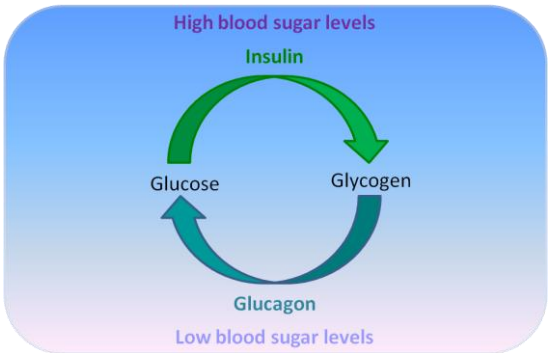
Exploring the Science

The human body needs glucose as a fuel for all the cells.

Ideally, the levels of glucose in the blood (blood sugar level) should be kept within a very narrow range. If blood sugar levels remain high in the body for long periods of time this can damage the blood vessels that supply vital organs, which can increase the risk of heart disease and stroke, kidney disease, vision problems, and nerve problems. If blood sugar levels are too low you might feel hungry and shaky. You may get a headache, feel drowsy or even pass out.

There are two special chemicals (hormones), insulin and glucagon which have the job of keeping blood sugar levels balanced. These hormones are made in the pancreas. When blood glucose levels are too high, insulin is produced by the body to reduce the levels. When blood glucose levels are too low, glucagon is produced by the body to increase the levels.



A disease called **diabetes** causes the amount of glucose in the blood to be too high because the body cannot use it properly. This can be for one of two reasons;

1. The pancreas does not produce any insulin, or not enough (Type 1 Diabetes)
2. The body cannot properly use the insulin that is produced (Type 2 Diabetes)

More than two million people in the UK have the condition and more than three-quarters of these have Type 2 diabetes. The number of people with type 2 diabetes is rapidly increasing because it more common in those who are overweight and the level of obesity in the population is rising all the time. Why not make this the introduction to a healthy living project?

Clinistix are normally used to test a patient's urine sample for glucose. If glucose is present in urine it may mean the patient is diabetic.