Sweet Chromatography

Aim: This hands-on workshop is designed to teach students more about what is in the food they eat by separating out the dyes that give sweets their colour.

Curriculum Links:

I have participated in practical activities to separate simple mixtures of substances and can relate my findings to my everyday experience. **SCN 2-16a**

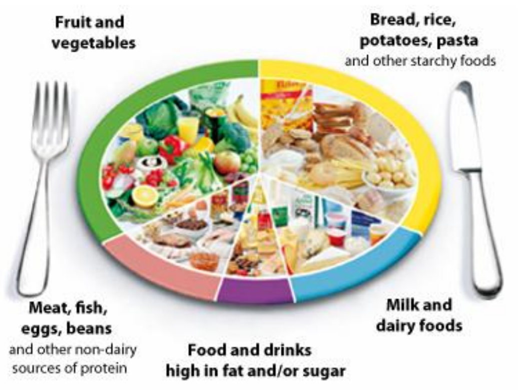
By investigating food labelling systems, I can begin to understand how to use them to make healthy food choices. **HWB 2-36a**

Using my knowledge of nutrition and current healthy eating advice, I can evaluate the information on food packaging, enabling me to make informed choices when preparing and cooking healthy dishes. **HWB 3-36a**

I understand that people at different life stages have differing nutritional needs and that some people may eat or avoid certain foods. **HWB 2-32a**

Background Information

To stay healthy, it is important for us to eat a range of foods so that we can get everything we need - vitamins, proteins, fats and carbohydrates. We get these from eating a variety of different foods like those below.



So we can make sure we follow a balanced diet, it is important that we know exactly what is in the food we are eating.

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How can we find out more about the food we eat?

Nutrition labels on food let us know what is in the food we eat.

Nutrition information (Typical values)	Per 100g	Per Pack Serving
Energy - kJ/kcal	247/59	742/176
Protein	2.5g	7.5g
Carbohydrate	9.0g	27.0g
- of which sugars	0.8g	2.4g
Fat	1.4g	4.2g
- of which saturates	0.9g	2.7g
Fibre	1.9g	5.7g
Sodium	0.3g	0.9g
Salt equivalent	0.8g	2.3g
Guideline Daily Amounts	**Women**	**Men**
From official figures for average adults of a healthy weight	2000 kcal	2500 kcal
Fat (of which saturates)	70g (20g)	95g (30g)
Salt	6g	6g

This type of label usually includes information on the amount of energy (calories), protein, carbohydrate and fat.

There are guidelines to tell you if a food is high in fat, sugar or salt.

High Fat	=	more than 20g of fat per 100g
Low Fat	=	3g or less of fat per 100g
High Sugar	=	more than 15g total sugar per 100g
Low Sugar	=	5g or less total sugar per 100g
High Salt	=	more than 1.5g of salt per 100g
Low Salt	=	0.3g or less of salt per 100g

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Have a look at the nutrition label below. Are the foods low or high in fat sugar and salt? Circle the correct answer.

Nutritional Information

TYPICAL COMPOSITION WHEN COOKED	PER 100G
ENERGY	1260kJ
	300kcal
PROTEIN	13.2g
CARBOHYDRATE	32.6g
OF WHICH SUGARS	3.6g
TOTAL FAT	12.5g
OF WHICH SATURATES	5.4g
FIBRE	2.3g
SODIUM	0.48g
SALT EQUIVALENT	1.2g

Fat

High Low Neither

Sugar

High Low Neither

Salt

High Low Neither

Nutritional information Typical Values	Per 100g
Energy (kJ)	495kJ
Energy (kcal)	117kcal
Protein	5.3g
Carbohydrates	17.7g
(of which sugars)	0.7g
Fat	2.8g
(of which saturates)	1.5g
Fibre	0.6g
Sodium	0.11g
- equivalent as salt	0.3g

Fat

High Low Neither

Sugar

High Low Neither

Salt

High Low Neither

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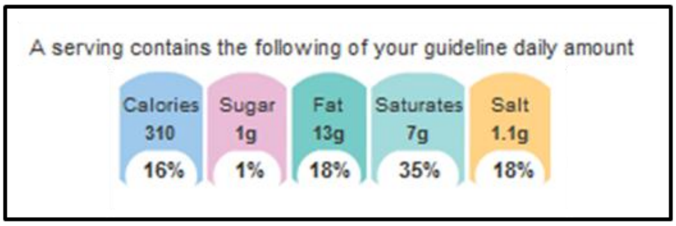
You might have seen labels like this on the front of some food packaging;



These labels are good for comparing foods quickly at a glance. They also let you know how much of each is in a portion of the food. The % lets you know how much of your recommended daily amount of the nutrients the food provides. Be careful with this though because the amount needed will be lower for children.

The experiment we will do now allows us to investigate the different dyes found in sweets that give them their colour.

Equipment Required

- 6 pieces of filter paper per group.

  NB Some websites recommend using kitchen towel or coffee filters instead but these will not work.

- Ruler (1 per group)
- Small cup of water (1 per group)
- Dropper (1 per group)
- 6 disposable plates per group
- 3 Skittles per group (one red, one green and one purple)
- 3 M&Ms per group (one red, one green and one blue)

  NB Smarties are often recommended for these experiments but they do not work too well. Using them alone therefore isn't sufficient but they could be used in a comparison experiment to show they have less dye than the other brands.

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What to do

1. Place a piece of filter paper onto each plate.
2. Place one sweet into the centre of each piece of paper.
3. Using a dropper, place about 15 drops of water onto each sweet.
4. Leave the paper to dry for about 20 minutes. After a few minutes you should be able to see bands of colour around each sweet.
5. Remove the sweet from the paper and record the number of bands in the table below
6. Measure the distance of these bands from the middle of the sweet and record in the table below.

Results

Type of Sweet	Colour of Sweet	Number of Bands	Distance travelled from the sweet (cm)				
			Band 1	Band 2	Band 3	Band 4	Band 5
Skittle	Red	2	2.5	3.0			
Skittle	Green	3	1	2.5	4.0		
Skittle	Purple	3	0.8	1.0	1.5		
M&M	Red	3	0.5	1.8	2.2		
M&M	Green	3	0.5	1	2		
M&M	Blue	1	3.5				

NB. Your actual results may differ a little from this but you can use the table above as a guide.

Conclusions

1. **Which sweet(s) had;**

   a) **The most bands?**
   Green and red M&Ms, green and red skittles.

   b) **The least bands?**
   Blue M&Ms.

   c) **Bands that travelled the furthest distance?**
   Green skittle

   d) **Bands that travelled the shortest distance?**

Green and red M&Ms

2. **Which sweet(s) had the most colourings?**
Green and red M&Ms, green and red skittles.

3. **Why do you think the different coloured dyes travel different distances?**
Students' opinion

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Exploring the Science

Paper chromatography is used in chemistry to separate mixtures, especially those of different colours.

In this experiment, the colours in the sugar coating of the sweets dissolve in the water and the water is drawn out through the paper forming a growing circle.

The different colours which make up the sweet colour are separated on the paper because they move at different speeds based on the size of the particles. Small particles will move faster and further than larger ones.

Look back at your results.

How far did the smallest dye move? ______0.8______cm

How far did the largest dye move? ______4.0______cm

Smarties contain no artificial colourings. They get their colours from natural sources like lemon, red cabbage, safflower, radish, black carrot and hibiscus.

Why not tie this in with the Cabbage Chemistry experiment?

Nowadays there are several different methods of chromatography for different purposes but they all work on the basic principle of separating mixtures. Chromatography was first used by Russian scientist Michael Tsvet in 1900 who used the technique to separate plant pigments. Chromatography developed significantly due to the work of Archer John Porter Martin and Richard Laurence Millington Synge (who later became director of Rowett Institute) during the 1940s and 1950s and they were awarded a Nobel Prize for this work.

Food colouring is usually added to food to make it look more attractive or appealing. There have been some concerns that these colourings may not be good for us so there are laws in place to make sure there isn't too much colouring in our foods.

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An extra demo to try

You can also use chromatography to separate the ink from felt tip pens.

Equipment Needed

- Tall jar
- Ruler
- Clothes peg
- Pencil
- Felt tip pens (dark colours)
- Filter paper

Procedure

1. Cut strips of filter paper (about 3 cm wide and taller than the jar).
2. Draw a line (in pencil) about 2 cm from the bottom of the strip
3. In the middle of the line make a small dot with the pen. Wait until it is dry and add another dot of the same colour on top.
4. Add water to the jar (~ 1.5 cm) (don't make the water higher than the line on the paper).
5. Place the paper in the jar so that it is not touching the sides.
6. Bend the paper over the side of the jar or clip with a clothes peg so that it doesn't move.
7. Leave until the water has travelled almost to the top of the paper. You should be able to see the dyes that have separated.

You could also try this experiment using a few different brands of black ballpoint pen instead of the felt tips. Although the final colour of ink from each pen looks the same, the component dyes may not be. After the experiment, you could use one of the pens to write a message on the filter paper and, after performing chromatography on the message, the children should be able to guess which pen wrote it. This ties in with how chromatography can be used in forensic investigation.

You can also perform chromatography to separate the pigments in leaves;

http://www.msichicago.org/online-science/activities/activity-detail/activities/see-the-colors-in-leaves/