Fostering skills for life

The benefits of this STEM activity

The Primary School Mathematics Curriculum (1999) promotes the use of genuine data investigations (see Hourigan, Leavy and Mc Mahon, 2012; Hourigan and Leavy, 2016; Leavy and Hourigan, 2016). These may take the form of a project or a problem to be explored across a number of lessons. This paper describes how a teacher might structure an investigation of the sugar levels in breakfast cereals. Children are increasingly curious regarding the nutritional make-up of the foods and drinks they consume. This interest comes from a growing focus on healthy eating in society and a closer examination in the Irish media. TV programmes focusing on healthy lifestyles such as *Operation Transformation* as well as relevant documentaries, namely *Sugar Crash* and *What Are You Eating,* have become increasingly popular. Schools also address this issue. It is commonplace in schools to find displays demonstrating the sugar content of various foods/drinks, particularly treats.

Image 1: Example of a school display of sugar in various drinks

As well as examining the nutritional contents of treats, it is important that children become aware of the hidden content of seemingly healthy foods e.g. fruit juices. The investigation presented in this article focuses on the sugar content of breakfast cereals. The investigation can be integrated with other curriculum areas such as SPHE or feed into a whole school initiative around health and wellbeing.

The Problem-Plan-Data-Analysis-Conclusion (PPDAC) cycle (see Leavy, Hourigan and Mc Mahon, 2012) provides an appropriate cycle of enquiry for this investigation (Wild and Pfannkuch 1999). The investigation approach outlined here can be modified for other foods/drinks.

While mathematics is the lead STEM discipline in this investigation, there is much potential to integrate the other STEM elements. The enquiry approach taken promotes a lot more than statistical literacy. This STEM investigation has the potential to develop a range of valuable skills (such as problem solving and analytical thinking) and dispositions (including curiosity, flexibility) required by pupils to reach their potential in school, transitioning to post-primary as well as in their everyday lives and futures. The investigation promotes collaboration, which in turn affects motivation positively. The investigation can also tap into pupils' technology skills and target their existing knowledge of various forms. It requires pupils to interpret and analyse data to derive appropriate conclusions. There are also multiple opportunities for pupils to communicate and justify their ideas and findings.

In this article, we map out suggested activities for each of the five stages of the PPDAC cycle. The investigation is targeted at fourth-sixth class pupils.

Facilitating the investigation

Step 1: Problem (PPDAC)

You may choose to explore one or both questions at the same time:

1. Are children's cereals so sugary they should be in the supermarket's biscuit section?
2. Do cereals marketed towards adults contain as much sugar as children's cereals?

The problem can be introduced to the pupils using newspaper articles, webpages or by using a clip from a documentary on the issue.

Step 2: Plan (PPDAC)

A number of key decisions need to be made in Step 2: the planning phase. While you, as the teacher, guide the investigation, it is essential for pupils to be involved in all decisions made.

Decision 1: categorising cereals. How do we determine what is a child's cereal? How do we determine what is an adult's cereal?

Discuss these questions with pupils. They may be aware that some cereals are marketed to children especially those which use cartoon images or advertisement campaigns that make them attractive to children. Allow pupils to bring samples from home or to use internet searches to identify some examples. If you wish, ask pupils to present cereal boxes or images and advertisement clips.

It is necessary to include a large selection of cereals (images of approximately 40 cereal types). Pupils can be given responsibility for gathering the relevant images of cereal packs. Consider a class trip to a local supermarket to retrieve the relevant information (take photos). Alternatively, pupils could source the images through online searches.

Once the cereals have been selected, it is necessary to sort the cereals into adults' and children's cereals. Use a whole class activity or alternatively group work to sort the cereals. Whichever approach is taken, pupils should be given opportunities to justify their decision. It is necessary to seek agreement. It may be possible that some cereals are considered to be both adult and children's cereal and are placed in both groups (for example, cornflakes).

The class is now ready to move onto the next big decision: How will we investigate to see if the claim in the question is true? Do children's cereals have a lot of sugar?

Decision 2: Investigating sugar levels. How do we decide what is too much sugar?

Referring to the relevant articles/web pages, allow pupils to discover the recommendations around sugar levels in cereals. A commonly used standard (the official traffic light labelling system) is that cereals that have more than 12.5% sugar (12.5g per 100g) are considered to be high

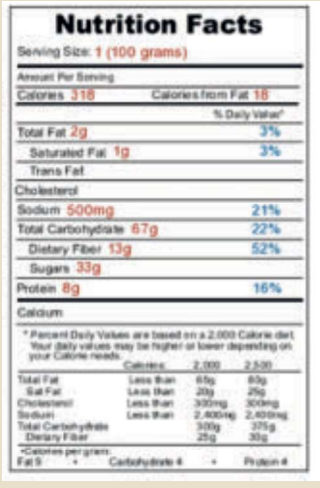
Nutrition Facts
Serving Size: 1 (100 grams)
Amount Per Serving
Calories 318 Calories from Fat 18
% Daily Value*
Total Fat 2g 3%
Saturated Fat 1g 3%
Trans Fat
Cholesterol
Sodium 500mg 21%
Total Carbohydrate 67g 22%
Dietary Fiber 13g 52%
Sugars 33g
Protein 8g 16%
Calcium
* Percent Daily Values are based on a 2,000 Calorie diet. Your daily values may be higher or lower depending on your Calorie needs.
Calories: 2,000 2,500
Total Fat Less than 65g 80g
Sat Fat Less than 20g 25g
Cholesterol Less than 300mg 300mg
Sodium Less than 2,400mg 2,400mg
Total Carbohydrate 300g 375g
Dietary Fiber 25g 30g
*Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Image 2: Sample nutritional information per 100g of cereal

Engaging with meaningful data

in sugar.

The class will become aware that the best way to test the question 'are children's cereals so sugary they should be in the supermarket's biscuit section?' and 'do cereals marketed towards adults contain as much sugar as children's cereals?' is to check the nutritional information on a large range of cereals (both adult and children).

Following these important decisions, the pupils are now ready to move to collect the data.

Step 3: Data (PPDAC)

Guide pupils to identify how to collect and record data from the cereal boxes. As previously outlined, the nutritional information can be sourced via internet searches. It is also be beneficial to have pupils cut the nutritional information off cereal boxes and bring it to class. This increases their awareness of the location of this information.

Divide the class into groups of 3-4 pupils. You may focus on children's cereals only or get some groups to investigate adults' cereals also in order to facilitate comparison. Provide each group with data for a selection of breakfast cereals (either adult cereals or children's cereals).

Record all information on a pre-prepared table. Each group will identify the grams of sugar per 100g of cereal for each brand. It will be necessary for some of the data to be manipulated as the nutritional information is often only given for a 30g or 40g serving.

Image 3: Sample nutritional information per 30g cereal

Invite pupils to share and discuss possible approaches i.e. if you know how many grams of sugar for 30g of cereal, how will you work out the amount of sugar in 100g? Provide calculators for such calculations if deemed appropriate. Make class decisions regarding appropriate measures e.g. 'Will we round to the nearest whole number?'

Once all the data are collected, the class are ready to move to the analysis stage.

Step 4: Analysis (PPDAC)

This step is where most of the teaching takes place and constitutes a large proportion of the teaching time. Teaching focuses on selecting and creating a graph and analysing the data.

As the data for this investigation are numerical, there are no restrictions on graphs to use. We recommend a line plot as it is easy to construct by:

- Placing the range of possible data values on the x-axis.
- For each cereal, place an 'x' above the number (on the x-axis) that represents the amount of sugar for that cereal.

This graph is also easy for pupils to interpret.

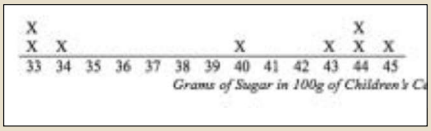

Image 4: Partially completed line plot

Once the graph is constructed, identify the following landmarks in the data:

- Clusters (where values bunch together).
- Gaps (where no data values occur).
- Outliers (a cereal with a very different amount of sugar).

Discuss what the graph communicates about the amounts of sugar in children's and adults' cereal.

To ensure appropriate challenge when exploring a data set, carefully select questions from each of the following categories:

Category 1: Reading the data

These are the simplest type of questions which require the child to locate information directly on the graph.

- What is the amount of sugar that appears most often in the cereals? [Note the answer is the mode of the data]
- What is the lowest amount of sugar found in any cereal? What is the highest amount of sugar found in any cereal? [Note the answers to these questions are the upper and lower values of the range]

Category 2: Reading between the data

These questions are more complex and require the child to interpret data presented on the graph.

- How many more grams of sugar are in the cereal with most sugar as compared to the cereal with least sugar?
- In general, how much sugar do you think there is in 100g of cereal? [Note the answer to this question is a representative or typical value for the data – a precursor to measures of central tendency (see Leavy and Middleton, 2011).

Category 3: Reading beyond the data

These questions require the pupils to extend, predict or infer from the data.

- How might we explain the differences between the adult and children's cereal?
- If we were to compare other adult and children's food products might we find similar results? Why/not?

If you chose to look at both children's and adult's cereals, then you should place one line plot above the other and spend some time allowing the whole class to identify similarities and differences in the distributions of data.

Step 5: Conclusion (PPDAC)

The conclusion provides an overview of the investigation and outlines the important decisions pupils have to make when working with data. Pupils can work in groups to respond to statements such as:

- True or False: children's cereals are so sugary they should be in a supermarket's biscuit aisle. Explain your decision.
- Do adults' and children's cereals differ in the amount of sugar? Explain your decision.
- Are there any other (interesting) analyses you could carry out on the data?

Ideally, each group can make a mini-presentation to the class, to other classes in the school or be part of an 'exhibition/presentation stand' during maths or science week. As a follow-up activity, pupils could be encouraged to write/email cereal companies or health agencies to share their insights.

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