

Crunchy fruit and vegetables

Purpose:

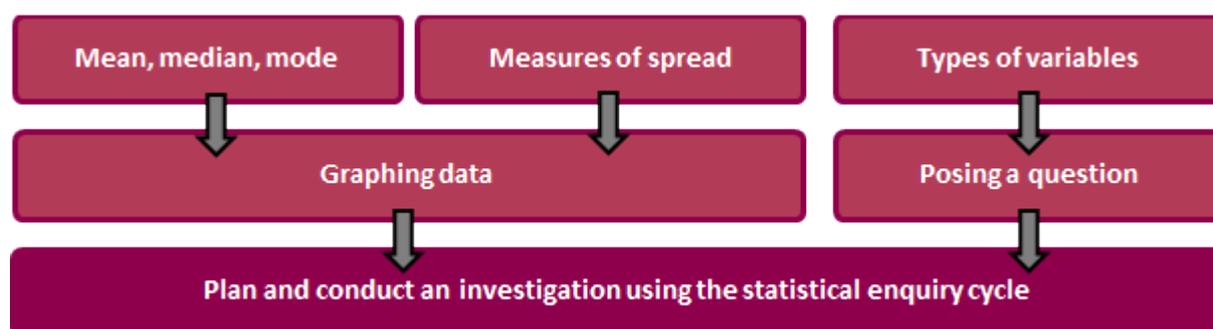
To engage the students in a practical investigation following the statistical enquiry cycle.

Achievement Objectives:

S5-1: Plan and conduct surveys and experiments using the statistical enquiry cycle: determining appropriate variables and measures; considering sources of variation; gathering and cleaning data; using multiple displays, and re-categorising data to find patterns, variations, relationships, and trends in multivariate data sets; comparing sample distributions visually, using measures of centre, spread, and proportion; presenting a report of findings.

Description of mathematics:

This background knowledge and skills that need to be established before and/or during this task are outlined in the diagram below:



This task may be 'scaffolded' with either a focus on the process of the enquiry cycle, or by encouraging students to respond to the key features of the data. The approach should be chosen in sympathy with their skills and depth of understanding.

Activity:

Task: Which is the noisiest to eat, a carrot or an apple?

Use a decibel meter (or a free app for one on a phone or a tablet) to measure the crunches that you make each time you bite into a carrot and an apple.

Combine your data with the rest of your group to find which makes the loudest crunch.



The procedural approach

The student is able to carry out a practical statistical investigation, using the statistical enquiry cycle, following the given processes and guidelines for how to make the call.

Prompts from the teacher could be:

1. Pose a question for investigation.
2. Record the data for the crunches you make.
3. Collect and sort all the data from your group.
4. Calculate the sample statistics for your data.
5. Look for the key features of raw data and the statistics that you have calculated.
6. Construct box plots and dot plots to compare the noisiness of the two foods. Follow the guidelines for how to make the call to see if a claim can be made.
7. Write a conclusion for your investigation.

Ideally, the students should check with their teacher at each stage of the investigation, before proceeding to the next stage.

Crunchy Fruit and Vege

1. I wonder if apples make a bigger crunch when we bite in than carrots...

- raw apples
- raw carrots
- bigger crunch measured in dB on app.

2,3 all in dB:

apples 80, 79, 80, 84, 71, 76, 93, 85, 72, 78, 68, 74, 93, 91, 95, 88, 89, 69, 68, 90, 84
 carrots 84, 82, 90, 92, 81, 84, 90, 98, 79, 82, 84, 100, 83, 81, 97, 98, 95, 99, 100, 98, 82

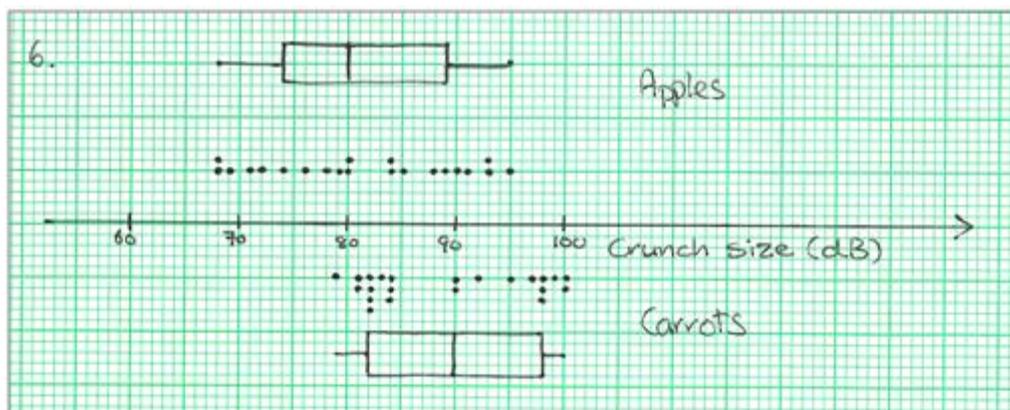
4,5 Apples mean 81 dB

Carrots mean 89 dB

looking at the raw data, carrots appear to be louder. They also have a higher mean (dB of crunch)

	Apples	Carrots
min	68	79
	68	81
	69	81
	71	82
	72	82
LQ	74	82
	76	83
	78	84
	79	84
	80	84
Med	80	90
	84	90
	84	92
	85	95
	88	97
UQ	89	98
	90	98
	91	98
	93	99
	93	100
max	95	100
	81.28571	89.47619

6,7. The medians lie outside the boxes so I can make the call that carrots make a bigger crunch than apples.



The conceptual approach

The student is able to carry out a practical statistical investigation, using the statistical enquiry cycle, following the given processes and guidelines for how to how to make the call, drawing a conclusion based on the key features of the data.

Students may show an ability to link the mathematical statements, within the data, to the context. Such students are likely to distinguish between significant differences in data sets and suggest practical reasons, within the context, for those differences. These students should be encouraged to follow the conceptual approach, independently noting the key features of the data to draw an appropriate conclusion.

Prompts from the teacher could be:

1. Pose a question for investigation.
2. Carry out your practical investigation using the statistical enquiry cycle.
3. Write a conclusion for your investigation.

Question for practical investigation:

I wonder if ^{raw} apples tend to give a louder crunch than ^{raw} carrots when bitten into.

Practical problems:

The maximum reading on the app is 100dB. We had to crunch 1m away from the phone to be under 100 dB. Because we still got a few readings at 100dB, we know those crunches might actually be louder.

Although we have 5 in our group, two have braces, so only 3 had to do all the crunching and eating (about 10 crunches per piece).

The apples were the floury sort, so we might get different results with better apples.

Limitations of the experimental apparatus

Recognition that the test might not be fair. The apples might not be representative of all apples

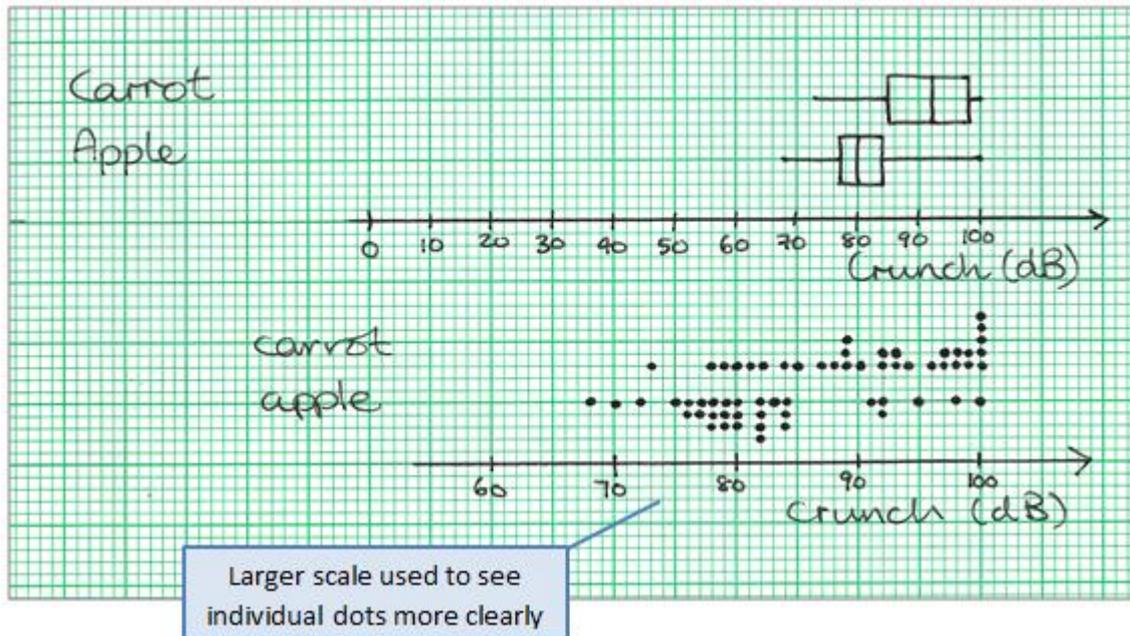
Carrot
(dB)

* max is 100
* background 65

Apple
(dB)

Recognition of limiting factors

97		83	
100		68	
98		72	
96	min: 73	78	min: 68
73	LQ: 85	79	LQ: 77
80	med: 92	80	med: 80
92	uQ: 98	80	uQ: 84
100	max: 100	76	max: 100
89		92	
79	mean: 91	84	mean: 82
78	mode: 100	82	mode: 82
81		77	
99		79	
93		77	
100		82	
84		100	
87		84	
92		92	
89		98	
99		95	
100		91	
94		76	
88		75	
93		78	
97		79	
82		82	
85		80	
98		84	
90		78	
89		82	
100		70	



From the graphs:

Box Plots: There is no overlap of the boxes so I can make the claim that raw carrots make a louder crunch than raw apples when bitten into.

Also: the minimum crunch (68 dB) is still louder than our maths class working (65 dB).

the range of noise levels for raw carrot crunches (27 dB) was similar to the range of crunches for raw apples (32 dB).

Dot Plot: The crunches are not evenly spread although the range of values are similar for carrots and apples, the apple crunches are mostly at the quiet end (towards the minimum) and the carrot crunches are mostly towards the maximum.

This supports the claim.

Claim: Raw carrots tend to make a louder crunch than raw apples when bitten into.