General Certificate of Secondary Education

Controlled Assessment

GCSE Additional Applied Science

Assignment 2, Option 3:

How a food analyst uses evidence to solve problems

Controlled Assessment Exemplar Materials

Teachers' Notes

Assignment 2, Option 3: How a food analyst uses evidence to solve problems

Notes for teachers

This assignment relates to Unit 1 Section 3.3.5 – The use of science in food production

Method

In this option for Assignment 2, candidates should be given the opportunity to carry out an investigation involving a number of qualitative and quantitative techniques that could be used to analyse the content of drinks. They should be given a scenario and drinks to analyse and use to draw scientific conclusions.

Candidates should be given the opportunity to practice the techniques to be used in their analysis before completing their investigation. Each candidate should, individually, plan their investigation and make decisions on equipment to be used and readings to be taken.

In the practical stage, candidates may work singly or in groups to obtain their data. However, each candidate must record and process the data individually, and must identify the data collected under their own direction.

Candidates should be encouraged to validate their work by the use of secondary data in order to comment on the reproducibility and effectiveness of their own work. The secondary data could be data from packaging of drinks, the results of tests on known samples, group or teacher-obtained results or data from other sources.

Area of investigation

This work should be carried out during the teaching of Unit 1, section 3.3.5 – The use of science in food production.

Approach to the investigation

Teachers should present candidates with a scenario involving the content of certain drinks, and provide them with drinks to analyse using qualitative and quantitative techniques. Candidates should be given the opportunity to test the drinks and draw some conclusions about the content of the drinks. Candidates should also be given access to secondary data for them to use to comment on the effectiveness of their own work.

Candidates will need to use **at least four** analytical techniques to test the drinks. Candidates could use qualitative techniques to measure the pH or perform food tests (food tests would count as just one of the analytical techniques). They could use quantitative techniques to measure the vitamin C content, acid concentration, percentage water content or mass of suspended solids.

At least one of the techniques used must give candidates the opportunity to carry out quantitative analysis so that they can manipulate numerical data.

Suggestions for contextualisation of investigation

Teachers should put the task into a context, so that candidates understand the reason for the investigation that they are carrying out. An example scenario, which teachers are free to use or adapt to suit their circumstances, is given below:

Research has shown that the foods and drinks that are given to young children can affect their development and how well they progress at school later on in childhood and adolescence.

Fruit juices can seem like a healthy option for young children but there are concerns by the NHS because different juices contain differing amounts of vitamin C, sugar, acidity and fibre.

You are a food analyst working for the Food Standards Agency (FSA). You have been asked to investigate 5 different fruit juices.

Your investigation could include:

- *pH tests*
- *food tests*
- *vitamin C content*
- *acid concentration*
- *mass of suspended matter*

You should write a report on your findings which could be used by the NHS to help parents, nurseries and child minders choose the best fruit juice for toddlers and young children.

Working safely in the laboratory

It is the responsibility of the centre to be aware of any health and safety implications of the investigation and ensure that a risk assessment for the practical is carried out. Teachers should remind candidates about safe working when carrying out laboratory procedures.

Preparing secondary data

As part of the investigation, candidates are required to compare their own results with secondary data.

These data could be the data from packaging of juices, results obtained by other groups within the class, or results that have been obtained by the teacher or technician before the candidates do the investigation for themselves.

Stage 1 – planning

The teacher should lead a discussion with the candidates to outline the scenario and the problem that needs to be solved. The discussion should include the importance of obtaining and analysing scientific evidence to draw conclusions. The scenario suggested above could be used, but this should not preclude centres from adapting the scenario or devising their own scenario to suit their own needs.

Candidates should be given the opportunity to have hands-on experience of the techniques to be used during the delivery of Unit 1. Candidates should then be left to themselves to decide on a plan for the investigation and exactly which measurements and observations they should take.

At the end of the planning session, candidates must work on their own, under informal classroom supervision, to write their plan and prepare their risk assessment for the practical. Teachers must collect all work in at the end of the session (including that on removable media) and keep it securely for marking and submission with the final report for moderation.

Stage 2 – Practical work

For this part of the investigation candidates may work individually or in groups under normal laboratory supervision.

Each candidate must contribute to the collection of data.

Once the candidates have completed their investigation, they should use secondary data to research and analyse the validity of their own results.

Stage 3 – Data processing, analysis and evaluation

For this part of the investigation candidates must work on their own, under informal classroom supervision, to write up their findings, analyse their own and the secondary data and present their evaluations and conclusions.

In their report candidates should:

1. Describe the purpose of the investigation and plan how they will carry out their investigation, including selecting appropriate equipment
2. Prepare a risk assessment for the investigation
3. Record the data they have obtained appropriately
4. Process and analyse the data, carrying out calculations
5. Make scientific conclusions based on their analysis of the data
6. Evaluate the investigation
7. Explain how a food analyst might use the results of the investigation in their workplace

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Candidates' Notes

Version 1.0

Exemplar Work

Assignment 2, Option 3: How a food analyst uses evidence to solve problems.

This assignment relates to Unit 1 section 3.3.5 - The use of science in food production.

Area of Investigation

Food analysts use a variety of analytical techniques to determine the content of food and drink.

Task

You will need to design, plan and perform a practical investigation to analyse and make comparisons between several different drinks.

You will be given the opportunity to:
- use a number of analytical techniques to determine the content of different drinks and suggest why a particular drink may be better
- compare your results with secondary data in order to comment on the reliability of your data and effectiveness of your techniques.

You will be expected to:
- practice the techniques that you will use in your investigation
- write a plan for your investigation
- write a risk assessment for your investigation.

When you write up your plan and risk assessment you must work on your own, without talking to your classmates or teacher.

You will be shown the equipment available for you to do the investigation.
You will have to decide on things such as:
- how to do the investigation
- appropriate readings and measurements to take
- which readings to repeat.

You will then do practical work to analyse the drinks and make a comparison between the different drinks. When doing the practical work you may work in a group with classmates, but you **must** record the data obtained yourself, and you **must** identify the data that you have obtained.

After the practical, you will be given some results obtained by other people to use in your data analysis.

You must write a report on your investigation, which should contain:
- your plan, including information on why you are doing the investigation and the equipment you think you will need
- your risk assessment, in which you should identify the hazards and risks and give the control measures needed to manage the risks
- your results and observations, recorded in an appropriate format
- an analysis of your data, including calculations
- a comparison of your results with other results
- the scientific conclusions you can make from your analysis of the data / evidence
- an evaluation of your investigation
- an explanation of how a food analyst might use the results of the investigation in their workplace.

Which fruit juice is the best for a nursery to give to its toddlers?

Introduction

Research by the Institute of Education at the University of London last year, showed that what they eat from their earliest years matters more that their diet later on. In fact, when children are older nutrition seems to have less effect on attainment. Even when their diet subsequently improved, those who had eaten the most junk and processed food at 3 years of age still tended to do below average at school than more healthily fed children. "We were surprised by the results. We thought children's current diet would be more important than their diet several years previously," Dr Emmett says.

1.3a

And then when children start school irreversible damage may have already been done by their poor diet at home and sometimes at the nurseries, playgroups and child minders that they have attended. Latest figures show that a quarter of children starting school are overweight or obese. With pre-school diets not necessarily laying down the best nutritional foundations, children are also not always steered towards good eating habits when they are most impressionable.

In full-time daycare the children attending has more than doubled in ten years and with more than half a million children spending up to ten hours a day in mostly privately-run nurseries in England and Wales, some are getting most of their food away from home. Many more children are looked after by child minders. Just like schools, registered child minders, daycare centers and nurseries are inspected and must undergo assessments. And though the meals, drinks and snacks they provide must be healthy, balanced and nutritious there's no nutrient-based nitty-gritty to inspect because the standards for nurseries are less strict than those for primary and secondary schools. You will hunt high and low for crisps or a sugary drink in a secondary school, but won't have to look far to find them in a nursery. I am going to do a variety of tests on 5 different juices to see which one would be the best suited for toddlers in a nursery.

7.1

Vitamin C

Vitamin C is required for the growth and repair of tissues in all parts of your body. It is necessary to form collagen, an important protein used to make skin, scar tissue, tendons, ligaments, and blood vessels. Vitamin C is essential for the

other well-known antioxidants. Antioxidants are nutrients that block some of the damage caused by free radicals, which are by-products that result when our bodies transform food into energy.

Sugar Content

1.3a

Sugar is used to provide energy. Foods and drinks containing lots of sugar contain lots of calories but often have other nutrients and these foods should be eaten in moderation with other foods. Too much sugar in drinks and foods can cause tooth decay, for example fruit juice and honey. Too much sugar in the diet can also lead to diabetes and rotting teeth.

Acidity

Our stomach produces acid to digest the food that we eat. This is a regular and natural process. Whenever we eat, cells within the lining of the stomach pump acid to liquefy your sumptuous dinner, from mash potatoes to a slab of steak. Fatty and spicy foods are harder to digest than most food; this, in effect, prompts the cells that pump acid to produce more acid than is necessary.

Fibre

Fibre is an important component of a healthy balanced diet. We get fibre from plant-based foods, but it's not something the body can absorb. This means fibre is not a nutrient and contains no calories or vitamins.

→ Fibre helps your digestive system to process food and absorbs nutrients.

→ Fibre lowers blood cholesterol.

→ Fibre helps to control blood sugar levels, which in turn controls appetite.

Measuring Suspended solids

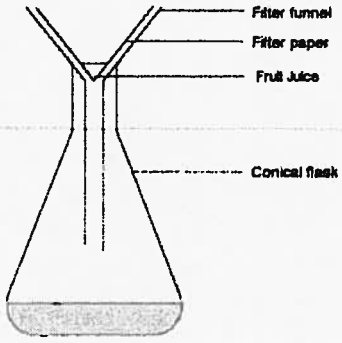
Fibre is made of indigestible plant material. It's what the 'bits' in the fruit juice are. We can get an idea of how much fibre there is in our fruit juices using the following method:-

1.1b Equipment list:-
: Measuring Cylinder
: Filter paper
: Fruit juice
1.2b : Beaker
: Weighing scales

Method:-

1. Label the filter paper with juice name and weigh at start.
2. Measure 100cm3 of fruit juice into a measuring cylinder.
3. Filter the juice to collect the fibre using the apparatus below:-

1.1a
1.2a
1.3a



4. Dry the filter and residue.
5. Reweigh the filter paper and calculate the weight of fibre.
6. Repeat 1-5 two more times to check reliability, and then work out the average.
7. Repeat 1-6 for the other juices.

Risk Assessment

We have to do a risk assessment for any experiments that we do to identify any problems that may occur and what to do if they do.

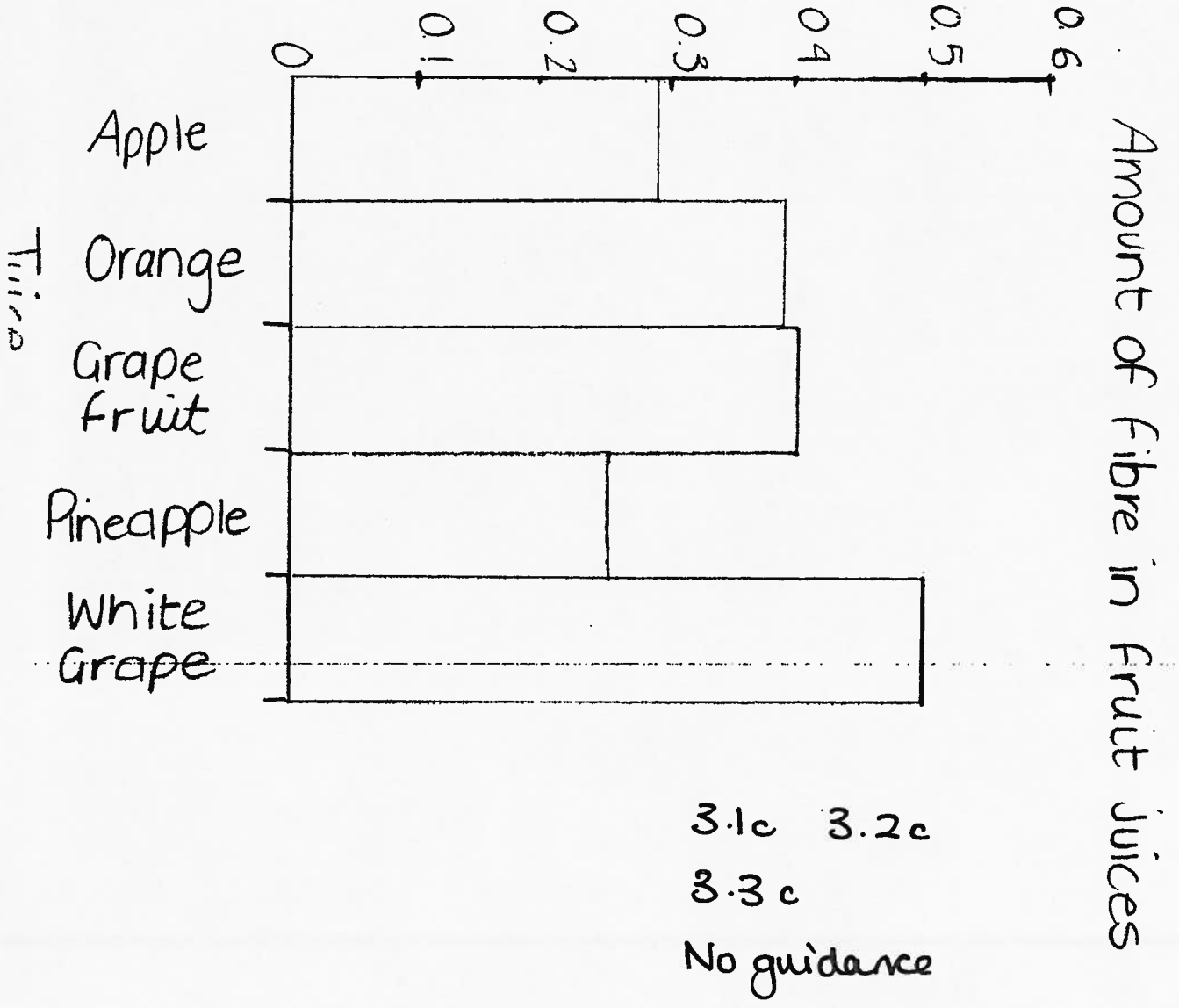
Hazardous chemical/material/ Equipment/procedure	Type of Hazard	Risk of accident 1-3	Control measures	What to do if accident happens
Glass Beaker	Broken glass can cut	1 (low risk)	Wear safety goggles. Keep tubes in a test tube rack.	Get teacher to clean up broken glass. Seek medical help.

2.1a
2.1b

Results

Juice	Weight of suspended material (fibre) (g/100cm³)						
	Repeat 1			Repeat 2			Average weight of fibre (g/100cm³)
	Start weight (g)	End weight (g)	Weight of fibre (g)	Start weight (g)	End weight (g)	Weight of fibre (g)	
Apple	0.56	0.94	0.28	0.58	0.87	0.29	0.29
Orange	0.61	1.01	0.4	0.59	0.96	0.37	0.39
Grapefruit	0.59	0.98	0.39	0.6	1.01	0.41	0.40
Pineapple	0.59	0.86	0.27	0.61	0.85	0.24	0.25
White Grape	0.58	1.05	0.47	0.59	1.11	0.52	0.50

4.1a We only did 1 repeat because it took so long to filter the juices.
The results show me that White Grape had the most fibre in it and Apple had the least.

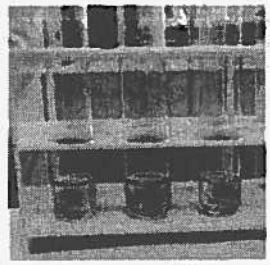


3.1c 3.2c

3.3c

No guidance

Testing for sugar



Benedict's Solution:-

Most foods contain sugar only some foods contain very high amounts. We need sugar in our diet because it provides us with energy. Foods which contain lots of sugar needs to be eaten in moderation with other foods as too much of this can lead to most likely to diabetes. We will carry out 2 tests in total to find out what amounts of sugar are in fruit juice.

Equipment list:-

1.1b
: Test tubes
: Fruit Juice
: Goggles
: Pipette
1.2b
: Benedict Solution
: Water Bath

Method:-

1.1a
1. Pour 1–2 cm^3 of Fruit Juice into a test tube.
2. Add 1-2 cm^3 of blue Benedict's solution.
3. Heat the test tube in a water bath.
4. It will turn an orangey brown colour.

1.2a
5. This is a positive result for reducing sugar.

Risk Assessment

Hazardous chemical/material/ Equipment/procedure	Type of Hazard	Risk of accident 1-3	Control measures	What to do if accident happens
Test tubes	Broken glass can cut	1 (low risk)	Wear safety goggles. Keep tubes in a test tube rack.	Get teacher to clean up broken glass. Seek medical help.
Benedict solution	Copper sulphate is poisonous if swallowed	1 (low risk)	Don't drink in lab.	Seek medical advice.

2.1a

2.1b

Results

3.1a
3.1b

Juice	Colour of Benedict's	Sugar Content
Apple	Orange - red	Very high
Orange	Green	Some sugar
Grapefruit	Orange	High
White Grape	Orange	High
Pineapple	Blue	No sugar

4.1a From the results I can see that apple juice contains lots of sugar. Also I can see that pineapple juice seemed to have no sugar.

Clinistix:-

Clinistix sticks are used commonly in doctor's surgeries and hospitals to test for the presence of glucose in urine. The sticks contain two enzymes. The enzymes react with the glucose which changes the colour of a pigment in the stick. The intensity of the colour is linked to the amount of glucose present. he reaction is very quick and within a minute, the colour of the end of the stick can be compared with a chart printed on the stick container, making Clinistix very easy to use.

Equipment list:-

1.1b : Clinstix Strips
: Fruit Juice
1.2b : Beaker

Method:-

1. Measured 1-2cm3 into a glass beaker.
1.1a 2. Dip the Clinstix strip in.
3. Wait for 10 seconds.
1.2a 4. Pull strip out.
5. Compare the colour with the strip on the side of the bottle.

Risk Assessment

2.1a

Hazardous chemical/material/ Equipment/procedure	Type of Hazard	Risk of accident 1-3	Control measures	What to do if accident happens
Glass Beaker	Broken glass can cut	1 (low risk)	Wear safety goggles.	Get teacher to clean up broken glass. Seek medical help.

2.1b

Results

Juice	Colour	Amount of sugar
Apple	Blue	+++
Orange	Pink	+
Grapefruit	Pink	+
White Grape	Purple	+++
Pineapple	Blue	++

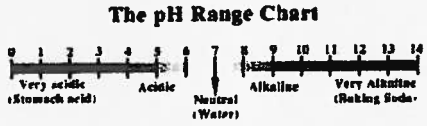
Key:-
+ = Low amounts of sugar
++ = High amounts of sugar
+++ = Very high amounts of sugar

3.1a

3.1b.

Testing for PH

Universal Indicator



The low the PH the more acidic the juice. This is bad for you because it can eventually lead to tooth decay. This test is very important. We will use two methods to measure the PH.

Equipment:-

1.1b
: PH Paper
: Glass Beaker
1.2b
: Fruit Juice
: PH Scale
: Glass Rod

Method:-

1.1a
1. Pour 1-2cm3 of juice into a glass beaker.
2. Using a glass rod put juice onto the PH paper.
3. Wait for 10 seconds and pull out.

1.2a
4. Compare the colour on the card to the PH scale.

Risk Assessment

2.1a

Hazardous chemical/material/ Equipment/procedure	Type of Hazard	Risk of accident 1-3	Control measures	What to do if accident happens
Glassware	Broken glass can cut	1 (low risk)	Wear safety goggles.	Get teacher to clean up broken glass. Seek medical help.
Universal indicator	Irritant and Flammable	1 (low risk)	Wear safety goggles.	Wash it off hands. Seek medical help.

2.1b

Results

Juice	Colour	PH
Apple	Orange	4
Orange	Orange	4
Grapefruit	Orange	4
White Grape	Orange	4
Pineapple	Orange	4

3.1a

3.1b

We will also use a meter to test the PH in fruit juice, as you can see these results aren't very precise, they are all the same. I will use the PH meter next.

Measuring PH (2) Meter

Equipment:-
: PH Meter
: Fruit Juice
: PH 4 Buffer
: PH 7 Buffer

1.1b
1.2b

Method:-
1. Make sure that the pH probe has been stored in pH4 before use.

2. Rinse the probe of the meter in distilled water. Shake it off before placing it in a pH 7 solution for calibration.

1.1a

3. Leave for 30 seconds to allow time for the meter to stabilize, and then adjust the meter so that it reads pH 7.

1.2b

4. Rinse once again and then place it into a pH 4 solution, giving time for the meter reading to stabilize. Adjust the meter so that it reads pH 4. The meter has now been calibrated.

5. Rinse the probe once again. Place in the first juice. Take the pH reading after allowing the reading to settle.

6. Repeat step 5 for the other juices, recalibrating the probe every time.

7. Check reliability by testing each juice 3 times.

Risk Assessment

2.1a

Hazardous chemical/material/ Equipment/procedure	Type of Hazard	Risk of accident 1-3	Control measures	What to do if accident happens
Glassware	Broken glass can cut	1 (low risk)	Wear safety goggles.	Get teacher to clean up broken glass. Seek medical help.
PH 4 Buffer	Weak acid.	1 (low risk)	Wear safety goggles.	Wash eyes or use eye tube.

2.1b

Results

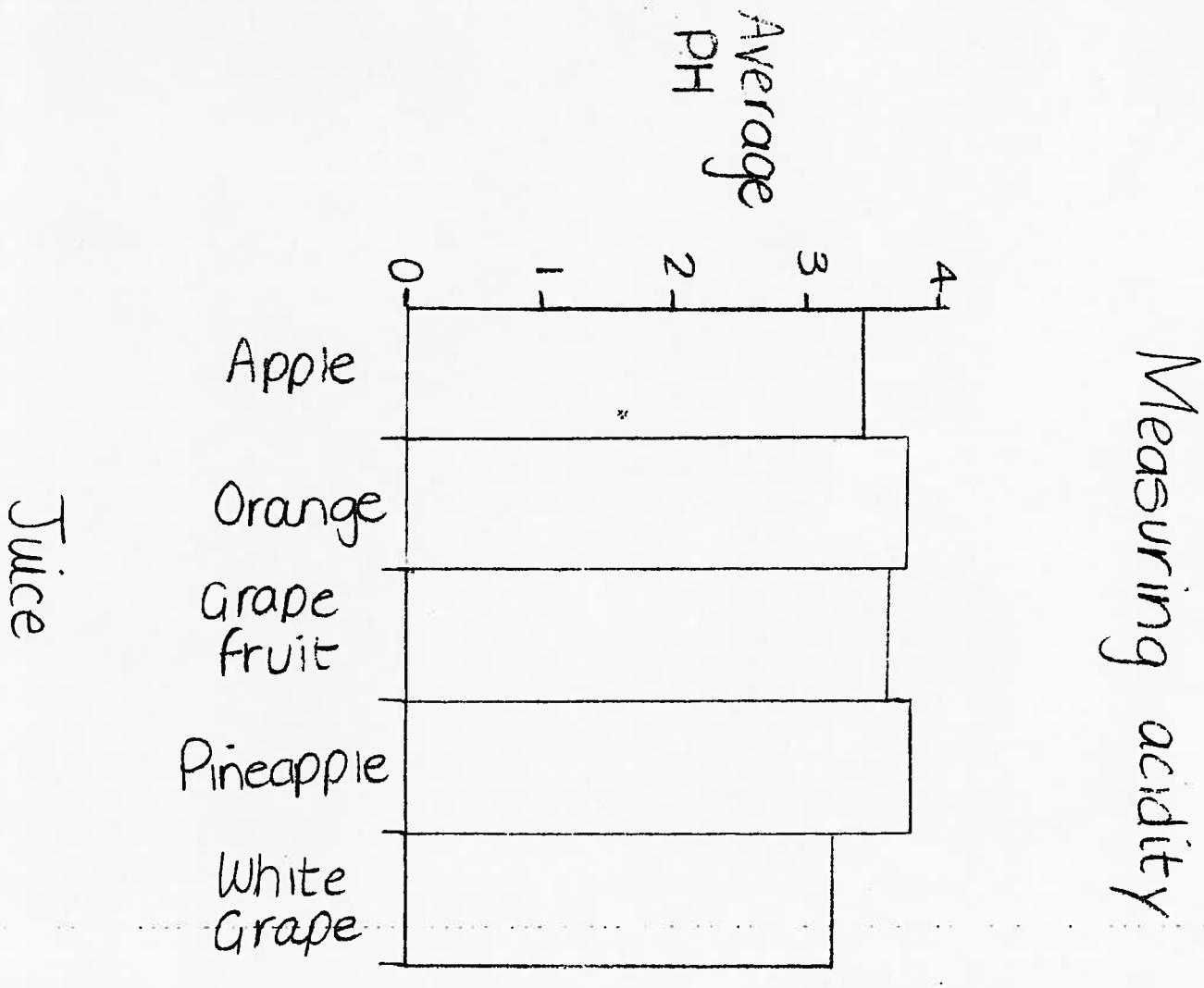
3.3a

Juice	PH Reading			
	Repeat 1	Repeat 2	Repeat 3	Average
Apple	3.44	3.5	3.47	3.47
White Grape	3.31	3.31	3.26	3.29
Orange	3.75	3.74	3.75	3.75
Grapefruit	3.13	3.05	3.09	3.52
Pineapple	3.79	3.73	3.75	3.75

4.2b

These results show me all the juices are acidic, but White Grape is slightly more acidic than the others.

4.1a



3.1c

3.2c

3.3c

No guidance given.

Testing for Vitamin C

Vitamin C is a water-soluble vitamin, meaning that your body doesn't store it. We get what we need, instead, from food. You need vitamin C for the growth and repair of tissues in all parts of your body. It helps the body make collagen, an important protein used to make skin, cartilage, tendons, ligaments, and blood vessels. Vitamin C is essential for healing wounds, and for repairing and maintaining bones and teeth.

1.1b Equipment list:-
: Burette
1.2b : Fruit Juice
: DCPIP
1.3b : Conical Flask
: Ethanoic Acid
: Clamp Stand

Method:-

1.1a The method below is copied from 'Science uncovered – AQA additional applied science' by Heinemann. The method we used is the same but step 3 and 4 were
1.2a combined, we measured 15cm3 of DCPIP and 5cm3 ethanoic acid into a conical flask. And also step 6 we did a rough titration and two accurate ones.

DCPIP reacts with vitamin C to form a colourless solution.

1. Carry out a risk assessment for this procedure.
2. Dilute the juice down 10 times.
3. Measure out $5cm^3$ of DCPIP solution into a conical flask using a small measuring cylinder or a plastic disposable syringe.
1.3b 4. Add $10cm^3$ of distilled water and $5cm^3$ of $1mol/dm^3$ ethanoic acid.
5. Titrate with the orange juice until the pink colour just fades.
6. Repeat until you have consistent results. Record these in a suitable table.
7. Work out the average volume and use this to find out the concentration of vitamin C with:

$$\text{Concentration of vitamin C} = \frac{10}{\text{Volume of juice added}} \times 10 \quad (mg/100cm^3)$$

Risk assessment

Hazardous chemical/material/ Equipment/procedure	Type of Hazard	Risk of accident 1-3	Control measures	What to do if accident happens
Glassware	Broken glass can cut	1 (low risk)	Wear safety goggles.	Get teacher to clean up broken glass. Seek medical help.
DCPIP	It can be poisonous if swallowed.	1 (low risk)	Wear safety goggles.	Immediately wash where it has been dropped. Seek medical help.
Ethanoic Acid	Irritant and can cause burns.	1 (low risk)	Wear Safety goggles.	Immediately put the affected area under water. Seek medical help.

2.1a
2.1b
2.2a
2.2c

Results

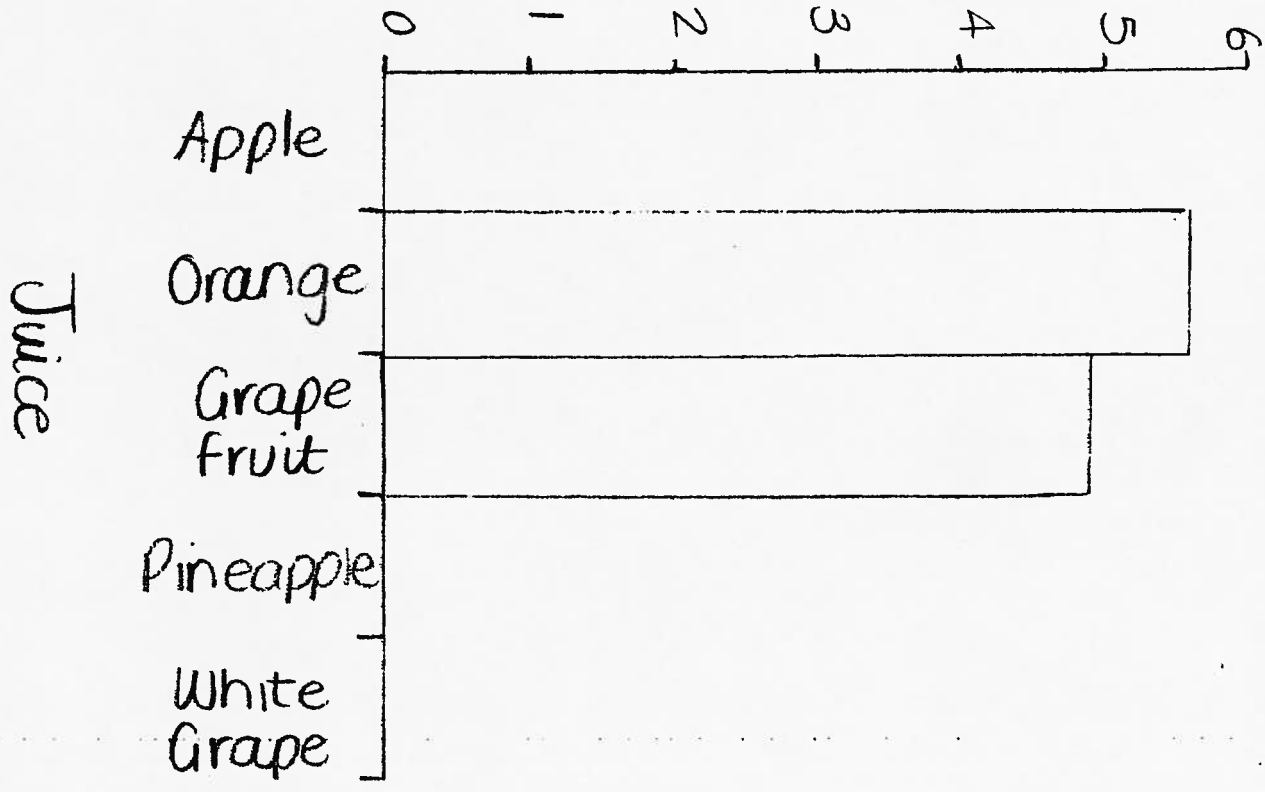
3.2d repeats.

Juice	Volume of juice added (cm^3)				
	Rough	Accurate A	Accurate B	Average (A+B/2)	Concentration of vitamin c ($mg/100cm^3$)
Apple	no	colour	change	150 added	0
White Grape	no	colour	change	150 added	0
Grapefruit	21.2	20.6	20	20.3	4.9
Pineapple	no	colour	change	150 added	0
Orange	20	17.2	18.4	17.8	5.6

3.1a
3.1b
4.2b

4.1a Apple, White Grape and Pineapple didn't have any vitamin as they are concentrated juice and they are boiled before being put into the containers, and as a result destroying all of the vitamin C content.

Average concentration of Vitamin C (Mg/100ml)



3.1c
3.2
3.3c
No guidance given

Vitamin C content of Fruit Juices

Conclusions

Fibre

4.1a 5.1a 5.2a
4.2a 5.1b

We need fibre in our diet because it helps with our digestive system. We can get fibre from lots of food and drink, for example certain fruit juices contain fibre and we did a suspended solids experiment to find out which fruit juice contained the highest amount of fibre. From the suspended solids test I can see that apple contained the least amount of fibre. White Grape had the most containing 0.5 g/100cm^3 on average. White Grape, Grapefruit and Orange contained the most fibre because they had the fruitiest bits. Based on my results I would recommend Whit Grape as a fruit juice to toddlers because it contains high amounts of fibre and as a results help with their digestive system.

Benedicts and Clinistix tests

We need sugar in our diet because it gives us energy. We can get lots of sugar from certain foods like chocolate and we can eat these foods as a treat every now and then but too much sugar can lead to tooth decay and diabetes in later life. From the Benedict's solution test I can see that the juice that's contains the most sugar is apple and the fruit juice with no sugar at all in it was pineapple. Based on my results I can see that from this test pineapple has no sugar whereas it should contain some sugar, so using Benedicts is not very precise. From the Clinistix test I can see that apple and white grape fruit juice contained the least amount of sugar. From my results I would recommend orange juice to toddlers as it contains an average amount of sugar and some sugar is needed for energy. The Clinistix test gave better results, from this test I would recommend orange or grapefruit juice because it does contain some sugar to give out energy but not enough to rott the children's teeth.

PH (Universal Indicator)

5.3b

Our stomach produces acid to digest the food that we eat. This is a regular and natural process. Fatty and spicy foods are harder to digest than most food; this, in effect, prompts the cells that pump acid to produce more acid than is necessary. From my results I can see that all of the juices contained the same amount of acidity, all turned orange. Therefore no conclusion can be made. All the juices are fairly acidic so should not be drunk all the time. This method again is not very precise.

PH (Meter)

From my results I can see that all the juices are acidic but white grape is slightly more acidic than the others, therefore I would recommend any of the other juice apart from white grape as it's more acidic. All juices have the potential to cause tooth decay so there is no winner.

Testing for vitamin C

5.3b Vitamin C is required for the growth and repair of tissues in all parts of your body. It is necessary to form collagen, an important protein used to make skin, scar tissue, tendons, ligaments, and blood vessels. From my results I can see that apple, white grape and pineapple contained no concentration of vitamin c, this is because the juices were boiled and this destroyed any vitamin C present. I would recommend orange juice to toddlers as it contained the highest concentration of vitamin c.

Overall...

I would recommend orange juice as it contains high amounts of fibre, it has just enough sugar to give out energy and as a result of this it wont lead to tooth decay. Also I think that orange juice has more taste than grapefruit and is more appealing to children because of the colour.

Evaluation

The thing I found difficult was to see the colour change in the DCPIP test, to make it easier I put a whit tile under the flask. In the suspended solids test the filter paper that we used clogged up very quickly, we changed the filter paper and replaced it 6.1a with thin filter paper; this reduced the time to separate the fibre from the liquid. 6.2a Both sugar tests that we did were very reliable and didn't cause any problems, however Benedict's didn't give us a result for pineapple juice, pineapple juice does contain a certain amount of sugar and the Clinistix test gave us more precise results. 6.1b Clinistix is a better test. We carried out two tests for acidity, we used a universal 6.2b indicator and a ph meter, the ph universal indicator wasn't very precise as it provided the same results each time, whereas with the meter the results were more precise and could be followed easily. The only problem was that it took so long to do, 1 hour per juice! These results would be useful to a nursery supplying juice to toddlers as it would help them decide which would be the most suitable to give. 7.2a.