

# SCHOLARSHIP EXEMPLAR

93601



S



NEW ZEALAND QUALIFICATIONS AUTHORITY  
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD  
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

## Scholarship 2020 Technology

Total score: 24

### INSTRUCTIONS

#### CHECK YOUR NSN

- Find the printed nine-digit number above. The number must be the same as the NSN from the top right-hand corner of your *National Schools Qualifications – Examinations Admission Slip*.
- If the number above IS NOT the same as the NSN on your admission slip, **return this folder to your teacher immediately**.
- If the number above IS the same as the NSN on your admission slip, tick (✓) this box:
- Print the NSN from your admission slip here:

0								
---	--	--	--	--	--	--	--	--

- Print this number clearly at the **top right-hand corner** of the first page of your report.

#### COMPLETE THIS DECLARATION

- I have checked my NSN.
- I have printed my NSN at the top right-hand corner of the first page of my report.
- The report in this folder is my entry for Scholarship Technology.
- This work presented for assessment is my own.

Signature:

Date:

If the information above is not correct:

- it may not be possible to award a grade
- there may be an investigation for a breach of NZQA's Rules and Procedures.

	Score
Synthesis and integration	
Justification	
Critical reflection	
<b>TOTAL</b>	

ASSESSOR'S USE ONLY

0061-133456263-93601

# Chilly Options

Hokey pokey frozen dessert with fluffy marshmallow atop a gingerbread cookie enrobed in dark chocolate



Product in situ

Nutrition Information			
Servings per package:	8.00	Serving size:	85.00 g
	Average Quantity per Serving	Average Quantity per 100 g	
Energy	1800 kJ	1440 kJ	
Protein	3.9 g	3.1 g	
Fat, total	16.7 g	13.4 g	
- saturated	14.8 g	11.8 g	
Carbohydrate	64.8 g	51.8 g	
- sugars	46.8 g	37.4 g	
Sodium	299 mg	239 mg	

NIP



Final product

**Context: CHILLY OPTIONS**

New Zealand being home to the large dairy company Fonterra supports the explanation as to why New Zealand consumes more ice cream per capita than any other country worldwide. In previous years, Fonterra owned Tip Top, one of New Zealand's favorite household names and ice cream brands for over 80 years – and winners of many prestigious ice creams awards. In recent years, the evolution of ice cream has been extraordinary with the introduction of many new flavors, bases, shapes, [REDACTED] well as the product development to suit our populations varied dietary requirements.

**BRIEF:** Many products are being modified and improved to suit a purpose. Foods developed to suit a purpose can be convenience foods, lifestyle choice foods, cultural foods, specialty dietary foods, as well as food for people with food related intolerances and allergies.

**Brief one:** Although lactose free products are currently a niche segment in the market, there is an increased demand for lactose free products. Develop a quality lactose free frozen dessert product with all the attributes of a premium ice-cream.

**Brief two:** Although egg free products are currently a niche segment in the market, there is an increased demand for egg free products. Develop a quality egg free frozen dessert product with all the attributes of a premium ice-cream.

*I decided to combine both the egg free and lactose free briefs to develop a vegan ice cream that would contain all attributes and specifications of a premium ice cream, as although vegan products are currently a niche segment in the market, there is an increased demand for vegan products that are aimed at children to enjoy.*

**I am going to develop a quality vegan free frozen dessert product with all the attributes of a premium ice-cream. This is going to be themed and designed for a target market of children, but to be purchased and enjoyed by people of all ages.**

**Specifications:**

- Creamy, velvety, smoother
- Non-crystalline
- Flavour true to label
- Melts in mouth/has a good mouthfeel
- Palm oil free
- Vegan
- Contains on natural colours and flavorings
- Contains an inclusion
- 4x100g individual ice creams in package; makes a profit at less than \$2.59/100mL

93601

Vegan products are specifically aimed at those people who do not eat or use any animal products. This can be through choice, or due to food related intolerances or allergies.

Egg allergies and lactose intolerance can also be a driving factor for consumers to choose vegan products. Food allergies are often prominent in children and are often outgrown in later years. However, these conditions can often find children excluded in social occasions.

Approximately 65 percent of the world's population is lactose intolerant and about 9 percent of New Zealanders are the same. Lactose intolerance is the inability to fully digest the sugar lactose found in dairy products, with uncomfortable symptoms of nausea, bloating, stomach cramps and potential vomiting.

The number of vegans is increasing every year, 8% of the world's population is now vegan. Many children have a vegan diet – it is not uncommon for children, tweens and teenagers to experiment with being vegan, as well as those who need to for health/ dietary reasons. Consumer with food allergies/intolerances often feel sidelined in society today due to their options on the market being very limited.

My product needs to be accessible and enjoyed by the general public who have no specific dietary requirements or preferences. Family friendly products are *inclusive*. I have a number of stakeholders at my school, both children and adults who are vegan, so their feedback is very important to the success of my project. The wider stakeholders for my product are those who maybe are not vegan but will give me constructive subjective stakeholder feedback so I can modify and improve my product. These wider stakeholders will generally have a relation to the key stakeholders within my prototype. Although vegan products are currently a niche segment on the market, there is an increased demand for vegan products.

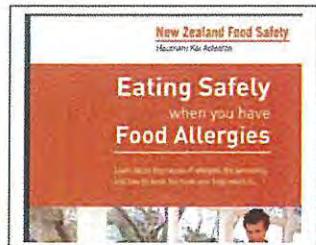
Covid 19 has impacted on the development of my prototype – mainly in terms of accessibility to my target market and stakeholders due to Lockdown's and the extended period at Level 2.5. This has meant that I have needed to use people within my own bubble at times for sensory analysis and feedback which has led to some of the most important decision making, particularly around concepts to reject or accept. Another constraint was the accessibility of resources – supermarket shelves were empty and visits to the supermarket were limited.

I was lucky to have on-line support through Teams of experts in the field. H [REDACTED] R [REDACTED] from Bowl and Arrow – a small business specializing in vegan products was great support as was H [REDACTED] B [REDACTED] from Little Lato – a winner in the NZ Ice cream awards, Food Technologist and business owner. H [REDACTED] is particularly interested in new product design and has been willing to give feedback. H [REDACTED] L [REDACTED] from Hawkins Watts NZ helped me when I was trying to refine the jelly component of my first concepts. This support gave me the confidence to move forward with my product and to develop an exciting, innovative new product which has received really positive feedback from my stakeholders and positive purchase intent.

Throughout the conceptual design phase, and later the prototyping phase, through functional modelling, I have evaluated materials - i.e. equipment, ingredients, techniques and processes to develop a delicious frozen dessert that meets the needs of the vegan target market. Testing, including both *subjective* and *objective* methods, made this possible. I thoroughly investigated existing products. Generally, specialty products -including those in the vegan market frozen desserts that are vegan are expensive, so I have taken this into account when selecting ingredients that will make my product affordable to this target audience. Understanding substitutions for non-vegan products that are typically found in frozen desserts was vital when ensuring that my product was 100% true to label. The functionality of my product has been carefully researched and considered to ensure it was portable, stackable and reusable/recyclable. This meant that the maintenance and disposal was considered at all stages of production taking into account cultural, social and environmental factors.

93601

# Need/ Opportunity



It is no small issue. On top of the terrible social pressure allergy sufferers can feel and the anxiety that comes with constantly having to worry about what you touch or eat, there is also a very real threat to their life.

specially ice creams for children with milk and egg allergies

[www.jadentline.org/article/fvilexst](http://www.jadentline.org/article/fvilexst)

**"Hidden" allergens in foods - Journal of Allergy and Clinical ...**

"Hidden" allergens in foods - Salad bars and ice cream parlors offer good examples of this practice. ... as ice cream and milk-free sorbet, without adequate cleaning of the equipment ... Reactions may occur the first time a child is given egg... products made from oats, rice, soy, barley, or corn or specialty foods made for ... by MA Steinman - 1986 Cited by 113 Related articles

LIFESTYLE

## Yes, more kids have allergies now. Here's why

[community.kidswithfoodallergies.org/blog/cme-ingredient-ice-cream-recipe-allergy-friendly-sugar-free-cookies.html](http://community.kidswithfoodallergies.org/blog/cme-ingredient-ice-cream-recipe-allergy-friendly-sugar-free-cookies.html)

Frozen treats are always a challenge for food-allergy families. For many of us, commercial ice creams are not safe, and we often make our own treats. However, the hard part is most ice cream freezers need either significant freezer real estate and lead time, or specialty ingredients and equipment. This recipe needs neither! One ingredient, four steps, and a 4"x 4" space in the freezer. Loving it already! It's also a very kid-friendly recipe - even a preschooler can help prepare it! It's also a great alternative to banana bread for those lone extra-ripe bananas on the counter.

[www.allergy.org.nz/A-Z-allergies/Egg-allergy/](http://www.allergy.org.nz/A-Z-allergies/Egg-allergy/)

Egg allergy - Allergy NZ

Egg allergy. Egg is one of the most common food allergens affecting young children. The first reaction usually occurs when the child is between six and 19 months old.

[www.bbcgoodfood.com/how-to/guide/is-a-vegan-diet-healthy-for-kids](http://www.bbcgoodfood.com/how-to/guide/is-a-vegan-diet-healthy-for-kids)

- BBC Good Food

The short answer is yes - with the right planning and knowledge, a child can get everything they need following a vegan diet. The biggest concern with vegan

Anaphylaxis is a severe, potentially life-threatening allergic reaction. It can occur within seconds or minutes of exposure to something you're allergic to, such as peanuts or bee stings. Sep 14, 2019

Eggs are one of the most common **allergy-causing foods** for **children**. Egg allergy symptoms usually occur a few minutes to a few hours after eating eggs or foods containing eggs. Signs and symptoms range from mild to severe and can include skin rashes, hives, nasal congestion, and vomiting or other digestive problems.

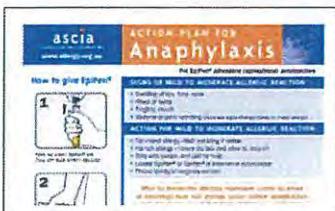
## Jonnie Meek: Second inquest finds boy, 3, died from milk allergy

[www.sohome.com.au/milk-allergy-inquest-finds-boy-died-from-milk-allergy](http://www.sohome.com.au/milk-allergy-inquest-finds-boy-died-from-milk-allergy)

products recipes about find us

Sorry, No Locations Found

Complete the form below to request our products near you or click the button below to buy online



NEW ZEALAND

Grieving mum whose daughter died from an allergic reaction warns others



cashewmilk  
FROZEN DESSERTS

Cafe-to-convenience. Frozen dessert flavored with all-natural cashews. From Peas & Purple Peas. Soya-free, dairy-free, and specifically for dairy-free. Non-GMO Project Verified and Certified Vegan. Dairy-free frozen dessert packed in pouches.

[www.godairyfree.org/Food-and-Grocery](http://www.godairyfree.org/Food-and-Grocery)

Best Dairy-Free Ice Cream Bars: 10 Vegan Treats Worth ...

Jun 23, 2019 -- Have the school snack it's best for your milk-allergic kid can join in during ice cream socials. Or simply keep them on hand for slumber parties, after

Companies may diversify product lines in order to create new markets. For example, the baked bean market was diversified by offering the product with flavoured sauces, such as barbecue or curry, or by adding burger bites.

To offer a greater choice of products and reach a larger portion of the consumer market, companies often target groups of consumers who are similar in one respect. This may be their age, income, taste, lifestyle, health or beliefs.

Foods are then produced to meet their needs. The product range is designed to meet the needs of the particular types of consumer, such as children or single people or slimmers.

Some product lines are not expected to sell in vast amounts, but they fill a special gap or 'niche' in the market. A 'niche market' is usually based on a reaction to a trend in consumer purchasing.

#### **Constraints:**

Time, budget for testing (money), final price range of product must be less than \$10.00 per litre, resources – in short supply, seasonal produce, skill level, equipment

#### **Specifications:**

Creamy, velvety, smooth, non-crystalline, flavour true to label, melt in your mouth, good mouth feel, vegetarian, vegan, scoopable, must contain an inclusion, must only contain natural colours and flavorings

#### **Trial and testing:**

Disassembling existing products was the first test completed. Looking at products on the market, I was able to discover what attributes premium ice creams contained. I also needed to compare Regular/premium ice creams to ones for people with dietary requirements. These existing products were broken down to look at the function of each ingredient. I tested some of these ingredients until I was able to recognize the ones that worked well in my ice cream base.

## **WHY DO WE... Disassemble and research existing products?**

- STAKEHOLDERS
- Critically analyse
  - To develop, create, improve, modify
- To find flaws → make comparisons
- To find a GAP in our target market
- Need/opportunity to get started
- Establish specifications
- BREIF
- Research – don't know what we don't know
- Inspiration
  - Brilliance
  - Disappointed
- Analyse: ingredients
  - Flavour | discover what we need to find out
  - Texture

## COSTING – existing products:

	Appleby Farms 850g \$12.00 \$1.45 per 100g <b>Dairy free</b>		Wahiki Coconut Chocolate 480g \$10.49 \$2.15 per 100g <b>Gluten free, vegan</b>		Killinchy Gold 1000g \$10.49 \$1.04 per 100g
	Kohu Rd Dairy free 500g \$13.00 \$2.60 per 100g <b>Dairy free</b>		Movenpick 500g \$8.49 \$1.70 per 100g		Ben and Jerrys 458g \$12.99 \$2.70 per 100g
	Little Island 475g \$8.49 \$1.70 per 100g <b>Dairy free</b>		Halo Top 473g \$8.00 \$1.70 per 100g		Tip Top 2000g \$7.50 \$0.35 per 100g <b>No gluten/egg</b>
	Pams Vanilla 2000g \$4.49 \$0.17 per 100g <b>No egg</b>		Countdown 2000g \$4.80 \$0.24 per 100g		

After researching into existing ice creams from different brands on the market I was able to identify that the more "premium" an ice cream became, the more expensive the product would be to purchase. The "premium" status could, in fact, be due to its "niche" in the market -its place in amongst specialised products, for which consumers are willing (?), or REQUIRED, to pay more. All differing ice creams were compared with their cost per 100g price. With a standard, cheaper, "home brand" ice cream being around \$0.35 per 100g comparing to one of the more premium ice creams costing \$2.60 per 100g. The difference that separates premium from non-premium ice creams making costing more expensive, would be ingredients that were used along with any background costings.

## SO... I investigated the ingredients in existing egg or dairy free ice creams:

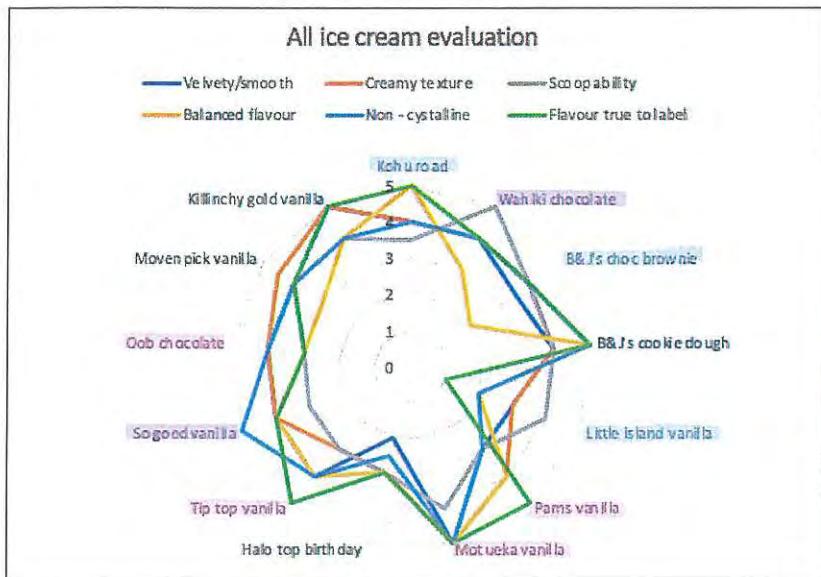
93601

	Kohu road Dairy free	Motueka Creamy Vanilla Egg free	So Good Vanilla Bliss Vegan	Little Island Vanilla Bean Dairy free	Wahiki Chocolate Gluten free, vegan	Pams Vanilla Egg free
<b>Milk</b>						
<b>Cream</b>						
<b>Sugar</b>						
<b>Water</b>						
<b>Egg yolk</b>						
<b>Vanilla Bean</b>						
<b>Cocoa powder</b>						
<b>Skim milk powder</b>						
<b>Sweetener</b>						
<b>Vegetable gum (Carob bean gum)</b>						
<b>Vegetable gum (Guar gum)</b>						
<b>Stabilizer (Carrageenan)</b>						
<b>Coconut milk</b>						
<b>Maltodextrin</b>						
<b>Chocolate</b>						
<b>Chicory root</b>						
<b>Monk fruit concentrate</b>						
<b>Stabilizer (412)</b>						
<b>Stabilizer (410)</b>						
<b>Stabilizer (401)</b>						
<b>Stabilizer (407)</b>						
<b>Emulsifier (471)</b>						
<b>Emulsifier (477)</b>						
<b>Glucose syrup</b>						
<b>Coconut cream</b>						
<b>Salt</b>						
<b>Soymilk</b>						
<b>Vegetable oil</b>						
<b>Vegetable gum (Cellulose)</b>						
<b>Corn syrup</b>						

The ingredients of existing egg/dairy free ice cream on the market were broken down so ingredients that were used can be identified and looked at closely. This gave me a clear idea of some alternatives that I would be able to use instead of egg or many dairy products that are generally used in the formula of a premium ice cream. Noticing that if an ice cream did not

93601

contain egg, the use of stabilizers or emulsifiers were often used as a replacement so ice cream would still be able to prevent ice crystals, resistance to melting is decreased along with structure is preserved. The ice cream that did use egg, didn't have a use of additional stabilizers



Key:  
Rating 1-5

(1 – being the lowest and 5 – being the highest)

Dairy free  
Egg free  
Vegan

### Comparison of fats and sugars of milks and creams:

I am looking at the fat and cream components of non-dairy products. I know that premium ice creams contain between 12 and 22% of fat, so by looking into these different liquids I am able to identify which combination will result in an ice cream that contains the required fat contents to meet the desired attributes of a premium ice cream.



Pureharvest  
Coconut milk

Fats: 6.80g  
Sugars: 9.50g



Trident  
Coconut  
cream

Fats: 6.3g  
Sugars: 0.8g



Sanitarium So  
good  
Soymilk

Fats:  
3.5g/100mL  
Sugars:  
2g/100mL



Alpro  
Soy cream

Fats:  
15.1/100mL  
Sugars:  
1.2/100mL

93601



### Sanitarium So good

Cashew milk

Fats: 3.7g

Sugars: 7.1g



### Cashew cream

Fats: 16.1g

Sugars: 1.1g



### Vitasoy

Oat milk

Fats: 5.0g

Sugars: 4.5g

### Testing flavours of different milks:

I tested the flavour of different milks through sensory evaluation to narrow down those which I might try initial testing. From these results I can form next steps with the milks that are worth testing and trialling in my ice cream base.

	Flavour	Aroma	Balance	Sweetness	Texture	Mouth feel through fat
Rice milk	1 – awful, taste bland	1 – bad aroma	1 – too overpowering	1 – not sweet	1 - watery	1 – bad aftertaste
Coconut milk	1 – overpowering coconut	1 – too strong	1 - overpowering	1 – not sweet	1 - watery	2 – slight after taste
Soy milk	2 - unappealing	2 – not strong aroma, bland	3 – not overpowering flavour of soy	2 – flavour is bland	2 - watery	1 – immediately leaves taste in mouth
Oat milk	3 – I personally didn't like it but it could mix well in ice cream	5 - not overpowering and really subtle	4 – the flavouring wasn't overpowering	2 – not sweet	1 – really watery	3 – there is a slight after taste
Almond milk	2 – the flavour is not appealing	4 – I can smell the almond but it was not overpowering	2 – all I can taste is almond, not appealing	1 – not sweet	2 - watery	2 – leaves after taste

93601

<b>Cashew milk</b>	5 – not terrible flavour	4 – aroma is not overpowering	5 – flavoured is well balanced	4 – sweetness isn't too much or too little	3 – was a little watery	3 – leaves a little taste in mouth
--------------------	--------------------------	-------------------------------	--------------------------------	--	-------------------------	------------------------------------

### Testing different homemade ice creams:

	<b>Flavour</b>	<b>Aroma</b>	<b>Balanced</b>	<b>Sweetness</b>	<b>Texture</b>	<b>Mouth feel</b>
Egg replacement – no egg ice cream	5	4 – not a strong sense	4.5 – improve on sweetness	4 – quite sweet possibly from adding slightly too much sugar	4 – still a little grainy	5
Peanut butter – no egg ice cream	4	3	3	4	2	2
Coconut cream Coconut milk – lactose free	1 – not a fan of the coconut strong taste	1 – not a nice smell to appeal audience	2 – too rich and overpowering	2 – had very little sweetness	2	3
Cashew milk Cashew cream – lactose free	2	2 – not an appealing smell/put off	2	4 – sweetness wasn't too bad	3 – was quite grainy/ crystalline	3
Oat milk Cashew cream – lactose free	2	2	2	2	3 – grainy icy texture	4
Soy milk Soy cream – lactose free	1 – didn't appeal to my taste buds	2	4 – sweetness and flavour balanced	4	4 – wasn't too crystalline in the mouth	3
Almond milk Coconut cream – lactose free	1 – coconut taste overpowered	2	2 – too coconuty made it taste like pure coconut ice cream	2	3	4
Rice milk Coconut cream – lactose free	3	3	2 – felt like sweetness could have been balanced more	2 – sweetness was very low	3 – difficult to scoop	5

93601

**Key for both tables:**

Flavour: 1 (horrible) – 5 (great)

Balanced: 1 (unbalanced or overbalanced) – 5 (balanced)

Sweetness: 1 (no sweetness or oversweet) – 5 (balanced sweetness)

Texture: 1 (thin, watery) – 5 (creamy)

Mouth feel through fat: 1 (residue, coating) – 5 (no lingering, mouth feel)

**Egg test one: egg vs no egg?**

I am completing a test to compare a traditional ice cream made with egg to a traditional ice cream made without egg.

*My key questions are... What is the function of egg in ice cream?*

How does the texture, flavour and appearance change? – if at all?

I will use pots, whisk, ice cream churner, fridge, freezer, ingredients, thermometer and a timing device. To ensure I am keeping safe I will make sure that my work area is uncluttered and all equipment is sterile. My workspace will be organised and I will make sure that I follow the correct health and safety procedures by using a process plan or recipe. Testing will be kept fair by keeping all ingredients and testing methods the same only changing a single variable of egg.

I think that egg will make a huge difference in the ice cream giving it a good smooth texture compared to the ice cream without egg being icy and difficult to roll. Key attributes that will be sensory tested are;

- *Appearance:* is it glossy? Fluffy? Non-crystalline? Smooth?
- *Texture:* is it smooth? Creamy? Scoops easily? Silky? Velvety?

	Egg	No Egg	Photo: Egg	Photo: No Egg
Immediately	Nice and smooth Easy to scoop Nicer consistency Holds shape	Melting fast Hard to scoop – took a lot more effort		
7 minutes	Still holding its shape Texture is still smooth Isn't runny	Melting faster Runny Chalky, icy, grainy Scoop ability is still poor		

93601

				
15 minutes	Scoops really well Isn't grainy Slightly melted on the sides which makes rolling even easier Better consistency	Melted completely Separated Sloppy Grainy Basically turned into cream – soft serve		

I found that even though at first I thought that the ice cream that contained no egg tasted better than the one that did have egg but as time went on there were several features that ended up making the no egg ice cream the worst out of the two. After the two ice creams were left out of the freezer for 7 minutes, I began to see the no egg ice cream melt as well as the scoop ability becoming poor which made it hard to serve. Comparing this to the ice cream that contained egg, after 7 minutes it still held its shape, the texture was still smooth and it hadn't become runny. We then looked at the features of both ice creams again after they were left out the freezer for around 15 minutes. At the point it was clear that since the no egg ice cream didn't have the stabilizers holding it together it couldn't withstand being out of the cold. The no egg ice cream became sloppy, grainy and looked like a soft serve whereas the egg ice cream had the ability to be scooped out easily and all premium attributes of an ice cream were still present.

I needed to really understand the **Function of egg in ice cream:**

Eggs leverage the fat that's already present in the ice cream base. They make it a creamier texture. Egg yolks also improve the stability of an ice cream, this reduces the tendency to melt before you can get from freezer to cone to mouth.

<https://sweets.seriouseats.com/2013/08/how-many-eggs-should-i-use-to-make-ice-cream.html>

The egg yolks help make it soft, rich, smooth, creamy, custardy. Without the egg it relies on the fat in the cream to pull through to make the ice cream soft, but without the egg it won't be as rich/smooth and will still tend to freeze harder.

<https://cooking.stackexchange.com/questions/34720/why-do-you-need-eggs-when-making-icecream>

The egg yolk is a...

**Stabiliser** – By adding yolks you extend the shelf life of your ice cream in the freezer as it inhibits thawing.

**Emulsifier** – The lecithin in egg yolk creates a really rich, creamy textured ice cream.

**Flavour** – They add a rich, custard like taste; another depth of flavour that can work very well with some flavours such as a rich dark chocolate variant.

**Colour** – Yolks add a yellow colour to your desserts which may or may not be to your liking.

<https://www.creamish.com.au/eggs-used-ice-cream/>

### Egg test two: egg replacement:

I am completing a test to see if using egg replacement powder gives the same results as when a regular egg is used.

*My key questions are... Does egg replacement give the same attributes as a regular egg?*

*How do the attributes change?*

I will use pots, whisk, ice cream churner, fridge, freezer, ingredients, thermometer and a timing device. To ensure I am keeping safe I will make sure that my work area is uncluttered and all equipment is sterile. My workspace will be organised and I will make sure that I follow the correct health and safety procedures by using a process plan or recipe. Testing will be kept fair by keeping all ingredients and testing methods the same only changing a single variable of using egg replacement rather than a normal egg.

I think that the egg replacer could work really well in my ice cream as it should have all necessary attributes to make an ice cream combine together well and still ensure that all attributes of the ice cream are still present after all the process. I think that my ice cream could turn out being smooth, creamy and non-crystalline just like a regular egg ice cream would have.

*Process photos:*



After completing this test I thought that the egg replacement worked really well instead of the egg yolk in our ice cream. All premium attributes of an ice cream were present apart from the fact that the ice cream did melt quite fast. Because of this, for future testing, we are going to have to complete additional research into which stabilizers will be able to hold the ice cream together for longer periods of time when out of the freezer. Once this issue is fixed, I think that this will be a very good ice cream base to continue testing with as it has a simple flavour to work with. Another factor that we could improve on is the sweetness of the ice cream. By looking at ways of possibly reducing the sugar content may mean that we will left with an ice cream that won't taste so sickly sweet, therefore appealing to a wider range of people.

93601

### Initial survey:

I conducted an initial survey to gain information on favourite flavours, themes and the type of product a group of children within my target market prefer. This will help me begin initial concepts.

1. What are your 3 favourite ice cream flavours?
2. How often would you have ice cream?
3. What is your favourite food?
4. What is your least favourite food?
5. Do you have any allergies? If so what are they?
6. What is your favourite book, movie, animated character?
7. What would you like included in your ice cream?
8. If you picked an addition for the ice cream, what kind of addition would you like?
9. How do you like your ice cream served?
10. What would your dream ice cream be like?

1. What are your 3 favourite ice cream flavours?

[More Details](#)

6  
Responses

Latest Responses

"Licorice, Boysenberry, Vanilla"

"Cookies and cream, Goody goody gum drops, hokey pokey"

"Chocolate, Vanilla, Hokey Pokey"

7. What is your favourite movie, book, animated character?

[More Details](#)

5  
Responses

Latest Responses

"I like heaps so i can't decide"

"Frozen 2, favourite book is billionaire boy. Favourite animated char..."

2. Why are these your favourite?

[More Details](#)

6  
Responses

Latest Responses

"They look and taste good"

"because they are sweet and yum and have stuff inside"

"Because I they are sweet and delicious "

8. What would you like included in your Ice cream?

[More Details](#)

5  
Responses

Latest Responses

"Any i like all"

"Lolly- gummy Chocolate- milk chocolate"

"Chocolate chunks"

3. How often would you have ice cream?

[More Details](#)

6  
Responses

Latest Responses

"Everyday"

"At least once or twice a week"

"Occasionally"

"Never"

"Lollies"

"Nachos"

"Pizza"

"Broccoli"

"Orange"

"I don't really have a least favourite"

"Nuts"

"No"

"Other"

"Ruled onto a cone"

"On a stick"

"Other"

4. What is your favourite food?

[More Details](#)

6  
Responses

Latest Responses

"Lollies"

"Nachos"

"Pizza"

5. What is your least favourite food?

[More Details](#)

6  
Responses

Latest Responses

"I don't really have a least favourite"

"Broccoli"

"Orange"

6. Do you have any allergies? If so what are they?

[More Details](#)

4  
Responses

Latest Responses

"No"

"Nuts"

10. How do you like your ice cream served?

[More Details](#)

6  
Responses

Latest Responses

"Ruled onto a cone"

"On a stick"

"Other"

11. What would your dream ice cream be like?

[More Details](#)

6  
Responses

Latest Responses

"tastes good licorice inside it "

"Yummy"

"Chocolate ice cream with chocolate chunks"

After looking at my results that I received from my stakeholders, I gathered information that is going to be important as it will influence my choices in ice cream flavors and designs in order to suit my stakeholders' specifications. One of my stakeholders has a 'flexible vegan diet' so it could

93601

be a good challenge to extend my learning from just completing an egg free ice cream, to incorporating the lactose free brief to produce a vegan ice cream. Most of my stakeholders like the idea of chocolate being incorporated into their ice cream in some way too so I am thinking about chocolate chunks or swirl possibly? All of my stakeholders all said that their favorite way to receive ice cream is rolled onto a cone therefore meaning that my ice cream will be stored in a tub, so it is possible for this to occur. Another flavour they also said they like is hockey pockey. Incorporating the chocolate and honeycomb flavor could produce a kid's ice cream that would appeal to many children as these are crowd favorite flavors.

**Thinking about the context and concept: Overwhelming support for the "FROZEN" theme.**

**SO:** My concept is inspired by the classic Kiwi favorite cookie, the Mallowpuff biscuit but as a snowflake shape. At the base of the concept design it will have a thin gingerbread cookie. This will be followed by another thin layer of marshmallow, topped with a hockey pokey ice cream. The concept will be enrobed in chocolate. A small white chocolate snowflake decal will be placed on top. By having the ice cream shaped in this way as well as incorporating the snowflake decal, it shows the focus around the movie "Frozen"

### Concept one:

Vegan vanilla ice cream with a vegan chocolate fudge and sauce

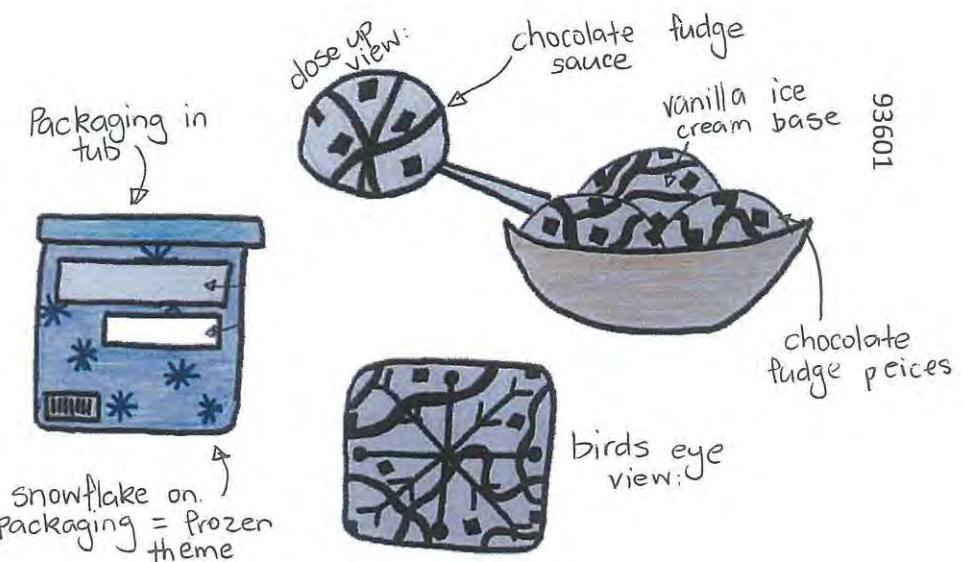
#### Description:

This ice cream I am planning to have a vegan vanilla bean ice cream base. Throughout this ice cream there will be a chocolate fudge swirl as well as chunks of chocolate fudge. Both of these inclusions will be vegan friendly and will have an even distribution throughout the ice cream. By having an even distribution, it should avoid any chance of getting some scoops without chocolate and others that will have a lot of chocolate inclusions. I have chosen to follow the egg free brief as well as the lactose free brief to create a vegan friendly ice cream as there are many children that have allergies to egg and lactose and the ice cream selection for these children is minimal. A white chocolate snowflake will be placed at the top of the ice cream to for a hard-top finish in the tub.

The inspiration that I have got for this ice cream idea is from Frozen. The frozen character of Olaf the snowman is my main inspiration. The white ice cream (snowman body) and the chocolate inclusions throughout the ice cream (buttons on snowman) is how I am reflecting this animated character into my ice-cream.

The packaging for this ice cream will be a tub which will allow consumers to roll into bowl or cone as desired. A blue, white and black colour scheme will be used as all of these colours contrast well together and represent cold conditions. A blue background with white snowflakes which should appeal to younger audiences. I have also chosen to use black writing to title and label packaging as it will be clear to the eye and easy for people to read in contrast to the blues and whites.

#### Ideas of inspiration:



#### Specifications:

- Must be creamy, velvety and smooth
- Must have a flavour that is true to label – vanilla with a chocolate swirl and fudge
- Should be non-crystalline which would allow the ice cream to melt in your mouth
- Must be vegan
- Should have a good scoop ability
- Must contain the inclusion of chocolate chunks and swirl
- Must be suitable for the target market of children
- Snowman/Olaf themed – inspired by well-liked children's movie, Frozen
- Must be suitable for kids to consume (simplicity)

#### Flavour:

Since a popular flavour suggested from my stakeholders was vanilla, I am thinking about creating a vegan friendly vanilla bean ice cream base. With this particular concept, I am going to include the particular inclusion of chocolate. This was the most popular inclusion asked for by my stakeholders. So, to represent the inclusion of chocolate there will be both a chocolate fudge swirl as well as fudge chunks throughout the vanilla ice cream. The contrasting flavors of chocolate and vanilla should work well together

## Concept two:

Vegan vanilla ice cream with a blue vegan jelly, coated in milk chocolate and dusted with blue and white sprinkles

### Description:

This ice cream I am planning to have a vegan vanilla ice cream and the base part of the ice cream closest to the top of the stick. Above this ice cream will be a blue jelly. Covering these two will be a milk chocolate coating it all with blue and white sprinkles at the top of the popsicle shaped ice cream. By having the blue jelly and white ice cream inside the chocolate coating, it will represent the idea of frozen themed ice-cream well through the contrasting colours. By creating a vegan friendly ice cream aimed at children, it should work well out in the market as several parents look for child friendly ice cream to suit their child's allergies and health requirements. This concept is also inspired by the classic New Zealand favorite, the Jelly Tip.

This is a Frozen inspired ice cream, with an emphasis on the cold and snowiness of the film. By including ideas like these it should positively impact children as Frozen is a crowd favorite film.

The packaging for this ice cream will be a small singular box that fits the ice cream on the stick inside. It will be a pastel blue and white package with glitter looking shapes all over the box in a darker shade of blue. Black writing to title and labels the aspects of the ice cream will be used as it will make it clear for consumers and more eye appealing.

### Ideas of inspiration:



### Specifications:

- Must be creamy, velvety and smooth
- Must have a flavour that is true to label – vanilla with a blue jelly coated in chocolate
- Should be non-crystalline which would allow the ice cream to melt in your mouth
- Must be vegan
- Should have a good scoop ability
- Must contain the inclusion of a blue jelly
- Must be suitable for the target market of children
- Snowflake themed – inspired by well-liked children's movie, Frozen
- Must be suitable for kids to consume (simplicity)

### Flavour:

Since a popular flavour suggested from my stakeholders was vanilla, I am thinking about creating a vegan friendly vanilla bean ice cream base. On top of this ice cream will be a blue jelly and covering both the jelly and ice cream will be a milk chocolate coating. This will support the popsicle shape to hold together as well as adding a hard crack to the texture. By including both the chocolate and vanilla flavors, it makes the ice cream appealing to my stakeholders.

### Concept three:

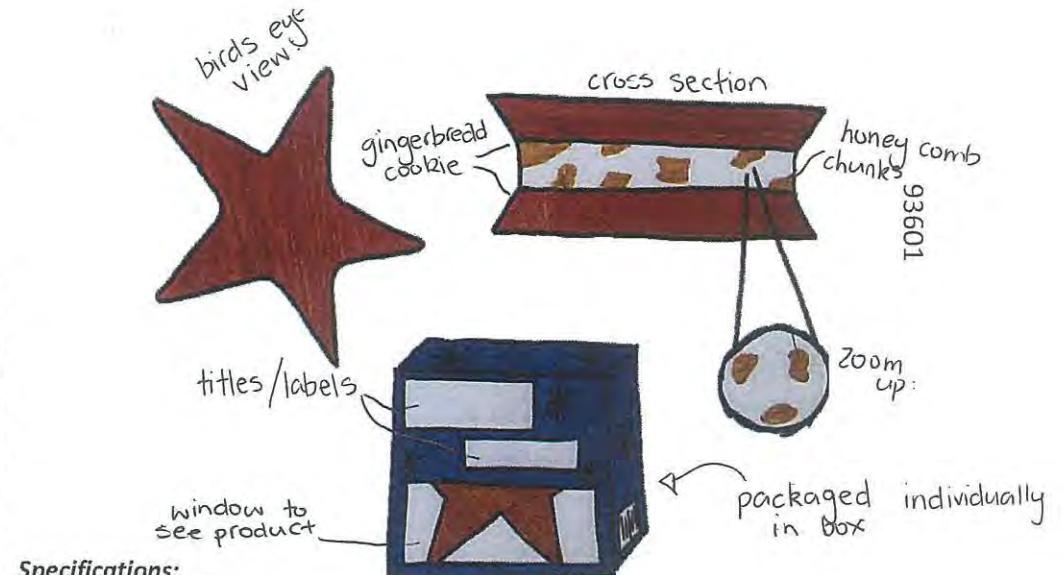
Hokey pokey vegan vanilla ice cream sandwich with a vegan gingerbread biscuit

#### Description:

This ice cream I am planning to have a vegan vanilla bean ice cream base. Throughout this ice cream there will be a chocolate fudge swirl as well as chunks of chocolate fudge. Both of these inclusions will be vegan friendly and will have an even distribution throughout the ice cream. By having an even distribution, it should avoid any chance of getting some scoops without chocolate and others that will have a lot of chocolate inclusions. I have chosen to follow the egg free brief as well as the lactose free brief to create a vegan friendly ice cream as there are many children that have allergies to egg and lactose and the ice cream selection for these children is minimal. A white chocolate snowflake will be placed at the top of the ice cream to for a hard-top finish in the tub.

The inspiration that I have got for this ice cream idea is from Frozen. The frozen character of Olaf the snowman is my main inspiration. The white ice cream (snowman body) and the chocolate inclusions throughout the ice cream (buttons on snowman) is how I am reflecting this animated character into my ice-cream. The packaging for this ice cream will be a tub which will allow consumers to roll into bowl or cone as desired. A blue, white and black colour scheme will be used as all of these colours contrast well together and represent cold conditions. A blue background with white snowflakes which should appeal to younger audiences. I have also chosen to use black writing to title and label packaging as it will be clear to the eye and easy for people to read in contrast to the blues and whites.

#### Ideas of inspiration:



#### Specifications:

- Must be creamy, velvety and smooth
- Must have a flavour that is true to label – hockey pokey vanilla ice cream sandwich
- Should be non-crystalline which would allow the ice cream to melt in your mouth
- Must be vegan
- Should have a good scoop ability
- Must contain the inclusion of honeycomb throughout the vegan vanilla ice cream
- Must be suitable for the target market of children
- Should contain a sturdy biscuit that wouldn't dissolve when being on top and bottom of the ice cream
- Snowflake themed – inspired by well-liked children's movie, Frozen
- Must be suitable for kids to consume (simplicity)

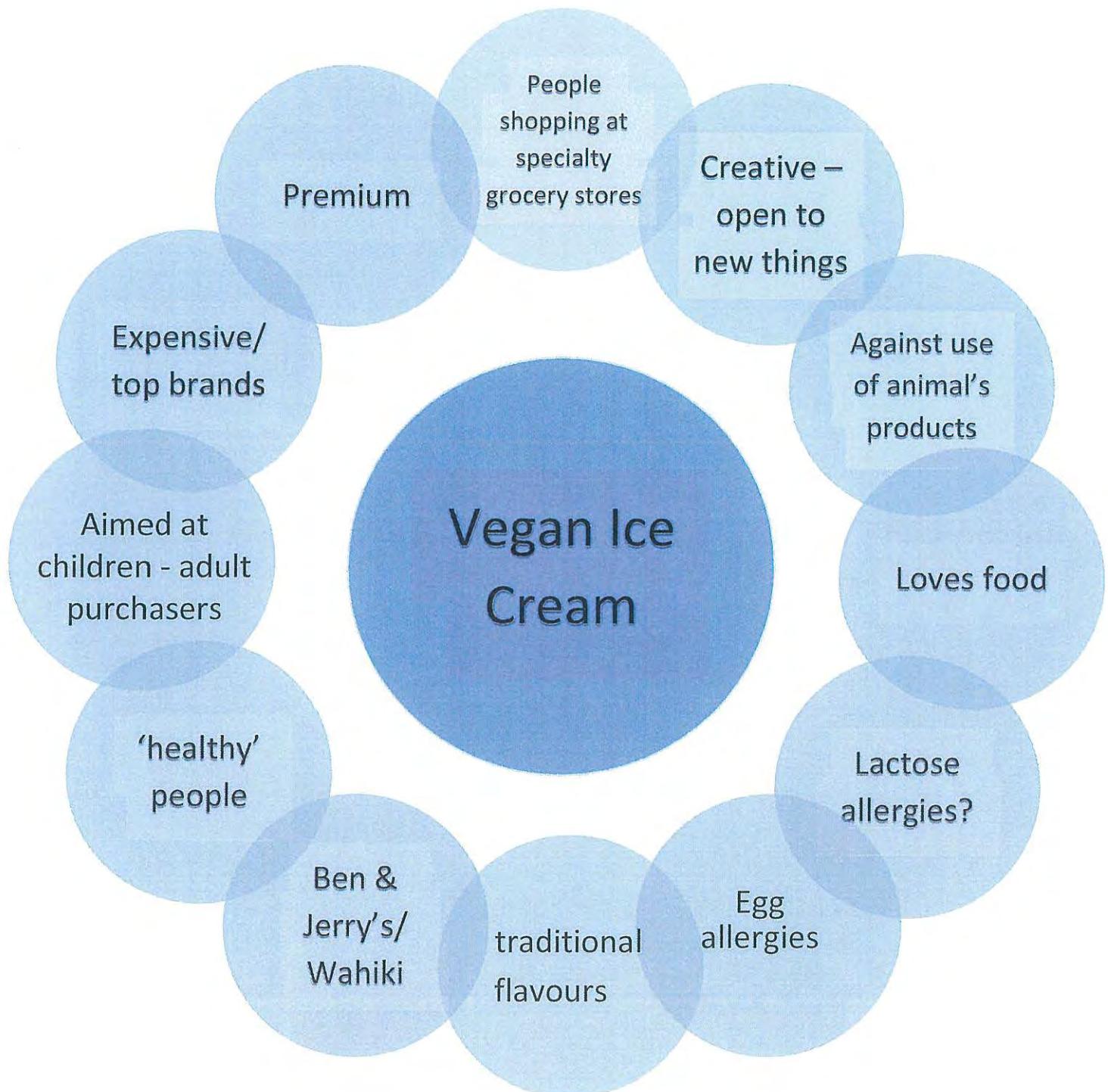
#### Flavour:

Since a popular flavour suggested from my stakeholders was vanilla, I am thinking about creating a vegan friendly vanilla bean ice cream base. With this particular concept, I am going to include the particular inclusion of chocolate. This was the most popular inclusion asked for by my stakeholders. So, to represent the inclusion of chocolate there will be both a chocolate fudge swirl as well as fudge chunks throughout the vanilla ice cream. The contrasting flavors of chocolate and vanilla should work well together especially since they are very popular ones too.

**Product in situ?** For my final outcome, the goal for my ice cream is for it to be appropriate for supermarket, dairy our four-square freezers. Specifically aimed at children to fill the gap in the market in.



**Target market:**



## Research/ initial functional modelling of materials

Stabilisers are used so water in the mixture may be bound together so the formation of ice crystals is prevented. When the water is bound together, we are left with an ice cream that has a good texture and is now resistant to heat shock during the storage and processing stages of production. Stabilizers have four main functions. These include...

1. Overall good mouth feel and texture of product
2. An enhancement of the uniform air distribution within product while increasing viscosity of product
3. An increase in the water capacity of the ice cream. This is because they are dehydrated before processes begin, however, their actions start coming into action during each stage upto when the product is stored
4. Impacting heat shock resistance with the finished product

Emulsifiers are important as they decrease the melting rate of the finished product. Just like stabilisers, they support the ice cream in creating smaller ice crystals and air cells by improving the whipping quality. When this happens, it creates an ice cream with a softer texture. When emulsifiers are used, we can expect the product to be protected from heat shock too.

Air cells are whipped into the base becoming responsible for consistency, texture and volume of the ice cream. The overrun measures/indicates amount of air held within ice cream impacting volume of the product. The more air that an ice cream has, the quicker that the ice cream will melt. Hence why premium quality ice creams melt slower than less expensive brands. The density of ice cream relates to the amount of air with the base. The more air contained, the lower the density.

When fat is used in ice cream, flavour is added and a velvety and rich texture in the mouth is created. If fat content is reduced too much, the creamy sensation is also reduced. When fats are used, the base mixture is stabilized along with enhancing flavours. If too much cream with a high fat level is included, the ice cream may completely harden when in the freezer. Too much fat can also create a grainy ice cream due to the crystallization of the fat particles. Since fat holds onto flavour, the higher the fat level, the slower the flavour release whereas the lower the fat level, flavour will be released immediately with no aftertaste.

Sweeteners support the body and texture as well as adding sweetness to the base. When the correct sweeteners are used, freezing point is lowered making sure that the product doesn't freeze hard. If too much regular sugar is added, ice cream may result in a final product that is too soft and melted. Whereas, if not enough sugar is included, ice cream may become chewy and grainy because of large ice crystals being formed. When sweeteners like glucose are used, the body of the ice cream becomes less resistant to melt away as it is not more stable.

93601

The next section of my report focuses on the Functional Modelling - and discusses some of many trials and tests that I used throughout the development of my product. I used a variety of tests -both subjective and objective.

Functional modelling is an essential tool and it key to the development of a product. The Functional modelling phase is where all the testing that had to happen in order to procure a possible design concept for the desired product. You will see throughout this section, the decisions I made, and why I made them, in particular, to **MODIFY** a popular, and probable outcome due to its technical feasibility. I had to consider functional reasoning - how to make it happen and practical reasoning - should it happen, and **although disappointing, this crucial decision making enabled me to modify an idea and take it through to prototyping stage.**

The ongoing trialling and testing was essential to my understanding of the functions of ingredients and how they could, or should perform to meet the specifications. I also needed to consider competing and contesting factors, and prioritise - with the competing factors over riding the contestable.

**Subjective testing** is opinion based and is consumer driven, focusing on people's preferences.

**Objective testing** is factual as measurable data is collected. These tests are unbiased as personal opinions were not included.

Types of subjective testing that I completed were surveys and preference testing. Surveys were used as concepts developed so stakeholder feedback was gathered. These surveys allowed me to create next steps. Preference testing was used to compare two products and understand which people wanted more. This subjective test was crucial in decision making. Results from these subjective tests were easy to understand as they were transferred onto graphs making them visual.

Some objective tests completed were churning tests, shelf life testing and viscosity test. Churning tests showed me which churners were going to be the best during production. I was able to see the difference of results and compare these to make decisions with which was going to make my ice cream the best it could be. Viscosity testing was used as a quality control point where time for ice cream base to flow through funnel was measured. Shelf life of inclusions was important as it gave me the information to understand if my honeycomb wasn't going to disintegrate when frozen within the ice cream.

The order of testing was important as each test provided information that allowed decisions to be made. Developments and next steps were able to be created. Each test that was completed built on prior tests.

## Trial one - Concept one:

Vegan chocolate ripple fudge ice cream

### Stakeholder feedback:

When I got my stakeholders to trial my ice-cream, they thought that the inclusion of the fudge sauce and fudge pieces were a good idea. After trying the chocolate fudge on its own they thought that it tasted really good as it had a balanced flavour since it wasn't too rich and sweet. They also liked how when left in the ice cream for a while, it did not disappear from the moisture of the ice cream. However, they did suggest that using a caramel sauce may have improved the overall flavour since the chocolate fudge sauce was extremely rich. Also suggesting making the chocolate fudge pieces a little bit bigger could improve the overall ice cream inclusions. Apart from a few aspects to improve and work on, they liked the swirling technique that was used with the fudge sauce which was apparent when looking at it from above. The frozen theme was clear to them with the white chocolate frozen hard top, but they did think that possibly this could be made clearer by including snowy colours or coloring the white chocolate snowflake to blue.

### Stakeholder notes:

**What would they change?** Chocolate fudge sauce to a caramel sauce, fudge pieces slightly bigger, maybe from one big tub to single serving tubs = lead to better detail in the snowflake white chocolate top

**What did they like?** Taste of the fudge pieces

**What did they dislike?** The chocolate fudge sauce – too rich and floated all to the bottom

**What would they remove?** Fudge sauce – swap to caramel

**What would they possibly add?** Some sort of aspect to make it feel more frozen inspired (blue colour? Glitter?)

### Photos:



### Conclusion/next steps:

This trial had many positives, however there were also several improvements that I could/need to make in order to improve the inclusions to this concept. It was a shame how all the inclusions floated to the bottom of the ice cream while in the freezing process. This would have been due to the weakness of the vanilla ice cream base and therefore not having the support to hold it up. This would have been why my stakeholders thought that it was a very rich ice cream especially since close to all the chocolate fudge sauce had drifted to sit at the bottom along with the fudge pieces. I liked the stakeholder feedback of a caramel sauce rather than a chocolate fudge sauce so that is an improvement I am considering as I think that it could work well with the chocolate fudge pieces that will be throughout the ice cream. By cutting these fudge pieces slightly bigger, I am hoping that it will improve this aspect of inclusions too as it should make them more noticeable and appealing to stakeholders and consumers.

### Intensity of the flavour of the fudge sauce:

Much to weak/mild	A little too weak/mild	Just about right	A little too strong	Much too strong
1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

### Intensity of the flavour of the fudge pieces:

Much to weak/mild	A little too weak/mild	Just about right	A little too strong	Much too strong
1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Overall ice cream concept review:

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like nor dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>					

this concept will be... STOP

## Trial two - Concept two:

Vegan jelly tip ice cream dipped in milk chocolate

### Stakeholder feedback:

The stakeholder feedback that I received back from this concept has left me with aspects that need improving. They thought that the initial idea was really good with the jelly top and vanilla ice cream at the bottom on the stick, inspired by a jelly tip ice cream. However, my stakeholders did think that the vegan jelly needed improvements. It was icy and wasn't smooth and silky like they were expecting the jelly to be. Also possibly changing the apple flavour of juice for the jelly to something else. They thought that the chocolate coating covering the ice cream and jelly on the stick was another good addition especially since it had a blue drizzle over it. They really thought that this concept showed the Frozen theme well since there was both a blue jelly as well as a blue vegan chocolate drizzle on top.

### Stakeholder notes:

**What would they change?** Jelly less icy, flavour of jelly

**What did they like?** The chocolate dipped, blue chocolate drizzle, idea of jelly and vanilla ice cream

**What did they dislike?** How icy the jelly was – didn't freeze well, apple flavour of the jelly

**What would they possibly add?** Maybe an inclusion into the vanilla ice cream base – sprinkles? Chocolate chunks?

### Photos:

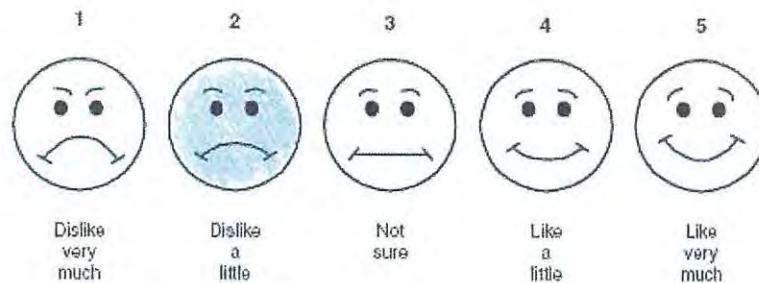


### Conclusion/next steps:

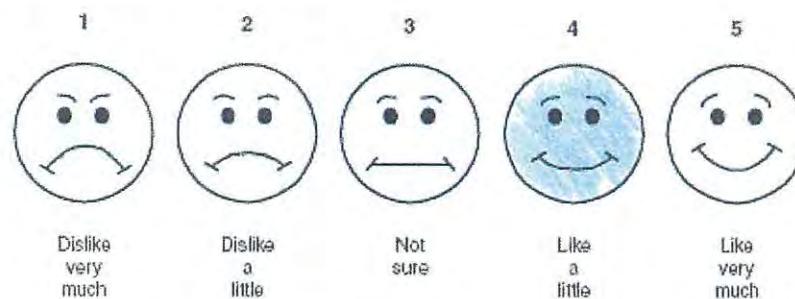
This inclusion trial of a jelly and ice cream on a stick I believe needs improvements in order to make it ready for consumers. I was expecting and hoping the jelly to freeze better than it did rather than going very icy. When making the vegan jelly I used blue food coloring, vegan gelatin and apple juice. I think in the future I will find a flavour of cordial or juice that I think will taste the best which may improve the flavour of this idea as well. This is something that my stakeholders also asked for. After a few more tests about the jelly and the best way to make one without it going icy when in a freezer, I do think that this vegan alternative for a children's ice cream could become extremely appealing to my stakeholders.

TO DO  
3601

### Consistency of blue jelly:



### Overall ice cream with hard top coating:



### Overall ice cream concept review:

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like nor dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9

the idea

### Trial three - Concept three:

Vegan ice cream sandwich with a hokey pokey ice cream and gingerbread cookie

#### Stakeholder feedback:

After receiving stakeholder feedback for concept three, overall, my stakeholders believed that it was a very successful trial with all aspects of this ice cream. They tried the honeycomb and gingerbread cookie on its own before it was added together to form an ice cream sandwich with the vanilla ice cream. They thought that the honeycomb on its own was a bit chewy and tough to eat. When the honeycomb was added into the ice cream and frozen for a few days, the shape of all the cut-up pieces held together well and did not disintegrate. However, even after the freezing process the honeycomb was still chewy, which was something they thought could be improved. They said that the gingerbread cookie was really good as the flavors were balanced and even when frozen the cookie was still easy to eat – soft chewy crunchy outside. They thought that by adding a decorative element on top of the snowflake cookie to represent the frozen them a bit more could also be another inclusion to make this concept better.

#### Stakeholder notes:

**What would they change?** Consistency of honeycomb – less chewy

**What did they like?** Overall concept, flavour of gingerbread cookie, ice cream didn't dissolve the cookie

**What would they possibly add?** Decorative element on top of the snowflake cookie

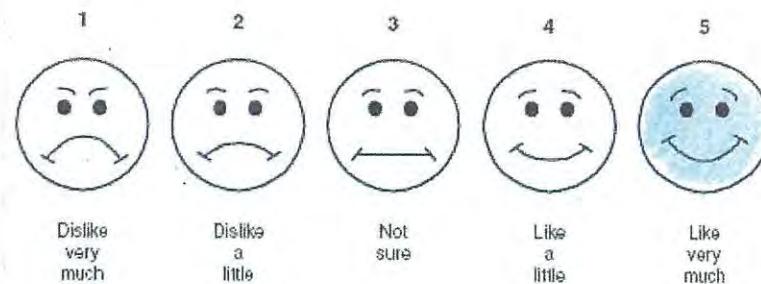
#### Photos:



#### Conclusion/next steps:

Overall, I thought that this trial was very successful with a few imperfections to improve on to make the complete ice cream really good. As said by my stakeholders, they thought that the honeycomb was slightly too chewy to eat. This would have been due to it being undercooked when heating the syrup and sugar together. I found it difficult to find a middle ground when heating it. It was hard to not over or under heat the sugar mixture before adding the baking soda in. If I can time it perfectly for the honeycomb to be less chewy and crunchier it would improve the honeycomb ice cream center. I was really happy and surprised with how the ice cream didn't soften the gingerbread cookie when the two were sandwiched together. This means that if I was to follow through with this concept, I would be able to have confidence in it working if I can improve the honeycomb.

#### Inclusion of honeycomb



#### Gingerbread cookie flavour:

Much too weak/mild	A little too weak/mild	Just about right	A little too strong	Much too strong
1	2	3	4	5
<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

#### Overall ice cream concept review:

Dislike extremely	Dislike very much	Dislike moderately	Dislike slightly	Neither like nor dislike	Like slightly	Like moderately	Like very much	Like extremely
1	2	3	4	5	6	7	8	9
<input type="checkbox"/>	<input checked="" type="checkbox"/>							

this concept will be... RECYCLE + GO

## ICE CREAM BASE TESTING:

### Test one:

#### Ingredients:

Egg replacement, full cream milk (regular), cream (regular), full sugar

I am completing this test in order to begin with an easy simple ice cream base that I can work from. I am going to use egg replacement which still gives all the same properties an egg will do in an ice cream base, just without the allergens. In this process I am going to use the Orgran Egg Replacer. In order to substitute one regular egg yolk, I will need to use 1 teaspoon (3g) of the egg replacer powder along with  $\frac{1}{2}$  tablespoon (7.5mL) of water.

This test will show me what my starting base formulation of this ice cream will be like. After completing this test, I will know possibly additions of ingredients like stabilizers or other milks I need to include to produce an egg free ice cream base that meets all specifications that have been set within the brief.

**Specifications:** creamy velvety, smooth, non-crystalline, flavour true to label, melt in your mouth, good mouth feel, egg free, scoopable, must only contain natural colours and flavorings

The appearance of my ice cream does look appealing for stakeholders as the colour is a clean white that isn't yellowy like the ice-creams that contained egg were like. When looking at it before it was rolled the texture didn't look too icy or crystalline. It is good that my ice cream had this appearance because for it to look appetizing for stakeholders to consume, it is an important aspect of my product.

When tasting my ice cream, it tasted like one of the standard Pams or Tip Top vanilla ice creams. However, it did melt very fast. This made it clear to me that higher fat content and some stabilizers are required to support the stability of the ice cream once removed from the freezer.

After completing all necessary processes for my ice cream base, I learnt that between taking my product out of the churner and into container than transferring into the freezer I need to get this stage completed faster. This is due to the formation of ice crystals that occurred giving my ice cream a grainy texture.

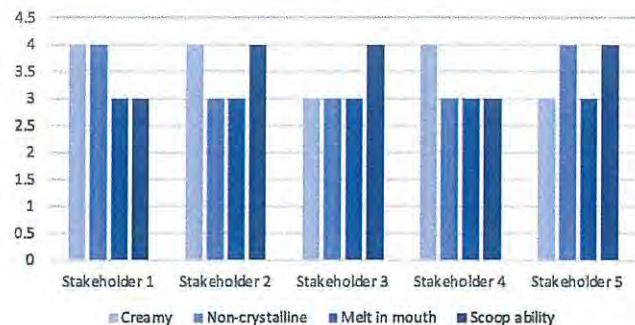


93601

### Next steps:

After thinking about inclusions and ice cream base recipes for my final ice cream product, I have decided to give myself the challenge of not only doing the egg free brief but the lactose free one too. This will mean that I will be creating a product that is vegan friendly which will appeal to many different stakeholders wants and needs.

### Test one stakeholder feedback



### Test two:

#### Ingredients:

$\frac{1}{2}$  LGB,  $\frac{1}{2}$  Xanthum, egg replacement, full sugar, coconut cream (green can), coconut milk (blue can)

After disassembling existing products, they most commonly used stabilizers are Xanthan gum, Guar gum and locust bean gum. To test the function of stabilizers I conducted a variety of tests. I used the same formulation and process, changing just the one variable for the stabilizer. I am interested specifically in the texture.

**Xanthan gum:** is a binder that is used in ice cream to help enhance the mouthfeel and creaminess to the texture. It also helps to prevent the formation of ice crystals, which is key to a rich, smooth and creamy ice cream

**LGB (locust bean gum):** is a water soluble and is a thickener and stabilizer for many products such as dairy products

**Guar gum:** prevents the formation of crystals in frozen foods like ice creams and it also extends the shelf life of the ice cream

I am testing this product in order to find out if my vegan vanilla ice cream base needs stabilizers such as LGB and Xanthum to increase the creaminess, provide good resistance to melting, prevent the growth of ice crystals and as a support ingredient with the viscosity of the ice cream base.

I am hoping that this test will give me a clear idea about if the stabilizers that are present within the egg replacement as well as the addition of 2 other stabilizers, from a creamy smoother ice cream that meets all specifications set within the brief. I will be able to recognize this if the ice cream produced has too many stabilizers as it will result in a gummy ice cream that has a chewy mouthfeel.

This test will be followed with another test which will include the stabilizers. By completing both of these tests and comparing them it allows me to identify what the level of stabilizers that is required within my ice cream is needed in order for an ice cream to be produced that is nor under or over stabilized.

93601

### Evaluation:

The appearance of this ice cream wasn't too bad but still could have looked better. I think that if I smoothed the ice cream down before going into the freezer it would have had a more appealing appearance. The coconut milks and creams it gives the ice cream a grey toned colour. Once I finalized my ice cream base that may still use grey toned coconut milks and creams, I could look into other ingredients that may be able to bring the ice cream to a whiter colour which may appeal to my stakeholders more. The scoop ability of this ice cream was poor as when attempting to roll it with the ice cream scoop it was very chalky and broke apart very fast. This would mean that there are too many stabilizers present within this ice cream now.

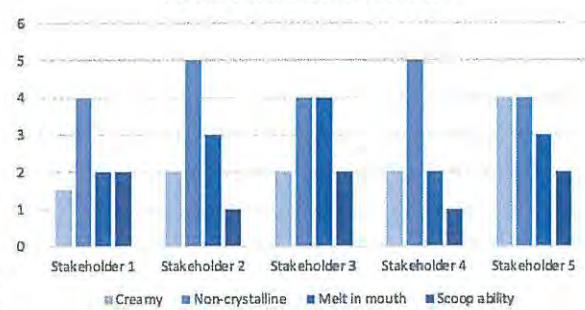


### Next steps:

From this trial I have learnt that the addition of stabilizers LGB and Xanthum Gum are not necessarily due to the presence of the egg substitute.

I am now going to complete a test without the addition of extra stabilizers. This will show me whether or not the stabilizers that are present within the egg replacement are enough to support the overall stability of the ice cream base. By doing this test, I am hoping it will become clear about whether or not it is necessary to include a  $\frac{1}{2}$  stabilizer or if no additional stabilizers will be okay. Without the addition of too many stabilizers it should improve the scoop ability of my ice cream. For future testing if I go forward with using a coconut milk along with a coconut cream, I may look at different ways possible for whitening the ice cream to remove the grey tones coming from the coconut's milks and creams.

Test two stakeholder feedback



### Test three:

#### Ingredients:

Egg replacement, no stabilizers, full sugar, coconut milk (blue can), coconut cream (green can)

I am testing this product to see whether or not the stabilizers that are present within the egg replacement are enough to support the stability of the vegan vanilla ice cream base. Neither of the coconut milks or creams have any stabilizers present however the coconut cream does have quite a high fat content so it will be interesting to see if this makes any difference to the ice cream without any obvious stabilizers being included in the formulation.

The reasoning for this test is to compare results from this test without stabilizers and the test that did contain stabilizers. By doing this I am hoping to find a middle ground for the ice cream base in which I will not have an over or under stabilized ice cream.

93601

From completing this trial, I am hoping that this test will give me a very good indication about if my ice cream base requires additional stabilizers other than the ones that are present in the egg replacement to create a base which doesn't have the chewy gummy mouth feel like the ice cream base that contained extra stabilizers did.



#### Evaluation:

The appearance of this ice cream was very much like the previous test that included all of the same ingredients however the only change to this trial was the removal of stabilizers. When attempting to roll this ice cream with the scoop, it was very chalky. However, even with a scoop ability result that needs improving, the overall texture of the ice cream was definitely better without the addition of extra stabilizers that were tested in the previous test.

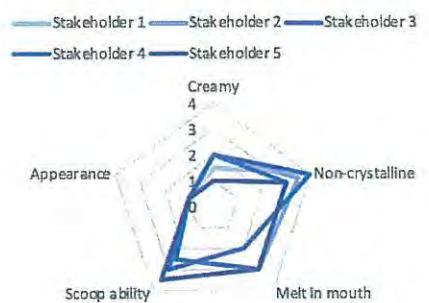
Stakeholders thought that the overall mouthfeel of the ice cream could be improved slightly by increasing the total fat content that was present within the ice cream between the milks and creams. With a higher fat content in an ice cream it gives a richer and creamier mouthfeel for consumers.

By ensuring that I have added in the correct quantities of salt when first mixing my ice cream base, along with making sure I am transferring the ice cream from the churner into a container to go into the freezer, I should prevent ice-crystals from forming therefore giving the ice cream a icy/grainy texture/mouthfeel.

#### Next steps:

After completing this I now need to look at completing a test that will compare fat contents in the coconut cream, so the overall texture, mouthfeel and scoop ability attributes of the ice cream are improved. I think that I will start with a test which will have a higher fat content within the coconut cream. I will see if this makes any changes to the overall taste and texture of my ice cream then make further changes from then if necessary.

#### Test three stakeholder feedback



#### Test four:

##### Ingredients:

No stabilizers, egg replacement, full sugar, high fat coconut cream, coconut milk

I am testing this product in order to see if a higher fat content within a coconut cream supports the overall texture of the ice cream. By increasing the fat content that will be in my ice cream, I should expect my ice cream to become creamier and richer. Fats also have the ability to act as a stabilizer as they can form air bubbles which infuse within the ice cream a slow the melting

93601

process down once the ice cream has been removed from the freezer. The differing fat contents of the ice cream also support the enhancement of the flavour of the ice cream.

I am hoping that this test will give me some answers about if a higher fat level within the coconut cream makes a big difference to the overall texture of my ice cream. Does it improve it for better or for worse? Does it make it creamier than when a regular coconut cream is used? Does it give the ice cream a better overall mouthfeel?



#### Evaluation:

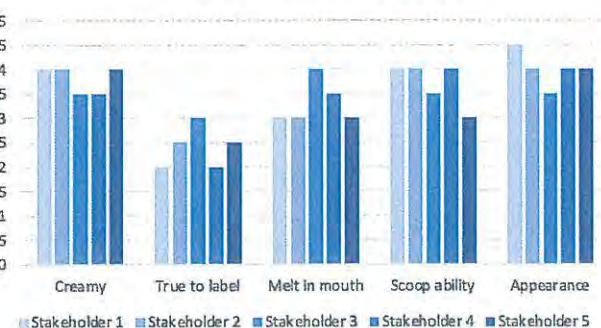
The appearance of this ice cream was a lot more appealing than those of previous tests. This was because the colour of the ice cream wasn't quite as grey as it had been. By using a coconut cream that had a higher fat content, it created an ice cream

that melted in the mouth a lot better than those with a lower fat level. However, the only stakeholder feedback that I received that could support my ice cream base is that it may be slightly too creamy and lingers on tongue too much. This would mean that further tests with varying levels of fat in both the milks and creams would be necessary to formulate a final ice cream base. Another point of feedback I received was how the ice cream does have a very strong coconut flavour even with a vanilla essence incorporated. I may look at using a vanilla bean paste in my next testing that should have a stronger vanilla taste to cancel the coconut out as much as possible.

#### Next steps:

- What coconut milks and creams with different fat levels can I use to formulate an ice cream that melts in the mouth but doesn't linger with a creamy taste.
- What vanilla paste/essence would be best for me to use to try and overpower the coconut flavour that is present within the ice cream
- How can I improve the scoop ability, so the ice cream rolls perfectly and doesn't break away?

Test four stakeholder feedback



#### Test five:

##### Ingredients:

Egg replacement, ½ sugar, ½ glucose, ½ LGB, hemp milk, coconut cream (green can)

I am testing this product to see whether or not a different milk that is not coconut makes a difference in the texture, flavour, mouthfeel and overall ice cream taste. I have chosen to use hemp milk because due to it being another alternative vegan milk to use it is having several health

93601

benefits and was another milk, I thought would be worth testing. Within this test I have also chosen to add half the quantity of stabilizers that I used in test two in an attempt to try and find a middle ground for the quantity of stabilizer so an ice cream will be produced that is not gummy or chewy. My final change to this ice cream base is instead of using full sugar, I have decided to go half glucose and half sugar. I have made this change because when liquid glucose is added to the ice cream base, it helps control the formation of sugar crystals as well as preventing the ice cream from freezing solid making it harder to eat.

I am hoping that this trial will give me a clear indication of whether or not using a more natural milk may cancel the strong coconut flavour out and make the vanilla taste stronger and more obvious when stakeholders test it. When using hemp milk, due to differing fat levels compared to the coconut milks previously used, it will be interesting to see if it makes much of a difference too.

**Specifications:** creamy velvety, smooth, non-crystalline, flavour true to label, melt in your mouth, good mouth feel, vegan, scoopable, must only contain natural colours and flavorings

Stakeholder feedback that I received from this test was that they all preferred the taste that the coconut milk brought to the ice cream rather than that of the hemp milk. The hemp milk gave the ice cream a very earthy taste and mouthfeel which didn't appeal to stakeholders. This means that it became a product that was no longer socially acceptable. They also said that there was no taste of vanilla that came through the flavour of hemp and coconut. This is an aspect of my ice cream that I need to look into to improve the flavour true to label specification.

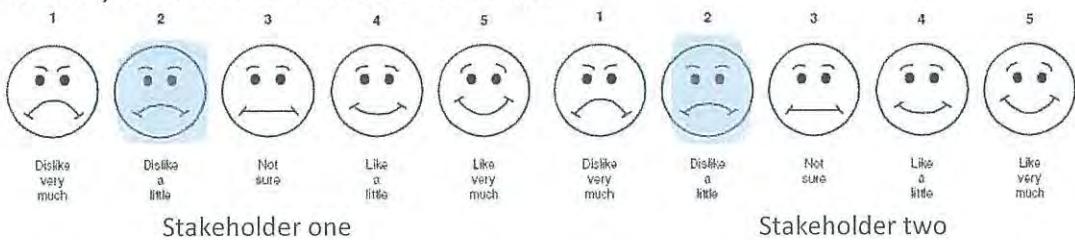
The mouth feel of this ice cream was very thick and didn't melt on the mouth as well as previous tests had done. This may be due to a change in the fat level of the ice cream due to the replacement of coconut milk with hemp milk.

**My decisions about this trial due to sensory feedback that I received is that I will scratch this whole idea of using a different milk that isn't coconut. This is because it brings in new flavors into the ice cream, many of which are not socially acceptable.**

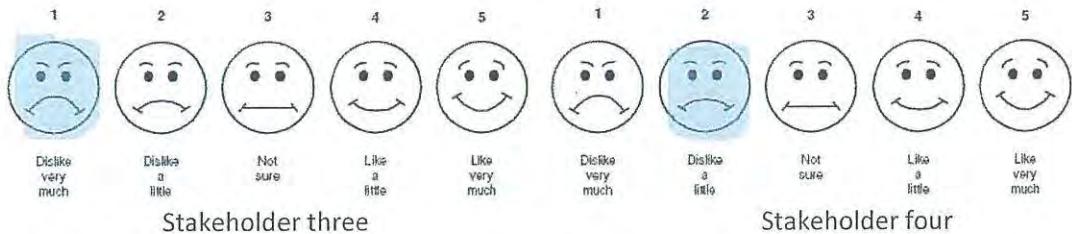


#### Stakeholder feedback:

How do you feel about this overall ice cream?



93601



*How did you find the vanilla flavour within this ice cream?*

Much too weak/mild	A little too weak/mild	Just about right	A little too strong	Much too strong
1	2	3	4	5
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Much too weak/mild	A little too weak/mild	Just about right	A little too strong	Much too strong
1	2	3	4	5
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Much too weak/mild	A little too weak/mild	Just about right	A little too strong	Much too strong
1	2	3	4	5
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Much too weak/mild	A little too weak/mild	Just about right	A little too strong	Much too strong
1	2	3	4	5
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Stakeholder one

Stakeholder two

Stakeholder three

Stakeholder four

The coconut milk and cream I have decided to use is the trident light coconut cream with a fat percentage of 10.5g per 100mL along with the Ayam coconut milk that has a fat percentage of 24.3g per 100mL because after testing high and low-fat contents with both milks and creams, I was able to decide that using a higher fat milk produced better results when accompanied with a low fat cream. The use of a low-fat cream gave the ice cream a good mouthfeel as it was too creamy that it lingered on the tongue for too long.

### Why is testing fat important?

When testing the different fat contents within both coconut milks and creams it allowed me to make decisions about which were going to be the most appropriate to use in my ice cream base. Each coconut milk/cream had varying fat contents ranging from high to low with some containing additional stabilizers impacting the final result of ice cream. Fat is important in ice cream because fats have the ability to form air bubbles when infusing ice cream mixture by reducing surface tension between water and air. Aromas are also absorbed by fats within the mixture. When finding coconut milks and creams that have the correct fat contents an ice cream that will meet the specifications set from within the brief and desired attributes will be met.



Ayam coconut cream  
270mL

No stabilizers  
Fat: 28.5g per 100mL



Pams coconut cream  
560mL

Stabilizer 466 & 412  
Fat: 21.0g per 100mL

93601



Fia Fia coconut cream  
400mL

Stabilizer 466 & 412  
Fat: 25.0g per 100mL



Trident coconut cream  
400mL

Stabilizer 466 & 412  
Fat: 10.5g per 100mL

Nutritional Information

Serving size: 9.8g Serving size: 250mL

Nutrient	Per Serving	Per 100mL
Energy	728J	1024kJ
Calories	173kcal	251kcal
Protein	1.6g	2.4g
Fat, Total	17g	24.3g
Saturated	15.7g	21.5g
Carbohydrate	2.7g	3.9g
Sugars	1.1g	1.6g
Sodium	17mg	26mg
Gluten	not detected	not detected

Ayam coconut milk  
270mL

No stabilizers  
Fat: 24.3g per 100mL

Jelly inclusion – concept two trial:



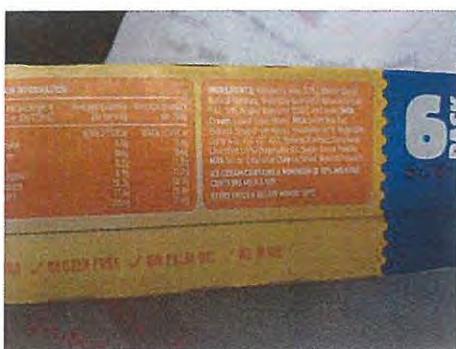
Ice crystals present in the jelly

What causes the jelly to go so icy?

- ⇒ Stabilizers?
- ⇒ Certain ingredients?

*How can I make a smooth, melt in mouth vegan jelly?*

Existing jelly's:



Jelly tip ice cream

- Vegetable gum (401, 412, 410, 407, 401)
- Acidity regulator (330)
- Emulsifier (417)

*Not vegan – contains gelatin*

93601



### Weight watchers jelly crystals

- Acidity regulator (330)

Not vegan – contains gelatin



### Greggs jelly crystals:

- Food acid (330)
- Acidity regulator (331)

Not vegan – contains gelatin

Vegetable gum 401 = sodium alginate

Vegetable gum 412 = guar gum

Vegetable gum 410 = locus bean gum (LGB)

Vegetable gum 407 = carrageenan

Acidity regulator 330 = citric acid

### What is sodium alginate?

- ⇒ Extract from brown seaweed
- ⇒ Used as a stabilizer
- ⇒ Acts as a thickener and gelling agent – forms heat stable gels

When sodium alginate is added to a liquid it acts as a thickener and therefore forms a gel like substance. Cold gelling agent that needs to heat to gel

A molecule also known as 'hydrocolloid' or a gum due to its ability to gel water. Unlike other hydrocolloids (gelatin or starch), alginate only thickens water-based substances in the presence of ions like calcium.

**H** [REDACTED] **L** [REDACTED]: business development manager at Hawkins Watts New Zealand. Hawkins Watts NZ is a company that provides many world leading ingredient companies with broad productive portfolios. Specializing in... hydrocolloids, emulsifiers, flavorings, colour etc... Following researching the company, we emailed him to find out more about sodium alginate and possible replacements in order to make the jelly.

93601

From: [REDACTED]  
Sent: Tuesday, 26 May 2020 9:39 am  
To: [REDACTED] <[REDACTED]@hawkinswatts.com>  
Subject: Food Technology help

Good morning,  
I am a Food and Processing Technology student at [REDACTED]. My teacher Mrs [REDACTED] has sent me your contact for some advice and help regarding a specific stabilizer/emulsifier. I am working on a project where I am trialing and testing vegan ice cream inclusions. One of which is a jelly. I am wanting to develop a jelly with the consistency of that in a Jelly Tip ice-cream. I have disassembled the ingredients in Jelly Tip and they are: E401 – vegetable gum – sodium alginate, and acidity regulator 330. We have a supply of the citric acid, but are trying to source the sodium alginate so we can do some trialling and testing. Would it be possible for us to purchase a small quantity through you, or can you suggest an alternative supplier, or an alternative product we could use?

Thank you so much

Kind regards,  
[REDACTED] and [REDACTED]

Hi guys,  
I can send you a sample to make a cold set jelly. I made a cold set Jelly using 100ml of water to the mix below. It begins to set within 1 min, gives an awesome, gelatine like set jelly. The mix for jelly tip will be higher sugar and less alginate.

SUGAR COLD SET JELLY	
Manugel L80 algin	1.7
Citric acid anhydrous	0.6
Sugar	13.5
P2274 Purple corn or Black corn	0.05
283202 Blackberry flavour	0.15
	15.9

} Cold set jelly without sodium alginate

Kind regards

H [REDACTED] Business Development Manager

COVID-19 Statement: Hawkins Watts is open as normal, but subject to strict hygiene and distancing protocol. We have some of our team working remotely on a rotational basis. Please contact us in advance if you wish to visit onsite so that we can safely arrange this.

- Manugel L98 algin – gelling blend
- Citric acid anhydrous – citric acid: used to maintain stability of the active ingredients

85g water

85g jelly

25ml water

85g water

85g jelly

100°

*Attempted cold set jelly formula:*

1.7g jel-it-in

0.5g citric acid

13.5g sugar

0.05g colour

0.15g flavour

Or would a  
gummy bear  
work better?

### Jelly inclusion trials:

#### Trial one: GUMMY VS JELLY?



Melt in mouth feel  
Post freezing jelly

- Jelly was still icy – but improved consistency
- Had a good flavour – strawberry (however except more flavoring could improve concept)
- Stakeholders believe that the jelly will add a refreshing flavour/taste to the ice cream
- Did stick to the tongue



### ***Stakeholders testing gummy and jelly***

- Stakeholders thought that the gummies were too tough to have on an ice cream
- Their taste compared to the jelly wasn't as nice for mouthfeel

### ***Stakeholders preference of gummy or jelly?***

- This photo gives a clear indication of stakeholder's preferences between both trials
- After receiving feedback from several people, it was clear that everyone enjoyed the jelly a lot more

### **Trial two: JELLY TRIAL 2 IN ICE BLOCK MOLDS**

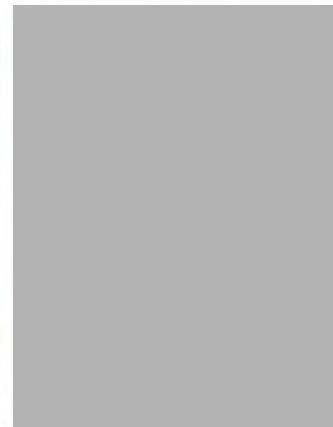


*Second trial of cold set jelly:*  
⇒ Lower quantity of water = should result in a less icy jelly

- Used a blue jelly along with a white to test the social acceptability of making jelly that is not coloured red = blue to represent frozen theme

#### ***Stakeholder feedback:***

- They like the difference of colour from the standard red jelly that we are typically used to
- Flavour was much better as a stronger strawberry taste was emphasized
- Reminded them of a lemonade ice block



93601

### Jelly tip trial two:

Improved jelly recipe and improved ice cream base



### Stakeholder feedback:

Stakeholder feedback from this design gave me a clear idea of improvements required if I wish to move forward with it. Stakeholders that have been involved have been able to see the progress that I have been trying to make within this concept. However, they still believe that this jelly still has more work that could be done to make it even better. They thought that it held on the tongue when eating, was still slightly icy, but the strawberry flavour that it had was super yum. Even though I changed the colours of my jelly tip from a traditional red jelly to a trial between blue or white, I all got positive feedback from that. They liked the difference that the blue/white jelly had which they said, "*would make it stand out on the market*" "*represents the frozen theme well.*" All stakeholders like the chocolate coating that the ice cream and jelly had as it gave a sense of crunch before getting into the middle.



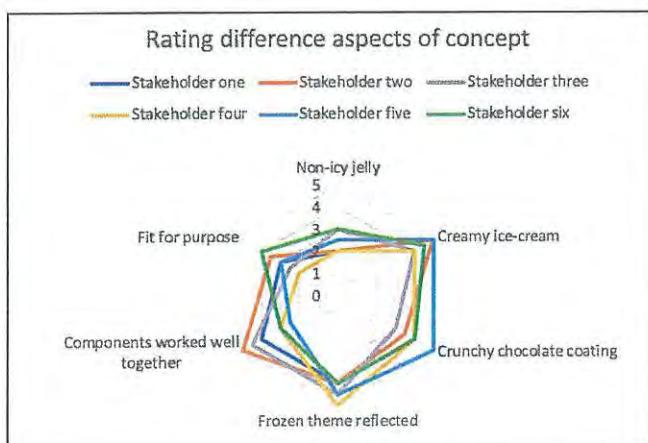
### Conclusion/next steps:

Even with ongoing testing with the jelly to work on improving its qualities and attributes, I am slowly getting to a smoother, silkier jelly but it is difficult especially when the jelly is a cold set and is water base. This makes it hard as it increases its chances of freezing when being put into the freezer. I started off with a very icy jelly, however, in this trial my jelly is much better and has turned into a very refreshing element of my concept that stakeholders quite like. But is it possible with the available resources to make a jelly that has all the properties and attributes a regular jelly tip ice cream would have? I was really happy with the consistency and texture that my ice cream had this trial around. With the use of the high fat coconut milk and a low-fat coconut cream along with a half glucose, half sugar formulation, it



made a vegan ice cream that met all specifications that had been set within the brief. It accompanied the jelly really well as it gave it a nice summer feeling from the refreshing sense.

If I were to choose this concept to move forward to develop even more, I would need to look into another jelly recipe or stabilizers/other ingredients that may prevent the jelly from freezing and going icy while in the freezer. Another idea I had was to maybe change the jelly to a marshmallow. By doing this it may create a better texture rather than having an icy jelly tip?



DECISION (see decisions chart) STOP...

### **Ice cream sandwich trial two:**

Improved ice cream base - more vanilla less coconut

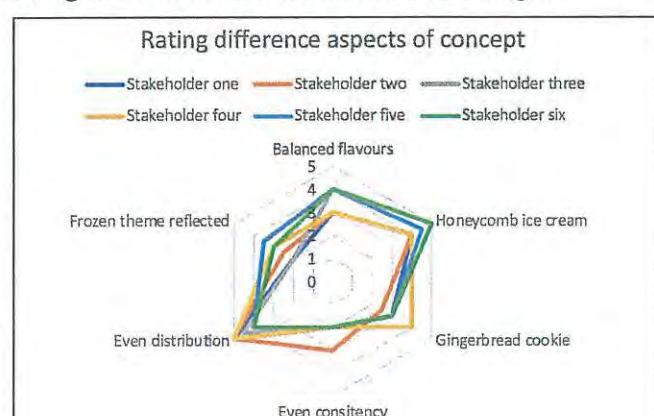
#### **Stakeholder feedback:**

From the stakeholder feedback that I received from this trial gives me a much clearer idea of what I think that I will work towards for my final concept idea. The overall feedback was positive and with a few changes it could make my vegan ice cream sandwich really good. Their first pieces of feedback were how they thought that the gingerbread cookie was too thick for the overall sandwich. It left the concept being very overpowered by the cookie and it was hard to identify the ice cream that contained the honeycomb. They thought that if the ice cream may have been slightly thicker it could have improved the concept too. By improving the thickness of both the ice cream and cookie it should balance out the flavors well. When testing the ice cream on its own, my stakeholders thought that it wasn't overpowered by coconut, so the vanilla bean paste toned it down slightly. They thought that there may be other ways to improve the frozen theme for this ice cream too. Possibly adding a snowflake decal. Dipping it in chocolate?



#### **Conclusion/next steps:**

Even though this trial is getting better and better each time I complete it there is still room for improvement to make it ready to be sold on supermarket shelves. I was happy with the way the overall concept freezes – gingerbread didn't freeze, and hokey pokey hadn't dissolved completely. However, I was finding it difficult to know how thick the cookies have to be rolled. Next time, I will just need to make sure I roll them a lot thinner, so it works better with the overall concept. After some thinking about this concept, looking at stakeholder feedback and doing a little bit more research into existing vegan products that are in the market already, I have decided to slightly alter this concept one more time to meet this idea. The changes that I am going to make for further development will be inspired by a classic kiwi favorite cookie. The mallow puff. My ice cream sandwich will have a thin gingerbread cookie base at the bottom. This will then be topped with a thin marshmallow layer. And finally, the hokey pokey ice cream will go on top of all this. I think that I will coat the full ice cream in chocolate to support its



93601

structure to hold together. I will also add a snowflake decal on top of this snowflake shaped concept. After explaining this concept idea to my vegan stakeholder [REDACTED], she thinks it sounds like such an awesome idea especially since there is a gap in the market for any products like this.

### Inclusion processes:

#### GINGERBREAD COOKIE:



#### Collecting ingredients:

- ⇒ Accurate measuring
- ⇒ Expiry/used by dates

- ⇒ Are these ingredients safe for consumption?
- ⇒ Are all these ingredients vegan and practical for use?

#### Preparing batter:

- ⇒ Mix all ingredients following recipe instructions
  - ⇒ Form a dough and roll onto a floured surface
  - ⇒ Making sure all ingredients are combined fully
- 
- ⇒ Were all of the ingredients combined properly?
  - ⇒ Was a dough formed well enough, so it holds its shape when getting kneaded?



#### Baking cookies:

- ⇒ Roll dough out to an even thickness and cut star shapes out using a cookie cutter
  - ⇒ Place on oven tray and bake in preheated oven
- 
- ⇒ Was my oven preheated to the correct temperature?
  - ⇒ Was the dough rolled evenly so all cookies had the same thickness?



**FINISHED COOKIES**

93601

## HONEYCOMB:



### Collecting ingredients:

- ⇒ Accurate measuring
- ⇒ Expiry/used by dates
- ⇒ Are these ingredients safe for consumption?
- ⇒ Are all these ingredients vegan and practical for use?

### Preparing honeycomb:

⇒ Pour sugar and golden syrup into a pot



⇒ Heat on medium heat until all sugar has dissolved and an ember colour is formed

⇒ Was the pot large enough for when baking soda gets added?

⇒ Was the pot kept on a medium heat and stirred constantly to avoid mixture burning?

⇒ When mixture is melted, let it bubble for a few minutes

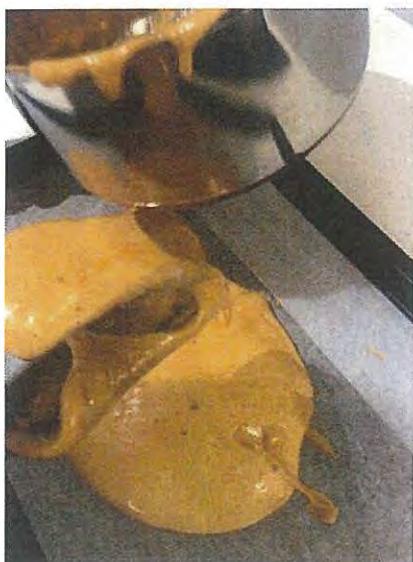
⇒ Add baking soda, stirring fast then pour into tray and let sit

⇒ Was the mixture properly melted before baking soda was added?

⇒ Was it transferred from a pot to baking tray fast enough to avoid it losing its honeycomb texture?



## FINISHED HONEYCOMB



93601

### **Ice cream base formulation:**

Ingredients:	Weight:	Percentage:
Sugar	70g	7.79%
Glucose	70g	7.79%
High fat coconut milk	330g	36.72%
Low fat coconut cream	410g	45.62%
Vanilla bean paste	3g	0.33%
Salt	0.7g	0.08%
Egg substitute	15g	1.67%

With initial testing being a homemade recipe using snowy churn I had to develop a formula with temperature control points to create an ice cream that met all premium attributes using proper ingredients and processes. This also required the use of a self-refrigerating commercial churn.



**Collecting ingredients:** All ingredients were thoroughly checked, including best before and use by dates making sure all ingredients were safe to use.

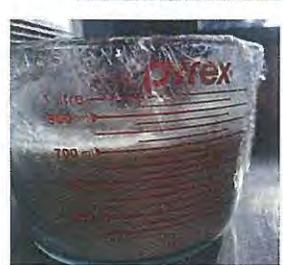


**Pasteurization:** Heating the milk and cream until a temperature of 82°C while stirring constantly. Once the temperature was reached, milk and cream were removed off heat and I waited for the temperature to drop to 60°C before continuing. Temperatures required to be meet so any dangerous bacteria are destroyed.



**Egg substitute and sugars:** While waiting for temperature of ice cream to drop, whisk egg substitute with sugar and glucose so a paste is formed. When temperature of milk and cream reaches 60°C, pour small amount of liquid over egg substitute and sugar while stirring.

**Heating:** Return new mixture onto heat adding in salt and vanilla bean paste. At 79.5°C temperature will be held there for 15 seconds before pouring mixture into glass bowl and covering with a labelled glad wrap skin.



**Aging:** By aging the ice cream it often creates a more stable foam during the churning process since the ice cream base is refrigerated at 4°C overnight.

Base is given time to mature before churning and freezing. Gives stabilizers and emulsifiers time to settle improving texture, smoothness, stability of final ice cream. Individual fat particles have time to partially solidify with surfaces getting covered by proteins.



**Churning & freezing:** After mixture has aged, transfer to an ice cream churner and churn for 30 minutes at -5°C. After churning time is completed, pour mixture into labelled container and freeze at -20°C, until ready to serve.

Enhancement of the emulsion and dispersion of fat in ice cream is improved when base is churned at heightened temperatures. Fat molecules that are evenly distributed give thinner base that can capture air more effectively.

**HIGH FAT COCONUT MILK & LOW FAT COCONUT CREAM = creates a better mouthfeel and taste as it sits on tongue much better**

## Decisions chart:

Concepts	I think...	My stakeholder thinks... (stakeholder feedback)	What next? Go, stop, recycle, hold
Concept one Vegan ice cream sandwich  Hokey pokey ice cream with a gingerbread biscuit	I think that this ice cream concept has a lot of potential with a few improvements and changes to make it more suitable within the current market. There were issues with my gingerbread cookie being too thick compared to the ice cream. This mean that the flavour of the gingerbread overpowered the freshness and chill the ice cream came. Even though the hockey pockey melted slightly throughout the ice cream, it gave it a nice caramel flavour which was another added bonus as it complimented the gingerbread flavour well. If I were to continue with this concept, I would need to work on the thickness of both the ice cream along with the ice cream layer that contained the honeycomb. I also think that if I were to either tip possibly half of the sandwich into either white or milk vegan chocolate or even have a small snowflake detail on the top. By doing these two changes it should make my ice cream concept more appealing to younger stakeholders as the frozen theme would be reflected more.	<ul style="list-style-type: none"> <li>Gingerbread cookie was too thick, so it overpowered the ice cream flavour and aspect</li> <li>The ice cream had a really good taste and all coconut flavor was masked not only by the vanilla paste</li> <li>Honeycomb gave a nice caramel taste to the ice cream sandwich</li> <li>Proportion sizes were maybe slightly too big for a child</li> <li>If it had a chocolate element (maybe being dipped in chocolate) could be a good addition – may appeal to children more</li> <li>All flavors worked really well together and complimented each other</li> </ul>	Recycle  Marshmallow? Change shape?
Concept two Vegan jelly tip ice cream	I think that this ice cream will fill a gap that is present within the market for a vegan jelly tip ice cream. With the improved jelly recipe, the taste, texture, mouthfeel I feel like it has produced a jelly that compliments the taste of the ice cream well. It gives the jelly tip ice cream a refreshing sense to it. But my only issue I faced with the jelly is how it is still slightly too icy rather than smooth like a typically jelly would be like. It is hard to find the right recipe that will create a jelly that becomes smooth and silky rather than icy and rough on the tough. It will have something to do with the water quantity within the jelly. This was an issue I have had for most of my trials. Even though it is slowly getting better, it is still appearing to be challenging to perfect this jelly. Some positives from this jelly trial was that how well the strawberry flavour of this trial was. This flavour worked really well with the ice cream which had all qualities of a premium ice cream. I also thought that the blue and white colour of the jelly looked really good and were socially acceptable as they reflected the frozen colours really well.	<ul style="list-style-type: none"> <li>Jelly held on tongue after eating – possibly caused because of the iciness</li> <li>The strawberry flavour was really good as it tasted very similar to a classic jelly tip jelly</li> <li>The blue and white colours looked really cool, will make your product stand out from others because it is different</li> <li>Jelly slightly too icy – if iciness was fixed the jelly would have a really good taste</li> <li>The jelly along with the ice cream worked really well together – felt super refreshing</li> <li>Could add a snowflake chocolate to the top or another aspect to show the frozen theme more</li> </ul>	Stop

93601

### Critical Reflection:

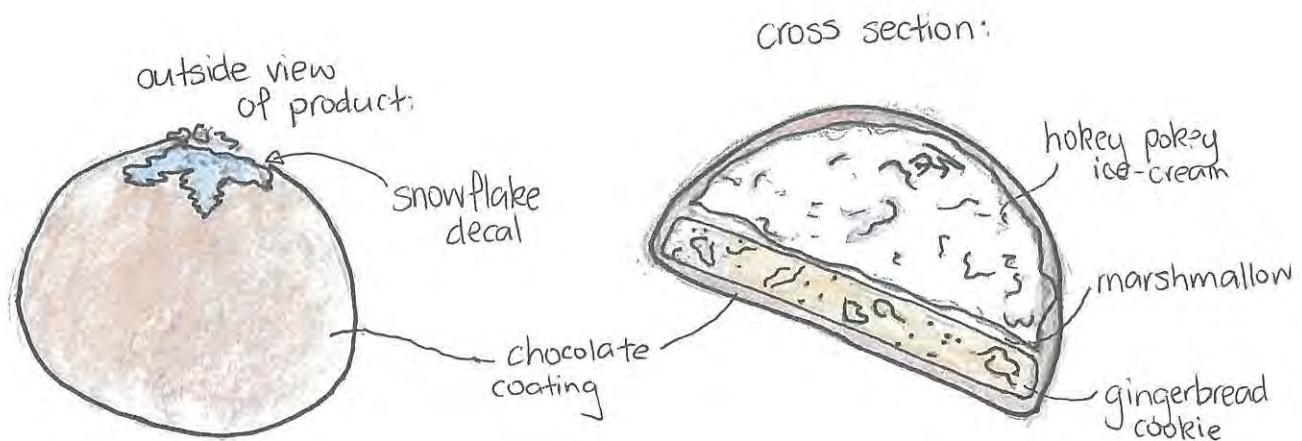
#### Change from star shape to mallow puff

While each individual component of the prototype worked really well together flavour wise, the product was not technically feasible. The gingerbread cookie layer that sat at the base of my ice cream gave the product a spicey/gingery taste which evened out the sweetness that came from both the marshmallow layer that followed, then finally the ice cream. The hockey pockey ice cream gave the product a caramelly flavour with the honeycomb chunks slowly melting into a caramel. This ice cream gave the whole frozen dessert a refreshing taste. Due to this whole frozen dessert being coated with chocolate, it meant that there was an element of surprise people experienced before knowing what's actually inside. The chocolate held together all three layers preventing it from falling apart. Stakeholders loved the concept and the taste. But the product did not look professional. I couldn't enrobe the star shaped cookie easily -and it was very difficult to get a consistent product. The shape was clearly the problem.

Stakeholders thought it had the potential to do well, but in "another" form.

### THE "LIGHTBULB MOMENT!!!"

Not wanting to via too much from the original concept, I brainstormed ideas about how to progress. I decided that a snowflake decal could be used to portray the theme, and if I changed the shape to a dome – very similar to the original mallow puff, the production would be very simple. This would enable quality assurance.



By making dome shapes rather than stars, it becomes more technically feasibly as time, money and resources are now being saved and a much cleaner final product is being produced. To form these dome shapes, I used a silicon mold and put chocolate on outside before filling with biscuit, marshmallow and ice cream. I topped these dome shaped ice creams with a small blue snowflake so the frozen theme could still be replicated and noticed by stakeholders.

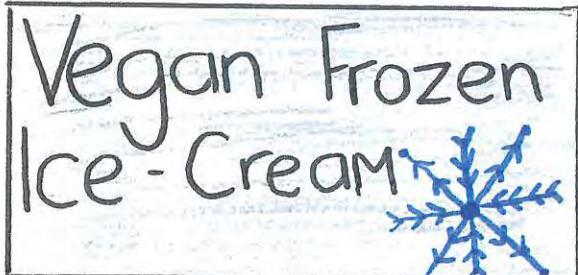
I used the same formulations and processes to complete several trials – mainly tweaking the technique.

93601

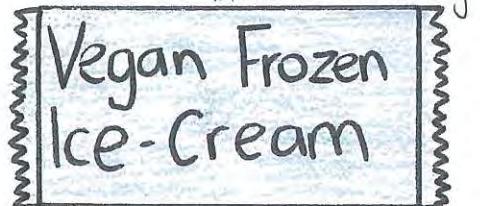
Packaging:

Idea one: rectangular box

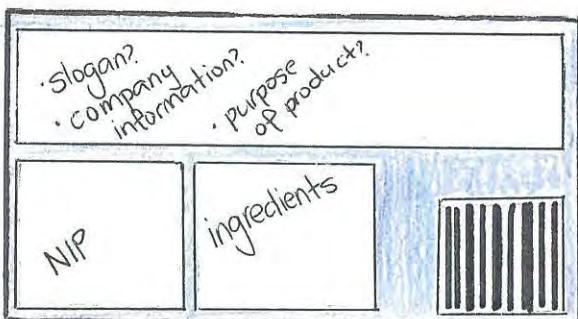
→ easy for packing  
in supermarkets  
→ sturdy, functional,  
stable.



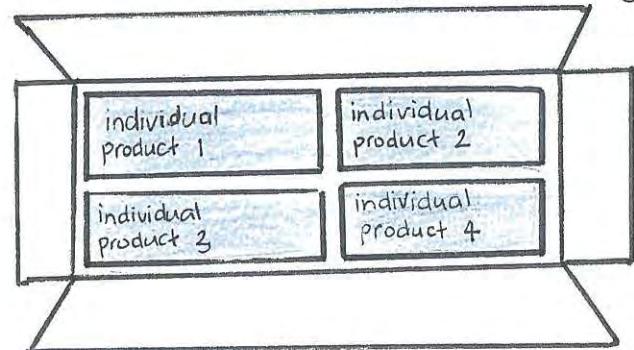
Front



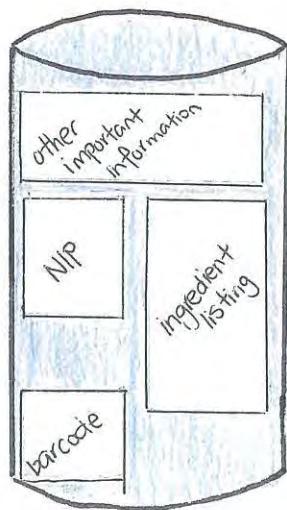
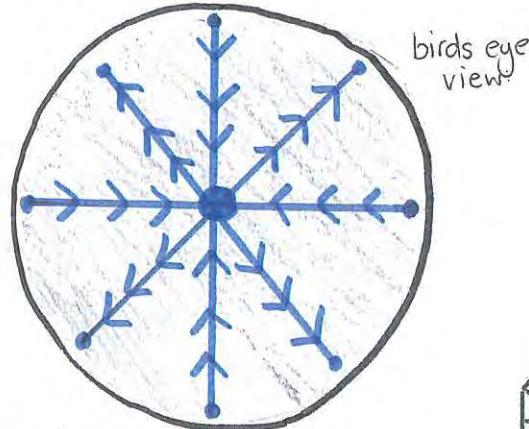
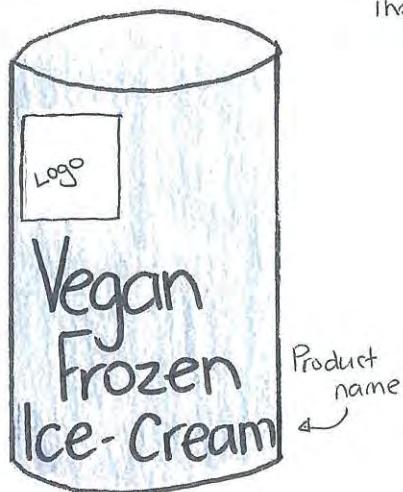
inside of packaging



back



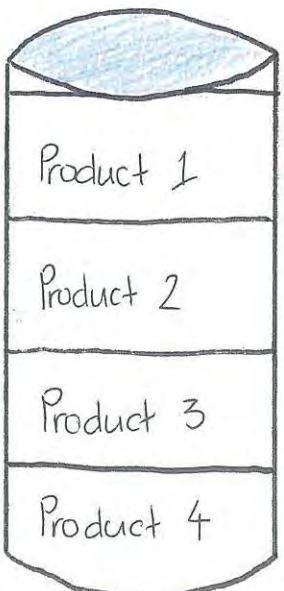
Idea two: cylinder box → Contains 4 individual servings.



information spread  
out across box.



cross section  
of packaging:  
each on top  
of each other  
up the cylinder



93601

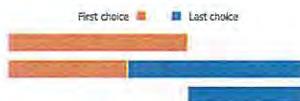


## Stakeholder feedback from packaging ideas:

1. Please rank the packaging ideas from most favourite to least favourite

[More Details](#)

Rank	Options
1	Idea one
2	Idea two
3	Idea three



5. What do you think of packaging design idea one, the rectangular box?

[More Details](#)

6  
Responses

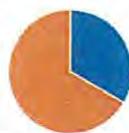


4.67 Average Rating

2. Would you prefer the background to be...

[More Details](#)

Blue and white	2
Silver and white	4



6. What did you think of packaging design idea two, the cylinder tube

[More Details](#)

6  
Responses

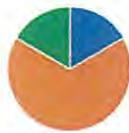


3.33 Average Rating

3. Do you think a window within the packaging would be ideal?

[More Details](#)

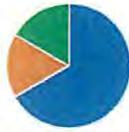
Yes	1
No	4
Maybe	1



4. If an image/clipart was on the front of the package, what would you like?

[More Details](#)

Snowflake	4
Snowman	1
None of the above	1
Other	0



### Conclusion:

After receiving stakeholder feedback about all three designs ideas for my packaging I have been able to decide to go ahead with a rectangular packaging shape. This packaging will contain 4 individual ice cream sandwiches, each individually wrapped. This allows my product to become family friendly and practical within supermarket shelving along with at home freezers. My stakeholders believe that a silver background would be a good representation of my frozen them along with a snowflake image on the front of the packaging. I was thinking to use a blue snowflake backdrop for the individual ice cream packaging within the box. I also asked them a question about if they thought a window would be a good idea within the individual boxes that go into petrol stations and dairy for a single serving. However, they didn't believe that this was necessary which I guess will be better for advertising the product now since it isn't inside a 4 pack box. I am going to ensure that my packaging will have clear easy to read information which I need to make sure will not be over crowded in one area as it will prevent it being extremely eye catching to consumers. By using the right colours and images it should portray the frozen them well to children therefore making it a popular product.

### My packaging will:

- Be a rectangular box that will be able to fit four individual ice creams
- Eco friendly
- Represent the frozen theme accordingly (blue, white and silver colours)

93601

- Contain relevant information that informs consumers about the necessary aspects of the ice cream (NIP, ingredients etc.)
- Have a clear logo – business and product name – informing consumers what the product is
- Appeal to children so they can request purchase from caregivers

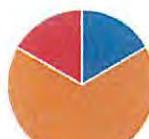
**Logos:**



1. Which logo do you believe is more eye-catching

[More Details](#)

<input type="radio"/>	Logo one	1
<input type="radio"/>	Logo two	4
<input type="radio"/>	Logo three	0
<input type="radio"/>	Logo four	1



4. What colour scheme of logos do you prefer?

[More Details](#)

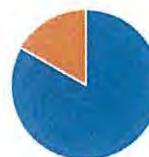
<input type="radio"/>	All blue	1
<input type="radio"/>	All black	4
<input type="radio"/>	Mixture of black and blue	1



2. Do you like the icon of the ice cream included within the logo?

[More Details](#)

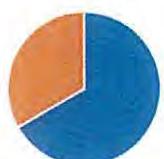
<input type="radio"/>	Yes	5
<input type="radio"/>	No	1



5. Do you like the different staggered layers of fonts and sizes of the words and icons?

[More Details](#)

<input type="radio"/>	Yes	4
<input type="radio"/>	No	2



3. Please rate your favourite logo

[More Details](#)

6  
Responses



4.67 Average Rating

[More Details](#)

<input type="radio"/>	Yes	0
<input type="radio"/>	No	3
<input type="radio"/>	Other	3



93601

After receiving stakeholder feedback about all four final designs of my logo, I have decided to go forward with logo design two as it was the logo that was most preferred by my stakeholders as well as receiving the most feedback to improve it. The development that I will complete to further improve this is to make the full logo black. This was a suggestion that many of my stakeholders suggested because they thought that it would make the logo stand out more on the packaging especially since it was a contrast of blue and grey colours. They like the icon of the ice cream on the side next to the writing so I will keep this on the logo as it is another good point of advertising for the product. By having a logo that stood out and was clear to consumers, should attract consumers to purchase the product as it makes it more eye catching. By including all stakeholder feedback to make these necessary changes, it further improves my product to reach the needs, wants and desires that stakeholders are specifying. My final logo design is below:



#### Churning test:

A very important test completed at the beginning stages of my ice cream development. I compared two different types of churners. A self-refrigerating churner and a frozen bowl chopper. The results that were gathered had two completely different outcomes, allowing me to identify which would produce a better ice cream. This experiment was kept fair by testing using the same ingredients and base across both of the tests with a single changing variable which was the churners.

Sample A was the snowy churn (frozen bowl chopper) and sample B was the Magimix chopper (self-refrigerating). Both samples began with 750mL of mixture. However, after churning, sample A had no change in volume whereas sample B increased over 1L. Giving an accurate representation of the overrun of these ice creams. The overrun is calculated by the percentage increase in volume of ice cream. This percentage change is the percentage of air that is incorporated into the ice cream.



93601



The simple choice of going ahead with the self-refrigerating churner was because it kept the ice cream chilled at all stages of churning. Comparing this to the frozen bowl churner which started off chilled but got warmer and warmer as the bowl defrosted, creating ice crystals and a gritty texture. Sample B's self-refrigerating churner produced an ice cream that was non-crystalline, smooth, creamy, had a good mouthfeel and had an increase in the volume/overrun of the base – better suited for sale. Churners contribute to the texture of ice cream making them an important material so selecting the correct churner was crucial.

#### **Viscosity test:**

Another important objective test that I completed once my base formulation was completed was the viscosity test. This ensured quality control at the same point during every test and to produce consistent products each time. This test was completed before the ice cream was refrigerated for aging but after it had been pasteurized. Viscosity is a measure of the flow of mixture at any one-time during production. This was measured by pouring 50mL through a funnel and timing it as it went through. If there was a difference in time between different tests, I was able to know right away if there was something wrong and if a new batch was required to be made.



#### **Critical control points:**

By making sure that all critical control points were managed at all times, it meant that I was able to minimize waste time and resources such as ingredients and labour work. It also resulted in all food safety hazards being removed from the possibility of occurring. During the production of my prototype, all materials that I was using were kept safely within appropriate areas of the food technology classroom. These were all stored correctly, sealed containers in either the fridge that was kept at 4 degrees Celsius or freezer at -18 degrees Celsius. When making inclusions, I controlled temperature of the oven by ensuring it was preheated before putting the food into it to cook and making sure it was set to the correct temperature as well. By making sure that each of these steps throughout my process plan were correctly completed, it prevented me from reaching situations where I didn't meet the critical control points therefore resulting in a discard of my products and having to re make them.



### ICE CREAM CRITICAL CONTROL POINTS:



1. **80°C** ice cream base of milk and cream has to be brought up to this temperature
2. After base reaches 80°C it has to drop down to **60°C**
3. Once temperature has dropped to 60°C, it has to be raised back up to **79.5°C** and held there for **15 seconds**



### Maintenance and disposal:

During the functional modelling and prototyping stages of the production of my vegan frozen snowflake ice cream, I considered the maintenance and disposal of materials, ingredients and packaging. I did this because within the classroom I am very passionate about the environment. This meant that we worked towards economizing resources, time and money which allowed us to minimize waste and become more efficient.

**Maintenance of equipment:** Ensuring the equipment that I was using such as the ice cream churns were thoroughly cleaned after each use, working properly and were safe to use was important with the safety of the production of my ice cream. By completing visual checks looking for loose/frayed cords was another important stage when making sure the equipment was safe to use.

**Health and safety:** Following a HACCP plan with identified critical control points at important stages of production, ensured a safe to consume product. Good personal hygiene practices were carried out such as thorough handwashing and sanitizing of workspace. A process plan ensured quality assurance.

**Storage of final products and ingredients used:** Making sure the temperature of the freezer was at -18°C and the fridge is at 4°C so products were kept at safe temperatures for consumption. Leftovers could be vacuum packed or tightly closed in airtight bags or containers.

**Packaging:** Product will be in a robust, airtight and food safe package. Clear instructions for responsible disposal were listed on the packaging. Currently I'm unable to use biodegradable packaging because of monetary constraints within the school environment. However, the packaging can be refurbished into storage for other products. Using a cardboard packaging with plastic containers for each individual ice cream making them leak proof and safe.

**Disposal/recycling:** Making sure that all coconut milk/cream containers and storage containers were washed with warm water and sanitized appropriately before using again or putting into recycling bin. Leftovers can be melted and washed down the drain.

**Planning trials:** Accurate food orders that are completed well in advance make plans of trials much easier. Correct quantities being prepared allows efficiency of time.

93601

**Ethical factors:** Was important when selecting ingredients to use. Ensuring that the chocolate used was Fairtrade meant it had been ethnically produced and those that may struggle financially will be supported.

**Feasibility:** Product created will make a profit when sold as the price will be under existing products already on the market.

**Quality of ingredients:** Testing all ingredients, checking at the used by/expiry dates ensures the quality of all ingredients is high. Storage instructions of ingredients are checked making sure they are all airtight so bacteria cannot get in. Visual checks conduction checking condition of ingredients used.

**Social environment:**

Who will the product be situated with?

- ⇒ School children – target market
- ⇒ Consumers?
- ⇒ Visual thoughts and opinions

The intended social environment of my product is younger children between the ages of 11-14.

A few older stakeholders = maturity of feedback

93601

**Physical environment:**

Where will my product be situated?

⇒ Place of purchase



The intended physical environment of my product is on supermarket shelves (4-pack) or service stations (individual purchase). In each of these physical environments my ice cream will be kept in a freezer that will be at -18°C. with the physical environment being contain/stabilized at this constant temperature, it allows food safety standards to be meet, therefore, resulting in a product that is safe for consumption. My ice cream product will be found among the other ice cream packaging so it can compete against existing products that are already available for purchase.

93601

### **SWOT analysis:**

<b>STRENGTHS:</b>	<b>WEAKNESSES:</b>
<ul style="list-style-type: none"> <li>Wide possibility of consumers and target market</li> <li>Visually appealing – clean dome shape ice cream and simple colours on packaging</li> <li>Can be part of a 4-pack (supermarkets) of individual sale (petrol stations)</li> <li>Point of difference – fills gap in market for vegan products for children</li> </ul>	<ul style="list-style-type: none"> <li>High cost of production = higher selling price to make profit</li> <li>Conservation when on the shelf – how long product can last on the market</li> <li>New product = will it last and be popular with consumers since it's not an everyday favorite</li> <li>Vegan = will non vegans consume?</li> </ul>
<b>OPPORTUNITIES:</b>	<b>THREATS:</b>
<ul style="list-style-type: none"> <li>The difference of product from those already on the market</li> <li>Increase of demand for these products</li> <li>No any competitions of similarity at this point of production</li> <li>Varieties of products – further development of other vegan frozen desserts – expand brand/company</li> </ul>	<ul style="list-style-type: none"> <li>A change in customers wants/desires/needs – no longer have a crave for vegan products</li> <li>Price – thin profit margins</li> <li>Competition from other products that have been innovated onto the market</li> <li>Growing population of vegans = more and more frozen desserts being introduced into the market</li> </ul>

### **Justification:**

From the development of my product from a star shaped mallow puff inspired ice cream, it has increased the possible opportunities and popularity of the product. It is improved the ease of consuming the product which should also hopefully increase the amount of people purchasing the product. There are many strengths with my product entering the market, some of which include the introduction of a brand-new product with nothing similar to it already present. The difference is what should set it aside and appeal to a wide range of consumers from children to adults especially since it is 100% vegan. However, it is not an extremely cost effect product to produce with added labour costing and ingredients. This means that when creating a selling price that will be competitive within the market but at the same time make a good profit will be something that could be a potential weakness I may face. The development of this prototype from originally being across three different concepts then drawing aspects from each of these out to form this final prototype has meant that the strengths and opportunities are increasingly high vs the possible weaknesses that can be improved and worked on to remove.

The findings of the trialing and testing, the stakeholder requirements and the feedback have allowed me to select the process and materials to use to make a functioning prototype that has reached a point where it can be put onto the market for consumers to purchase and enjoy. After

93601

completing several tests and trials investigating different milks, creams, sugars and stabilizers I was able conclude which ones are the best ones to use to produce a product that is ready to go onto the market. Ongoing stakeholder feedback was the information that allowed me to make these decisions about future changes in order for me to reach this functioning prototype.

### **Selected ingredients:**

The base ingredients of ice cream are fat, milk, sugar, egg replacement and air. Each of these ingredients allows my ice cream to meet the specifications.



**High fat coconut milk:** When figuring out which coconut milk would work the best within my ice cream, I tested different milks such as the Good Hemp, hemp milk (2.7g fat per 100ML) along with the Ayam coconut milk (24.3g fat per 100ML). This testing allowed me to conclude that using the higher fat content milk was preferable as it enhanced the creaminess and overall texture of the mouthfeel. There was also a reduction of ice crystals with high fat levels lubricating consumers palates.



**Low fat coconut cream:** Comparing levels of fat content in coconut creams is critical as it impacts the smoothness of the ice cream with ice crystals being lubricated between the cream. If the correct cream is used, air will be trapped while the mixture is being mixed as well as frozen giving the ice cream a stronger base. During the testing phases I used a low-fat cream which was Trident light coconut cream (10.5g fat per 100ML) as well as Ayam coconut cream (28.5g fat per 100ML). I decided to go ahead with a lower fat coconut cream being the Trident one because when accompanied with the high fat coconut milk the overall fat levels were balanced resulting in a smooth and creamy mouthfeel that didn't have the heaviness and density of an ice cream with too much fat may have had.



**Sugars:** Sweetness of ice cream is controlled by quantity and types of sugar used. Sugar plays a huge role with ice crystals forming when the ice cream is being frozen. Glucose makes the body of ice cream much more stable and less resistant to melt away. After completing testing with different sugars on their own and as combinations, I concluded that using a glucose and regular sugar combination enhanced overall sweetness and mouthfeel of my product.

**Egg substitute:** Eggs yolks play a key role in the base formulation of ice cream. However, with the production of a vegan product this ingredient was not possible. Instead I swapped it out for an egg substitute powder which provided nearly almost all of the same attributes that a regular egg yolk would provide. The presence of stabilizers within the egg substitute supported the strength of the ice cream base which also increased the resistance of the product to melt. By using the egg substitute, it also removed the eggy flavour egg yolks have which at times can put consumers off.



**Salt:** When the ice cream is transferred from the churner into the freezer it poses the possibility of ice crystals being formed from air entering the mixture. I made sure that I used a small quantity of salt to prevent this from possibly happening removing the risk that the ice cream would become gritty and grainy from ice crystals.

93601

**Vanilla bean paste:** Throughout testing and trialing I compared the flavour that different vanilla pastes/essences had on the ice cream base. Some of which enhanced the flavour whereas others were not noticeable. I finally decided to use the Taylor & College organic vanilla bean paste as it not only made the ice cream look appealing with the vanilla seeds, but also masked the strong coconut flavour from the liquids. Therefore, making it a product true to label.

**Air:** Air cells are whipped into base becoming responsible for consistency, texture and volume of ice cream. The overrun measures/indicates amount of air held within ice cream impacting volume of product.



#### Specifications:

Specification	Why
Lifecycle	The product I am developing is a commonly purchased product and therefore, needs to appeal to a wide range of people – this includes people of all ages not just children as generally the parents are the people purchasing the ice creams. This means that I was required to create a product that would be consumed by everyone by being commonly liked. By keeping flavours simple and not overcomplicating it too much when using materials that can be sourced easily it allowed me to form a product that could/would appeal to a wide range of consumers across many age groups. Especially since it is a vegan product aimed at children, it should have a longer life cycle within the market as there is a clear gap in the market for products that are different yet not too complicated for those with dietary requirements to enjoy.
Technical acceptability	My product needs to be made with the use of safe ingredients as well as being produced in a safe way. For this to be done I need to make sure that I used an accurate HACCP plan which will be followed by good hygiene practices which allow me to know that my product will be safe to consume.
Maintenance and disposal	My product needs to have a good shelf life to increase consumer appeal. By having a longer shelf life, it means that consumers don't have to feel the rush to consume the product if they do not want to. The risk of the food spoiling is decreased. Aspects such as appropriate packaging that doesn't let air in and is sealed so moisture can't get in either is a way to increase the shelf life of my product. By having a robust and sturdy package it removes the chances of my product becoming damaged ruining the visual appearance when broken. This is why I have decided to design a box packaging because the square shape holds its position and shape well on supermarket shelves well.
Ethical nature of testing	When preparing my product, I need to maintain safe food practices. I will follow both my process plan which has feedback loops and my HACCP plan. I will follow the NZ and Australian food safety requirements and their labelling requirements. Allergens will be labelled. When getting stakeholder feedback, I will set up formal sessions, seeking permission from my stakeholders first. I will ensure they understand what I am going to use the feedback for, and the ingredients in the product, where and how it was made. This will ensure they are not eating anything that may harm them or that may go against personal or cultural beliefs. Information about the source of the ingredients will be available also so stakeholders are aware of the origins. I will only use ethically produced ingredients and where possible, locally sourced.

93601

Cultural appropriateness of trailing and testing procedures	If using ingredients that are seasonal, are they in season? If they are not the cost could potentially be higher which would impact out profitably from the product. The ingredient may not taste as good either due to being shipped from overseas. I need to ensure that my product is being developed with correct moral and cultural values therefore it will be accepted by everyone. This means that all ingredients that I use need to carefully consider that they will be accepted. Due to making a vegan product, it does reduce the risk that my product will be against some cultures. By following necessary HACCP and health and safety measures, it ensures that all the food is prepared appropriately and safely for consumption. This means that aprons are on, hair tied up, jewelry off, hands and bench space sanitized. With the area of work set up like this, it gives the workspace a professional sense as everything is being treated to accordingly.
Social acceptability	Made using ingredients and processes accepted by NZ society which gives consumers confidence that their products are being formulated with high quality local ingredients. Especially at times like these that we are experiencing with COVID-19 it is very important to support local businesses. By purchasing ingredients that have been locally sourced, when my product is being sold to consumers on the market it will be accepted much more because of these reasons. Nutritionally valuable and healthy, with nutritional components that make a Kiwi favourite sweet treat much better to consume as there are no added preservatives or sweeteners. Coconut cream and milk are known to support our overall health. But selecting ingredients that not only improve our blood pressure along with sending necessary vitamins into our bodies, but due to them being vegan alternatives, aspects of my ice cream such as the coconut milk and cream contribute to the nutritional components. The social acceptability should be good because more and more people are becoming vegan throughout the world. In many cases we see parents/caregivers of children deciding to follow this way of life therefore causing the children to do the same. So by having a vegan frozen dessert for children that are vegan to enjoy, it should appeal to a wide range of consumers and be valid and accepted within the market.

My final concept fit for purpose because it meets all the specifications of the brief.

The frozen dessert is smooth, velvety and creamy in mouthfeel due to several previous testing's with milks and creams that contained different fat levels. From completing all of these tests, I gained a clear understanding of the fat contents I was going to need to produce an ice cream that meet this specification. In ice cream, fat supports the creaminess and richness of the final product as well as slowing down the melting process once being removed from the freezer. After choosing to use the high fat coconut milk and low-fat coconut cream, I did some more testing with the different sugars. I received stakeholder feedback and, in the end, decided to use a  $\frac{1}{2}$  glucose  $\frac{1}{2}$  sugar combination as it decreased the high level of sweetness that was present from a full sugar formulation.

93601

The frozen dessert was non crystalline because I made sure I added the salt when formulating my ice cream base. I also ensured that I churned the ice cream for the correct amount of time and removed it from the churned into a sealed container then into the freezer quickly to prevent ice crystals from forming.

The frozen dessert melted in your mouth, had a good mouthfeel and had a flavour that was true to label because I completed several tests on the different milks, creams, sugars and inclusion combinations until I could reach a perfect final concept.

This frozen dessert was suitable for my vegan stakeholder because I used coconut milk, coconut cream and egg substitute. The differing fat contents within each of the milks and creams performed well by adding a creamy rich mouthfeel along with the strong vanilla paste which masked the coconut flavour that was present.

This frozen dessert is going to be packaged within a 4-pack box. This will contain 4 x 100g frozen snowflake ice cream sandwich each individually wrapped within the box. By doing this it allows the diversity of either having a pack of 4 to be sold in supermarkets or individual in gas stations. This is the most effective size to produce for this ice cream concept.

The frozen dessert will contain the inclusion of a gingerbread cookie, marshmallow, hockey pockey ice cream all in which will be coated in chocolate. This is because after several different trials and tests along with stakeholder feedback that I received these flavour combinations and ideas worked the best together and filled the gap in the market.

#### **Accept or reject?**

After having to reject my prototype, I worked on making the necessary changes to my prototype so I was able to reach a point where I could accept it. This meant I was to change my idea from a snowflake mallow puff inspired ice cream to a dome shaped one that exactly matched what we would all recognise as a mallow puff. After making these changes I am now able to accept my prototype and say it is ready for consumers to enjoy. It was a much easier process of formulate this product decreased the hours of labour and number of resources that were required. Therefore making it a much more cost effective prototype. My stakeholders found this much easier to eat due to the simple shaped design. By being able to use molds, it meant that I was able to finish with a cleaner and more professional looking ice cream. Overall, the stakeholder feedback that I initially received for my prototype that I had to reject had some positives but by simplifying it down to be able to reach and acceptance I received feedback that was even more positive. The small blue snowflake that stuck on the top was an aspect that I got positive comments about as it was a nice was to reflect the frozen theme.

93601



First development =  
unsuccessful



Final development =  
successful



Stakeholders testing final  
product outcome

Cross section of the final  
development

**Conclusion:**

Decisions about the different materials and processes that were going to affect my final prototype, were made during the process of developing my vegan frozen dessert. By completing many tests to analyse these different materials and processes, I was able to confidently say that I have created a brand-new product to fill the current gap in the market. Surveys and research allowed me to make informed, knowledgeable decisions and next steps from the start. Certain tests with different churners, ingredients and methods, created a frozen dessert that met premium attributes. However, if I didn't complete the research a chalky, crystalline and hard frozen dessert would have resulted. Stakeholder feedback lead me through the correct pathways when making a frozen mallow puff inspired hokey pokey ice cream with a gingerbread biscuit and vanilla marshmallow.

I believe that my product is fit for purpose because it meets all specifications that a premium ice cream would have; smooth, creamy, non-crystalline, true to label, melts in your mouth along with meeting specifications within the brief; vegan, palm oil free and only contains natural colours and flavorings. By using blue and silver colours that contrast one another on my packaging, it makes it eye catching and appealing for consumers to take an interest in purchasing. However, if I were to make changes after putting my packaging in its physical environment, I would consider using brighter shades of blue so it would compete with current products on the market more effectively. My ice cream meets all specifications of the brief and from gathered stakeholder feedback, interests a wide range of consumers from my target market. By constantly referring back to stakeholder feedback along with the brief, it meant that I was able to make developed next steps from decisions that were made resulting in a successful final product.

**Bibliography:**

- [REDACTED] OneNote and teams page
- <https://www.icecreammation.org/science-of-ice-cream/>
- <https://www.euroglaces.eu/ice-cream-ingredients>
- <https://medcraveonline.com/JNHFE/effects-of-different-ingredients-on-texture-of-ice-cream.html>
- <https://www.compoundchem.com/2015/07/14/ice-cream/>
- <https://www.dreamscoops.com/ice-cream-science/air-in-ice-cream/>
- <http://icecreamscience.com/role-fat-ice-cream/>
- <https://www.stuff.co.nz/life-style/food-wine/116460433/behind-the-scenes-with-the-nz-ice-cream-awards-judging-panel?rm=a>
- <http://technology.tki.org.nz/>
- <https://www.uoguelph.ca/foodscience/book-page/stabilizers>
- <http://fairtrade.org.nz/Fairtrade-Products>
- <https://shop.countdown.co.nz/shop/searchproducts?search=cheesecake>
- <http://www.foodchemadditives.com/gluten-free/3547>
- <https://www.differencebetween.com/difference-between-gelatin-and-vs-pectin/>
- <https://www.saralee.com.au/about-sara-lee/>
- <https://www.huckleberry.co.nz/pages/our-roots>
- <https://www.healthline.com/health/allergies/gluten-allergy-symptoms>
- <https://celiac.org/eat-gluten-free/gf-services/coeliac-new-zealand/>

## Scholarship Exemplar 2020

<b>Subject</b>	Technology (Foods)		<b>Standard</b>	93601	<b>Total score</b>	16
<b>Q</b>	<b>Score</b>	<b>Annotation</b>				
Synthesis and Integration-	05	<p>This project developed an outcome for a genuine issue of creating a vegan frozen dessert that can be enjoyed by children. The final outcome was a well-constructed enrobed sphere with multiple fillings and textures. The product is attractive and interesting.</p> <p>There was deliberate decision-making around ingredients used and the techniques and processes employed during preparation and manufacture.</p> <p>Stakeholders, inclusive of industry experts and target market peers, were consulted throughout and their feedback contributed to decision making and subsequent action.</p> <p>The candidate demonstrated high levels of planning and organisation, and the product met the requirements of the brief.</p> <p>There was evidence of extensive testing and evaluation throughout, inclusive of subjective and objective testing methods.</p> <p>The product was of complicated, requiring a range of frozen, stovetop, and baking processes. The evidence provided demonstrated that the candidate had the necessary skills and culinary knowledge to complete the project.</p> <p>As challenges arose, the candidate used further trialling to refine and improve the performance properties of product components with relevant documentation provided.</p> <p>Overall, a good level of synthesis is evident throughout this submission.</p>				
Justification	06	<p>Markers were confident they could see the process and understand why decisions were made.</p> <p>Stakeholders were vital to the development process, and their feedback was ongoing, authentic and meaningful, which was reflected in the outcome.</p> <p>Throughout the process, next steps and improvements were identified, and analysis throughout the report was relevant and purposeful.</p> <p>There is evidence of extensive research of ingredients and processing equipment before recipe formulation began. This enabled informed decision-making from the beginning. There was evidence of comprehensive testing and evaluation of ingredients and formulation throughout which supported ongoing product development. Both subjective and objective tests are explained and utilised appropriately. As a result of this testing, markers felt confident that the outcome was going to be realised in due process.</p> <p>Further feedback and usage of the outcome by the target market within the broader community could have enabled further refinement, polish, and elegance.</p>				
Critical reflection	05	<p>The report demonstrated a narrative from start to finish, with the candidate reflecting on key decisions. There was consistent evidence of the candidate's thinking about the process and outcome.</p> <p>A good level of reflection and evaluation is evident throughout that is clearly relevant to the task at hand. This enabled the candidate to make informed and reasoned decisions, modifications and adaptations during product development as issues arose. The markers were able to understand why the candidate was making the decisions they made.</p> <p>The result was a professional-looking frozen dessert product which appeared to have the potential for further development and testing and evaluation.</p>				

# SCHOLARSHIP EXEMPLAR

93601



S



NEW ZEALAND QUALIFICATIONS AUTHORITY  
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD  
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

## Scholarship 2020 Technology

Total score: 24

### INSTRUCTIONS

#### CHECK YOUR NSN

- Find the printed nine-digit number above. The number must be the same as the NSN from the top right-hand corner of your *National Schools Qualifications – Examinations Admission Slip*.
- If the number above IS NOT the same as the NSN on your admission slip, **return this folder to your teacher immediately**.
- If the number above IS the same as the NSN on your admission slip, tick (✓) this box:
- Print the NSN from your admission slip here:

0								
---	--	--	--	--	--	--	--	--

- Print this number clearly at the **top right-hand corner** of the first page of your report.

#### COMPLETE THIS DECLARATION

- I have checked my NSN.
- I have printed my NSN at the top right-hand corner of the first page of my report.
- The report in this folder is my entry for Scholarship Technology.
- This work presented for assessment is my own.

Signature:

Date:

If the information above is not correct:

- it may not be possible to award a grade
- there may be an investigation for a breach of NZQA's Rules and Procedures.

	Score
Synthesis and integration	
Justification	
Critical reflection	
<b>TOTAL</b>	

ASSESSOR'S USE ONLY



# The Air Force Museum of New Zealand

## Interactive Museum Map



2020 Technology  
Scholarship

# Table of Contents

<b>Introduction Section.....</b>	<b>3</b>
Background .....	3
The Issues.....	3
Contextual Considerations & Relevant Implications .....	4
<b>Inquiry Section.....</b>	<b>6</b>
Initial Research .....	6
Considering Possible Solutions .....	7
An Idea .....	7
The Three Project Ideas.....	7
Presenting the Project Ideas .....	9
Selecting a Project Idea .....	9
Questions for Mr D.....	10
What would TIMM look like? .....	11
What could have gotten in the way of the project? .....	19
The Proposal .....	20
<b>Project Plan Section.....</b>	<b>21</b>
Project Management Methodologies .....	21
Selecting a Methodology .....	21
Project Management Tools .....	23
Comparing Tools .....	24
Selecting Tools.....	26
Plan of the Development Process .....	27
The Development Schedule .....	30
<b>Project Section .....</b>	<b>32</b>
Communication with Stakeholders .....	32
Testing TIMM .....	32
Decision Making .....	35
<b>Reflection Section .....</b>	<b>37</b>
The Final Product .....	37
Use of the Methodology .....	37
Use of Tools .....	38
Meeting of Proposal Guidelines .....	40
The Stakeholder's Thoughts .....	41
Future Opportunities .....	41
<b>References.....</b>	<b>43</b>

## Introduction Section

---

### Background

In the last year of High School my DTP (Digital Technologies, Programming and Computer Science) classmates and I were to each do a project. The project would involve finding an issue, planning a digital solution to solve the issue, and producing that solution.

our teacher, suggested we investigate the Wigram Airforce Museum to see if there were any project ideas. I conducted an inquiry to find issues and gather requirements for a solution. In the end, I created a digital solution, so that the museum could continue to thrive. The digital solution turned out to be a fully working prototype for an app that presents a map of the museum with many other features to assist visitors at the museum.

### Air Force Museum of New Zealand

The Air Force Museum of New Zealand is a museum located in Wigram, Christchurch which holds a collection of artefacts related to New Zealand aviation. Their mission statement is: *“To preserve and present the history of New Zealand military aviation for commemoration, inspiration, learning and enjoyment.”*. The museum has had free admission since 2009. This change was in order to make the RNZAF (Royal New Zealand Air Force) story as accessible as possible. Because the museum has free admission, there must be other sources of income to keep the museum running, and in fact growing.

### Stakeholders

There is a large team of people working at the museum to keep things running smoothly. But only some of the team were invested in this project. Most notably, D.

D, Education Officer at the museum, was my main stakeholder and has worked with me closely to build the solution. As sole Education Officer, Mr D’s main role is to create, promote, schedule and teach free education programmes to groups ranging from preschool to adult ages. Most education programmes are booked by school groups and are curriculum-linked to provide learning experiences outside of the classroom.

, the exhibitions technician at the museum saw my work multiple times in person and gave feedback on the project. Once an exhibition has been fully designed, Mr R utilises his technical skills to produce the physical aspects of that exhibition, before helping to install it in the Museum.

M Communications Manager, and D Collections Manager, both knew of the project all along, but only came to see it in person at the end. D leads a team of staff and volunteers that are responsible for ‘back of house’ operations, such as the archives, research facilities and collection storage. M and her small team are responsible for all communications from the museum to the outside world. This includes social media, branding, the museum website, graphic design and more.

### The Issues

The Air Force Museum is a non-profit organisation, which allows free entry. The organisation already makes revenue via donations, holding events, running a café, selling merchandise from their gift shop, selling treasure hunts for kids and from their plane simulator. It is

essential that the museum continues to collect enough revenue to keep afloat and continue to provide free education along with other services to the public. And it is an attainable ideal for the museum to collect enough revenue to grow without the financial restrictions. The salaries of workers at the museum are taken care of from sources separate to donations, so this is not apart of the issue. The revenue described here is used for things such as expanding infrastructure, improving exhibits, maintaining artifacts and providing free education.

The museum has their own website and social media promoting their organisation. Not only would the organisation greatly benefit from more traffic to these websites, but those who go to these websites would too.

Simply improving the experiences of those who visit the museum is hugely beneficial. In doing so, visitors will be more likely to come back, suggest the museum to others and donate. These examples of effects would all increase revenue, helping the museum.

Money is not the only benefit from the improved experiences of visitors. In general, it is a truly good thing for the organisation to be providing people with quality free services which leave them feeling happy.

Mr D [redacted] made it clear that providing help for visitors with disabilities was valuable. The museum has its quirks and oddities, with which those with disabilities might need assistance. Increasing the accessibility of the museum to everyone would always be a good thing.

Keeping the exhibits exciting and engaging is vital to the health of the museum. If the exhibits are not interesting, then neither is the museum, and less people will go.

My D [redacted] has also expressed how there is a large gap in the ages of people that visit the museum. Many adults come with their young children, and many elderlies come as well, but apparently very few teenagers come to the museum.

## ***Contextual Considerations & Relevant Implications***

There are relevant implications of a project like this that must be considered before beginning. Throughout the project these issues were referred to frequently so that they were made sure to be taken care of.

### **Target Users**

When designing and building a product, it is important to consider who the product will be used by. By relating everything about the user to the product during development, the final product will better suit the user.

In my case, the app would be used by visitors at the museum, as well as a few admin users from the museum staff. The visitors would by far out number the staff, but they would likely use it far less. Each visitor would be expected to use the app roughly once or twice a year for an hour at a time. Whilst the admin users would user the app possibly a few times a week. I had to consider the purpose the app would serve for each user and how the app could deliver their needs successfully.

### **Environment**

Where something is used greatly affects how it will be used. Therefore, it is important to consider the environment that a product will exist in while developing it. Questions like: "What is the lighting like?", "How crowded is the area likely to be?" and "Is there seating

available?" are all examples of questions that might be relevant when considering the environment.

I knew the app would be used in the air force museum. This had to be considered when designing and building the app. For example, although a visitor might need to know where the fire exits are, the app might not need to communicate this information because the environment they are in already communicated this well.

### **Security**

The users of a product might be concerned about how the product deals with any of their information and whether it is secure. A product should be made with security in mind.

Since I knew the product was likely to hold sensitive information and access to sensitive powers, I knew I would have to take action to protect these.

### **Future Proofing**

If a product is not made with the future in mind, it will likely expire quickly. The product might become unfashionable, incompatible, inferior, or out of date.

This is especially relevant when it comes to software. Since software is quickly changing, so are standards, regulations, and expectations. I knew that steps must be taken to protect the product from these issues. My product will need to be easily updated after the prototype is completed. Maybe someone at the museum will continue with not only my ideas, but my code. That person would appreciate detailed documentation of my code as well as code that is written well. I will document my code with detail. I will also do my best to write my code so that it is easily understood and altered.

### **Usability**

How a user can easily, effectively and efficiently use a product is crucial to how the user will be satisfied using it. Often users stop using a product or change to another product when the product is difficult to use.

I saw it vital to make my app as easy to use as possible. Especially since most users would not get a good chance to become familiar with the product, I knew the app must be intuitive and easy to use from when it is first picked up by the new user.

## Inquiry Section

### Initial Research

The inquiry involved cycles of research, planning, testing, asking Mr D [redacted] questions, and revising. This was continued until a viable plan and proposal was produced. To ignite this process, some started investigative questions were asked.

#### Are there already examples of digital solutions in the museum?

The visit to the museum to investigate it revealed a lot about the museum. They had a plane simulator video game, which naturally, was intriguing. This attracts mostly young people to the museum and collects revenue, since it is paid for. They also had a more modern game which detected a person's movement so that they could control a plane on a screen without a controller. There were no other digital solutions noticed, which allowed more freedom with generating ideas. It neither seemed like a need to, or seemed one could easily, improve on these games. Nor could anything be learned from them at this stage.

#### Are there any obvious digital solutions to help the museum?

The museum has a 'Wall of Honour', which is a long list of NZ Air Force members who have died in ways relating to the Air Force. Right now, this is physical. It seemed to be a good idea to make a digital version of this list with more depth than the physical version. It also stood out that their donation box is quite uninteresting. If it had some sort of incentive to donate maybe the museum would get more revenue.

**How could the museum help the project? What resources does the museum give access to?**  
Mr D [redacted] has said he would keep in contact throughout the development. He knows a lot about the museum so it was known that he would be a great source of information. The museum offers a free research service (Accessing The Collection, n.d.). If I needed details on historic events, planes, people who served, etc, I could use this service.

#### Further investigation on initial ideas

The idea of the electronic wall of honour at the museum was intriguing. After asking Mr D [redacted] about the idea, he explained that it could work and there was a book that would help in this venture if this task was pursued. The book is called "By Such Deeds" (Hanson, 2018). After conducting some research online about the book, it was clear that the resource was difficult to obtain and that there was not much information on it. It was decided that there was no need to investigate more into this book unless this path was chosen.

The donation issue brought a simple question to the surface: "How can we encourage more donations?". There was an article discussing this issue that museums face (Eric, 2017). Much of what this article talked about related well to the Air Force museum. For example, more than 70% of a museum's revenue comes from outside sources. One of the main opinions of the article was that museums needed to tell their story to motivate people to donate. One line said that "*If they hear that story, they would be much more inclined to help out.*". This seemed to align heavily with what Mr D [redacted] had talked about, and it seemed to be a possibly promising idea.

If there was an example of how a museum-esque entity dealt with donations, that could have given some valuable ideas. An example was Wikipedia and their online donation page

(Wikipedia, n.d.). The museum may have been able to learn from this example. It is very simple and talks directly to the reader which may be a good technique.

## **Considering Possible Solutions**

I spent some time thinking about my ideas, my research, and my visit to the museum. I considered what ways I could possibly create solutions for each of the issues I found at the museum. For each issue I was interested in, I came up with a question to investigate further.

### **Finances**

The museum already made revenue via donations, holding events, running a café, selling merchandise from their gift shop, selling treasure hunts for kids and from their plane simulator. By attracting more people, that would in turn increase, donations, spending money at the café, purchases at the gift shop, purchases of plane simulator tickets and participation in the treasure hunts. Alternatively, for example, the proportion of people who enter the museum that donate could be increased. This could be achieved by making the donation box more attractive.

*How could the donation box be made more attractive to visitors?*

### **Age Gap**

Less teenagers visit the museum than any other age group. Mr D [REDACTED] and many classmates talked about how they could increase the visitor numbers of this age group some way. It seemed that this would be a very difficult task, and it was venturing near impossible. Therefore, this issue would not be further approached.

### **Accessibility**

It would be fantastic if visitors with disabilities could be helped so that they can more easily enjoy the museum. This idea seems like something that would be added on the side to another project, as a supplement.

*In what ways could visitors with disabilities be helped?*

### **Exhibits**

If an interesting exhibit could be improved or even created, that would really help the museum by attracting more people and giving visitors a better experience. The only idea I had was the one to do with the Wall of Honour.

*What would the electronic wall of honour idea look like?*

## **An Idea**

During class I had the idea of a digital museum map, this would have potentially incorporated the accessibility idea. This idea was attractive because it would act a lot like a blank canvas, allowing many extra features of all types to be added in, for any purpose. At this stage it was just a brief idea, so it needed to be further developed.

*What would a digital museum map look like?*

## **The Three Project Ideas**

To answer my new inquiry questions, I fleshed out my thoughts into three ideas for possible solutions.

## The Electronic Roll of Honour

The electronic roll of honour would be an interactive list of all those on the roll of honour at the museum. It would be on a tablet like device next to the physical roll of honour at the museum. It would provide an aesthetically pleasing, informational way to see the roll and find out about those on the roll. It would improve the museum experience, in turn making visitors more likely to come back and helping the museum.

### Features

- Scrollable list of names
- Poppy laying feature
- Different views of list available
- Ability to select individuals to see more information
- Information on title, name, DOB, POB, DOD, POD, photo, rank, unit, etc.
- Looks nice and modern

### How

- Use Python to create a prototype app
- Using a GUI system, did not know how
- Obtain data from the Air Force Museum archive
- Store data in a database

## The Donation Box Reward

The donation box reward would be a game that would be pay/donate to play. As with the roll of honour, it would be on a tablet like device at the museum. It would add incentive to donate, in turn increasing revenue and helping the museum.

### Features

- Reward option to add face into digital world with planes flying around
- Reward option to add name to list of donations
- Ability to view digital world
- Ability to view past donators

### How

- A camera connected to python
- Make the digital world with planes
- Use database of donators
- Make a database interface
- Make the donation detectable

## The Interactive Museum Map

The Interactive Museum Map would be a phone app with the primary feature being to help visitors find their way around the museum. The app would also have other features. These features would help the museum in multiple different ways such as increasing profits, visitor experience and assisting those with disabilities.

### Features

- Shows where is what and details about exhibitions
- Can move around and zoom in and out of the screen
- Phone app
- Everything is updatable (exhibitions, map, details)

- Potentially has features for those with disabilities
- Advertises sources of income such as donations

#### How

- Use a database to hold admin accounts that museum workers log in to so they can edit the map
- Securely store the data
- Store information about the map in the database so that it can be changed and presented differently

### **Presenting the Project Ideas**

During the process of selecting a project idea to pursue, on Thursday the 19th of March, Mr D █ visited to see a presentation of the ideas in person. I presented only two of the three ideas to Mr D █. I did not present the donation box reward because I had already decided against it and we were short for time. The feedback I received was very exciting and predominantly positive. Mr D █ was mostly excited about the map idea, but he also liked the wall of honour idea.

He stated that some of data I would store in the database for the electronic roll of honour may be sensitive, so that would be an issue. He told me that some families do not want information about their relatives open to the public.

Mr D █ stated that those at the museum and himself, did not want the current Wall of Honour to be replaced. The current Wall of Honour is special and if the electronic wall of honour was to be pursued, then care would have to be taken not to ruin it. There would be difficulties with being respectful to the original and preventing it from becoming an eye sore.

Mr D █ was very supportive about the implementation of support for people with disabilities into the interactive museum map.

Mr D █ thought that both ideas had "great merit". But he made it clear the interactive museum map sounded the most exciting.

### **Selecting a Project Idea**

With Mr D █'s feedback, I chose the Interactive Museum Map to be my digital solution, which from now on will be referred to as TIMM. TIMM was chosen simply because the other two ideas had some major negatives to them, and this idea had some major positives to it.

#### **The Electronic Wall of Honour**

After hearing what Mr D █'s comment about how he didn't want the current Wall Of Honour to be replaced, I realised that if this idea was chosen, there would have to be great care taken with how it was executed. I would have needed to make sure that the product did not degrade or replace the original Wall of Honour. My product would need to only add to it, which seemed that it would be difficult.

Mr D █ told me that holding some data in the database about people and events may be tricky. This is because some families do not want information about their relatives open to the public. This issue was avoidable by simply not selecting this idea.

When referring to the issues of the museum, it was clear that this solution would not deal with many of them. It would only increase the experience of the visitors. Which is valuable, but it was preferable that the solution went further and wider to solve these issues.

### The Donation Box Reward

For this project to work, the reward needed to be attractive, and there was a lack of certainty that it could be made attractive. This combined with the lack of depth to the idea at that point removed the interest in continuing with it.

This idea required something that detects a donation. It was possible to create this device, however there were a few major issues. Creating a detection device would have cost money for physical supplies and materials. The intention was for this project to cost nothing but time and hard work to produce, so this device could not be made. No one would get to see a working product and it essentially would have just been a game with a label of ‘donation reward’.

There were also difficult issues of privacy and controlling of information. A visitor may have had to give consent to have their details and a photo of them stored on a computer. Also, a visitor might have taken an offensive photo, or inputted offensive text as their name, etc.

### The Interactive Museum Map

TIMM looked like something the museum would truly benefit from. TIMM would have improved the experience of visitors to the museum. It was clear that TIMM could have potentially been a tool to help people with disabilities at the museum. This could have also advertised any of the sources of revenue to the museum, as well as promoted social media and the museum’s website. All these impacts would have had a considerable positive impact on the issues of the museum.

This idea was also the most exciting to Mr D [redacted]. It was important that the stakeholders had strong interest in the project because then they would be more likely to provide their own time and thought into it. And of course, Mr D [redacted] being excited about TIMM was a great indication that TIMM had potential to act as a good solution.

The only issue anyone had thought of with this idea of a solution was size of scope. It potentially could have been too much work to be completed in the time set out. However, the idea of TIMM was a dynamic one, which could easily have had features taken out or removed from it without it losing much of its worth.

### Questions for Mr D [redacted]

I sent Mr D [redacted] an email (seen in figure 1) on the 3<sup>rd</sup> of April to gather some advice, thoughts, and information to help the inquiry.

<p>Hello Mr D [redacted]</p> <p>I have been working on the concept for the interactive museum map (TIMM) I have decided to create. I have gotten to a stage where I need your help with some things. Quite a few things actually.</p> <p>First and foremost I have started writing my proposal for the product. At this stage I am interested in developing the requirements of my proposal with you.</p> <p>The current version of my proposal is attached and I'd love for you to read it.</p> <p>And sorry but I do have quite a few questions:</p> <ul style="list-style-type: none"> <li>• If I am going to make a digital map for a museum, then a map already in existence would be very useful to me. Are there any maps of the museum already? Of course since I am making a map for regular visitors, the entire domain isn't needed, just the areas where exhibits are.</li> <li>• Maps of multistory buildings are difficult. The museum only has two floors, correct? Will there be any serious complications created by the nature of the levels of the museum?</li> <li>• This one dips into the requirements of my proposal - in what ways could I tackle the issue of helping disabled visitors? My only idea right now is to indicate which exhibits are friendly to people with which disabilities. Maybe this idea is enough.</li> <li>• This question is important, but is not needed now - At some point I will need details of the exhibits that will be displayed. These haven't been set in stone yet, but may include photos, names and descriptions. I recognise gathering and inputting this data could consume a lot of my time. So I am wondering: Are there already photos of exhibits in existence? Are there details of exhibits? And could I use them at some point? Especially with the hopefully temporary issue of no access to the museum. I thought this was important to ask.</li> <li>• And what do you think? Have I missed anything in my proposal? Is the proposal close to being acceptable? (afterall you will need to agree to it) And do you have any questions for me?</li> </ul> <p>I must say I'm quite excited to make this program. There's no need for a quick reply.</p> <p>Thank you in advance</p>
---

Figure 1: An email to Mr D [redacted] asking for thoughts and information

He replied with some great information (seen in Figure X), which was used in the inquiry.

Kia ora [REDACTED]

We're excited that you're excited about doing this! 😊 I'll do my best to answer your questions:

If I am going to make a digital map for a museum, then a map already in existence would be very useful to me. Are there any maps of the museum already? Of course since I am making a map for regular visitors, the entire domain isn't needed, just the areas where exhibits are.

Two files attached. The PDF Visitor Guide should be useful.

Maps of multistory buildings are difficult. The museum only has two floors, correct? Will there be any serious complications created by the nature of the levels of the museum?

Yes, two floors. One complication that occurred to me – if your app requires GPS location, would an upstairs location be the same as the downstairs location directly below? Or will it recognise altitude. You or your class members would probably know more about that than I. Apart from that, the disparity between the two floors could be tricky (layout, etc.).

This one ties into the requirements of my proposal - In what ways could I tackle the issue of helping disabled visitors? My only idea right now is to indicate which exhibits are friendly to people with which disabilities. Maybe this idea is enough.

Initially, you could start with one disability, as a template. This would be easier than trying to understand a myriad of different needs and the research behind them. I know that I mentioned autism but, unless you already know about autism, you might like to start with mobility issues, for example. For mobility impairments, I'd be pointing out the lift, wheelchair accessible toilets, and entry/exits. This could be an option for the user/visitor to overlay onto the master map, through the push of a button? Different disabilities could be added later.

This question is important, but is not needed now - At some point I will need details of the exhibits that will be displayed. These haven't been set in stone yet, but may include photos, names and descriptions. I recognise gathering and inputting this data could consume a lot of my time. So I am wondering: Are there already photos of exhibits in existence? Are there details of exhibits? And could I use them at some point? Especially with the hopefully temporary issue of no access to the museum, I thought this was important to ask.

Hopefully the attached PDF might help with this? We have many photos of our exhibitions, copies of the photos/images used in exhibitions, and the accompanying text files that go with them. It's a huge amount of information, so let me know if you need specific things and I'll do my best to get them for you.

And what do you think?

I think that this is a great initiative. I could imagine a lot of visitors using an electronic map, especially for special needs, links and hopefully, in the not-too-distant future, for different languages.

It can easily be updated/modified, and cuts down on paper & printing costs.

I like the ability to call visitors to donate, or purchase simulator tickets, etc.

Ease of administration is important – glad you've included it.

At a later date, the concept could also be extended to different age groups as well – a map of cool exhibits and interactives for children would be great, for example.

Have I missed anything in my proposal?

Nothing that I can think of, apart from points mentioned above.

Is the proposal close to being acceptable? (afterall you will need to agree to it) And do you have any questions for me?

Haig, this is an acceptable proposal. It sounds great in theory, and we look forward to seeing what you can come up with – you've got the hard part now. As I said, let me know if you need anything and we'll do our best to assist.

Take care,  
Noā mihī mahana,

Figure 2: A reply from Mr D [REDACTED] answering initial questions

## What would TIMM look like?

At this point the idea of TIMM was in early development. I needed to dive deeper into the idea of TIMM. I asked myself a few questions such as “What could get in way of development of the project?”, “What would be used to program this?”, and “What will the database look like?”. These questions were further divided into more specific ones. Weeks were spent investigating these questions to sharpen the vision of TIMM.

### Is there a digital map already?

In the email to Mr D [REDACTED] I queried about any maps of the museum. He sent back some files (seen in Figures 3 & 4). This is a great example of how useful of a resource Mr D [REDACTED] was. These maps proved to be extremely useful to the project. The way the parts of the museum floor are presented, what items are listed as being the most notable, and the styling used in these maps are some examples of aspects that were heavily taken inspiration from in TIMM.

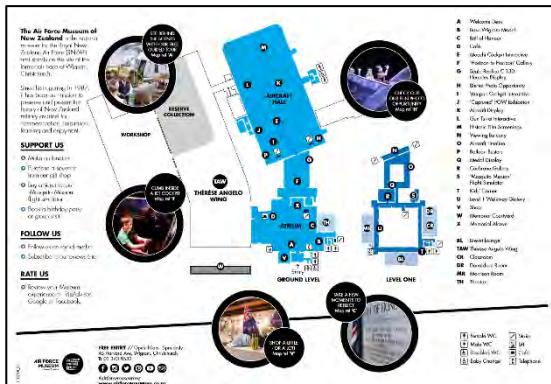


Figure 4: The first map of the museum given by Mr D [REDACTED]

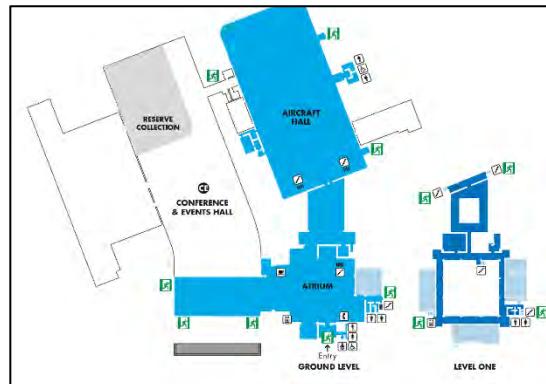


Figure 3: The second map of the museum given by Mr D [REDACTED]

## What will the main page look like?

It is important in software development to know what the layout of the app will look like. A rudimentary sketch (seen in Figure 5) of what the main page would look like.

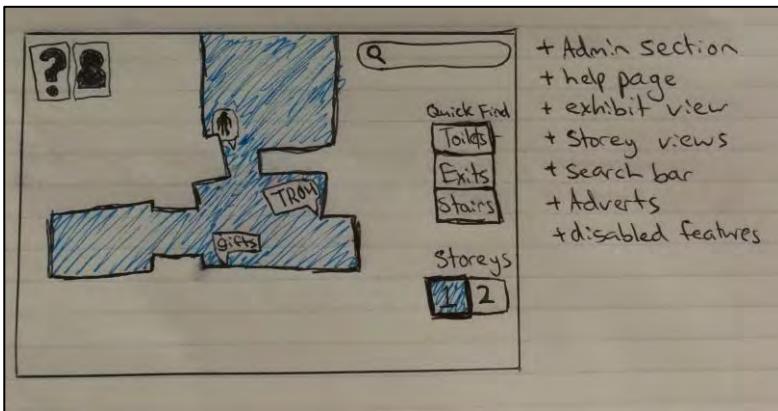


Figure 5: Rudimentary sketch of the app

## How would map markers be shown?

There were many important considerations at this stage, for example, the cluttering of map markers. There were planned to be map markers pointing to where in the museum exhibits were. If there was no limit to the number or position of these markers, they would clutter and block the view of each other. This was realised when looking at Google Maps for help. If every known place on Google Maps had a marker for it showing at once, it would be a mess. As the user zooms in and out on Google Maps, the markers are hidden and shown to prevent this (seen in figure 6). This applies to my contextual consideration of usability.

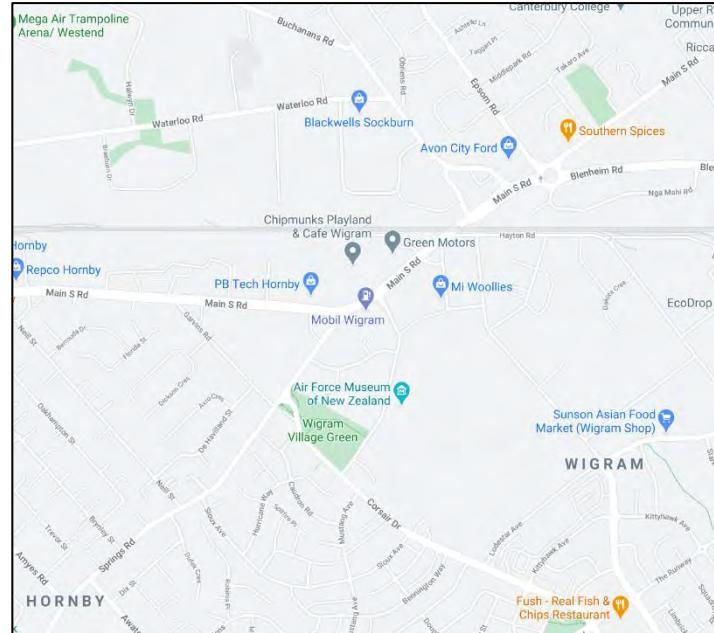


Figure 6: Example from Google Maps

## What aesthetic will TIMM have?

Usability and aesthetics of the app were important. The app had to have a theme to it. The colours and previous content of the Air Force and the Air Force Museum influenced these choices. I found that the Museum commonly used blue, black, and sometimes red, with a white background (seen in Figures 7 & 8).



Figure 8: The NZ Air Force logo

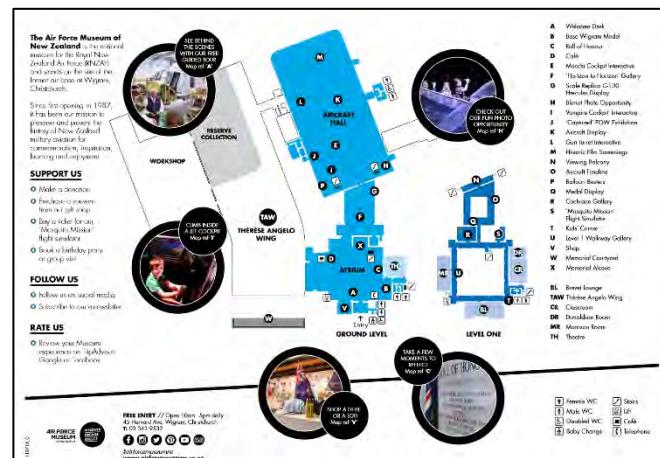


Figure 7: The first map of the museum given by Mr D

The app had to have a simple aesthetic to make it easier to use, because the app likely would not be one people would use often. The app was intended to be used by visitors occasionally for an hour or so at a time.

Figure 9 shows a mock-up button. I had access to photoshop through my Dad's account. He has photoshop on a personal adobe account, and there was no risk that I would lose access to photoshop.



Figure 9: Mock-up button for the app

#### Where will the admin section be located?

Where buttons were located was decided at this stage. For example, the admin section button, which would only be used by a small number of users, was chosen to be located on the main screen at the top. It could have been hidden away to prevent users getting confused or distracted by it and cluttering of the main screen. A bit of simplicity was sacrificed in order to make the app more intuitive, by placing the button on the main page.

#### What will the map item pages look like?

When a user clicked on a map marker, there was to be a page for that item to be shown. A sketch of this is shown in Figure 10. This sketch visualised the plan for this feature. It was considered whether or not this page should take up the entire screen. To keep the user aware of where they are in the app, it was decided the page would only take up a rectangle in the centre of the screen, with the background dimmed to put focus on the item page. This decision was made in order to increase the entire user experience. Inspiration was taken from zumiez.com (seen in Figure 11).

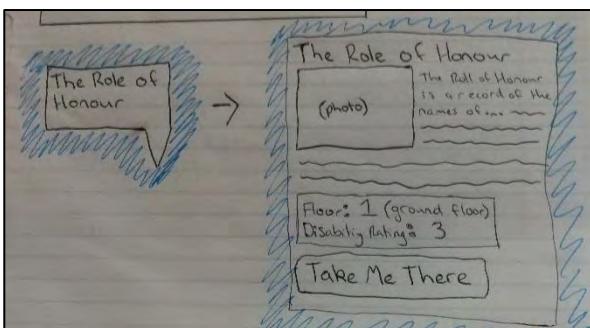


Figure 10: Sketch of the map item page

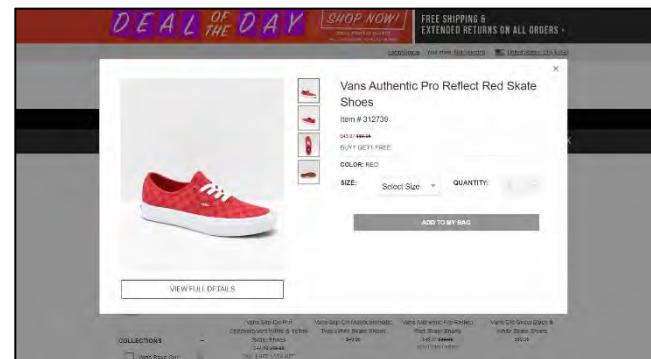


Figure 11: Example of design of website (zumiez.com)

#### How will the two storey views be shown?

The museum has two storeys. There were two options for how this would be dealt with. There could be a button(s) to toggle the overlay of level 2 over level 1. Or there could be a button(s) to switch between level 1 and level 2. I generated a mock up of what the difference would look like (seen in Figure 12).



Figure 12: Mock-up of two level 2 views

In making this example, it was realised that the first option level 2 view would be difficult. The exhibits on level 1 would have to hidden in this view, because it would look confusing to the user. The problem with the second option is that it might be difficult to see where things on level 1 are in relation to level 2.

To solve this issue, there was a compromise. In this option (seen in figure 13), you can see both floors at the same time so the user can tell where level 2 is in relation to level 1. But now, level 1 is slightly transparent so the user can easily focus on level 2. In this option, when the user clicks on the level 2 button, all level 1 exhibits will be minimised. But if they want to find where all the toilets are for example, the toilet will then pop up, but they will be slightly transparent too, showing that they are on floor 1.

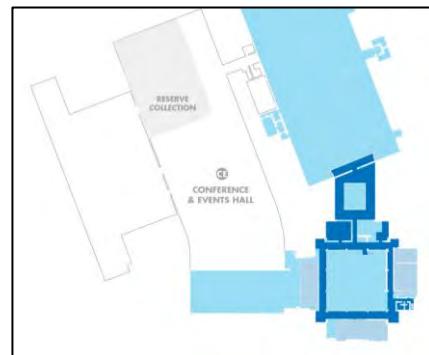


Figure 13: Final level 2 view

#### **What features will be included to help disabled visitors?**

In the first email response from Mr D [REDACTED] he told me about his ideas on features to help disabled visitors:

##### My Question

*"In what ways could I tackle the issue of helping disabled visitors? My only idea right now is to indicate which exhibits are friendly to people with which disabilities. Maybe this idea is enough."*

##### Mr D [REDACTED]'s Response

*"Initially, you could start with one disability, as a template. This would be easier than trying to understand a myriad of different needs and the research behind them. I know that I mentioned autism but, unless you already know about autism, you might like to start with mobility issues, for example. For mobility impairments, I'd be pointing out the lift, wheelchair accessible toilets, and entry/exits. This could be an option for the user/visitor to overlay onto the master map, through the push of a button? Different disabilities could be added later."*

There was the option of including markers on exhibits simply showing if they are friendly to certain disabilities or not. This could have been integrated into the quick find buttons so disabled visitors can see which exhibits are recommended. This would have been very easy to implement on top of what will have already been made.

Mr D [REDACTED] mentioned 'pointing out' the lift disabled toilets and entry/exits. This certainly seemed helpful to those with mobility issues. The problem is how to implement this 'pointing out' in my app. There was the idea of including a page for disabled visitors within the help page. But this might have been too hidden, and many users might not have found this feature. A notice for the user when they first open the app, telling them about the disability features might have been beneficial. But, instead of showing a notice covering the whole screen when the user opens the app, I considered adding a small speech bubble by the help page saying "Do you or does someone you're with have a disability? - [Yes] [No]". This idea appeared to be non-intrusive to most visitors, while very helpful those who are disabled. After talking to Mr D [REDACTED] about it, it was decided to be done this way.

## Will there be types of admins?

The admin section, where museum workers can edit the map, would be accessible through accounts. There was an option of making accounts different levels of authority. For example, maybe only one admin could make other admin accounts. Or maybe some admin accounts aren't allowed to edit some aspects of exhibits.

It was realised that the only point of having an admin account for someone is that they are able to edit the exhibits. It did not make sense that one person would be allowed to edit the names and descriptions for example, but they wouldn't be trusted to edit anything else. Also, there was no need to restrict the creation of admin accounts is important. If a person already has an admin account, what is the harm of creating another one?

It was decided that adding this feature is not only unnecessary, but it would increase my scope and clutter the app. The app was meant to be simple and easy to use.

## Will GPS be in TIMM?

There was no plan to include a GPS system into the app. The version was to be made was a windows prototype, so GPS wouldn't do anything, unless it was used on a laptop (laptops don't generally have GPS). Besides, the GPS service accessible to the public isn't very accurate. The USA website (USA Goverment, 2020) had more information about the accuracy of GPS. It was stated that "GPS-enabled smartphones are typically accurate to within a 4.9 m (16 ft.) radius under open sky". A radius of 4.9m gives an area of about 10m wide. Also, "accuracy worsens near buildings, bridges, and trees". Because this GPS will be used inside a building the accuracy will be worsened. The fact that the building is two-storeys makes it worse.

Because accuracy of GPS may not have been reliable and the product was to be a stationary prototype GPS was not used. Also, the scope was large as it is. This removes an issue of having two storeys that Mr D [REDACTED] mentioned.

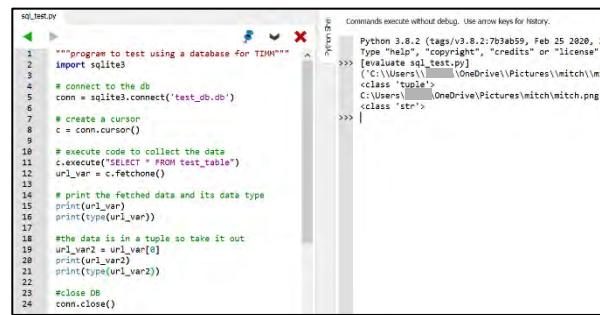
## How will storing images in a database work?

Essentially, knowing the best way to store the images of exhibits for the program to use was important. The program must have had quick access to the files, the method should not have taken up too much hard drive space, and a method that worked well with the code and is easy to understand would have been useful.

I found three forum type websites where people asked similar questions ( (Solo Learn, 2017), (how to save images, 2010) and (Best way to store images, 2013)). Essentially all three received answers suggested a different approach. On sololearn.com a user Kuba Siekierzyński, said that you could store the data of the images in the database using the 'BLOB' data type, but "*more reasonable would be to normally store images as files and keep only links to them in the db*". So there were two ways to do this, to store the images in the database or store the image locations in the database.

A test database helped to make the decision.

The database had a single table with one single column in it and one record. The record was a 'CHAR' type containing the text "C:\Users\[REDACTED]\OneDrive\Pictures...\\mitch\mitch.png". A test program was used to try how it would work (seen in Figure 14).



```
SQLITE3.DBF
1 """program to test using a database for TIMM"""
2
3 import sqlite3
4
5 # connect to the db
6 conn = sqlite3.connect('test_db.db')
7
8 # create a cursor
9 c = conn.cursor()
10
11 # execute code to collect the data
12 c.execute("SELECT * FROM test_table")
13 url_var = c.fetchone()
14
15 # print the fetched data and its data type
16 print(url_var)
17 print(type(url_var))
18
19 #the data is in a tuple so take it out
20 url_var2 = url_var[0]
21 print(url_var2)
22 print(type(url_var2))
23
24 #close DB
25 conn.close()
```

Python 3.8.2 (tags/v3.8.2:cb7dbb5, Feb 25 2020, 23:07:46) [Type "help", "copyright", "credits" or "license"]>>> [REDACTED]sql\_test.py
>>> [REDACTED]
>>> [REDACTED]
>>> [REDACTED]
>>> [REDACTED]

Figure 14: Test program for database

This demonstrated obtaining of a string holding the location of an image file from a database, so that it can be used to access the image file. This method seemed that it would work, but was it better than the alternative?

The 'BLOB' technique was something I did not know how to do. Also, it would mean that images would have to be stored in two places, increasing use of hard drive space.

Additionally, the user masoudk1990 on sqlservercentral.com mentioned that, "for example a 700kb image takes about 900kb space" (using the 'BLOB' technique). This technique clearly would have required more processing power too, because converting of the data into binary was required.

Because the 'BLOB' technique would use more hard drive space and processing power, was generally not recommended by many people on the internet, and I did not fully understand it, storing images this way was not chosen. Instead, storing file locations as 'CHAR' types in the database was the way chosen.

### **What Python GUI module will be used?**

Python was decided to be the programming language to be used to create the app. I had the most experience with Python, and it provided a great platform for a task like TIMM. However, Python alone would not have been enough to create TIMM. There are importable modules of code available online to provide more tools for software development. To create TIMM I needed a GUI (graphical user interface) module.

Various websites such as resellerclub.com (best python GUI frameworks, n.d.) give advice on Python GUI frameworks.

Kivy was the top choice on resellerclub.com, so naturally it was attractive from the start. Kivy was described as an "Open source Python library for rapid development of applications that make use of innovative user interfaces, such as multi-touch apps.". Kivy is 100% free to use which was required. Kivy almost seemed too good to be true. Kivy supported mobile app use and had all of the GUI elements required to make TIMM.

There was even an example of an advanced looking app with a map. Titled "Métropole de Marseille" this example of how Kivy has been used to create something very similar to TIMM. In a video (Display, 2018) the app was shown being used. Just like TIMM would, this app featured a map with locations that the user can click/tap on to see more details. The app had menus and even a place where the user inputted their details. This showed that Kivy can handle what was required for TIMM and more.

Kivy has an enormous amount of documentation, tutorials, examples and other resources online to help someone use it. This was also an essential resource seeing how complicated GUI modules can get.

Tkinter was also a consideration. Looking at examples, Tkinter seemed to be a very simple GUI module. It seems it would have been very easy to learn, but it did not seem to be able to produce sophisticated software smoothly.

On realpython.com (Amos, 2020) they stated that "One notable criticism is that GUIs built with Tkinter look outdated.". I agreed with them and decided to look into another option: PYQT.

The official website of PYQT (riverbankcomputing, n.d.) explained that PYQT can be used for free under a GPL license but this means some features will be unavailable. An article on PYQT

(Ramos, n.d.) said PYQT has many powerful features including those for dealing with SQL databases. It seemed PYQT could be used to make some sophisticated software, but it might not have allowed creation of the map in the particular way being imagined. Also, the examples on the website were quite ugly.

The decision was made that Kivy would be used. It offered advantages such as being free, being multi-platform, being capable of doing what was required, and being (or at least appearing to be) relatively easy to use. There did not seem to be another platform which was capable of what was required, was easy to understand, had great documentation and was free.

### **How will the program know the "shape of the museum"?**

An important part of the app was the shape of the museum which was projected as the backdrop of the app. The method that this was executed needed to not be harsh on computer memory, to be fast and to not take up too much hard drive space.

One obvious idea was to use an image file or two as the backdrop. It was clear that it would look good and work if the image(s) are detailed enough, but if the image(s) were too large they might have caused the app to run slow or take up too much space.

To know how big the image(s) would have to be, I figured out how far in and out I wanted the user to be able to zoom and the max resolution I expect the user to use on their computer. After doing some math I came to the conclusion that the user must be able to zoom in by at least 10.5 times. With the expectation that the user would have a monitor resolution of about 2560x1440, a good size of the image would be about 27,000 pixels wide. Tests on images this size showed that it would not work as a good solution. Depending on the file type and compression type, the images ranged from sizes 15MB to 4MB. These images were too large and/or too lossy to be used.

Using vector graphics seemed to be a far better solution. This method would be executed as a collection of points with lines between them. The shape would be stored as a list of coordinates, so it wouldn't take up nearly as much space as an image. And since there are no pixels, just geometry, there would be zero quality issues. The main issue with this was the programming behind it. Speaking with hindsight, the vector solution used an enormous amount of time and a considerable bit of innovation to get working. But it worked very well. This was expected.

I also had to consider the risk of the museum changing shape and creating a need for the shape to be changed. The vector idea would have potentially created a shape that is difficult to change. In an email to Mr D [REDACTED], he explained the risk of this occurring:

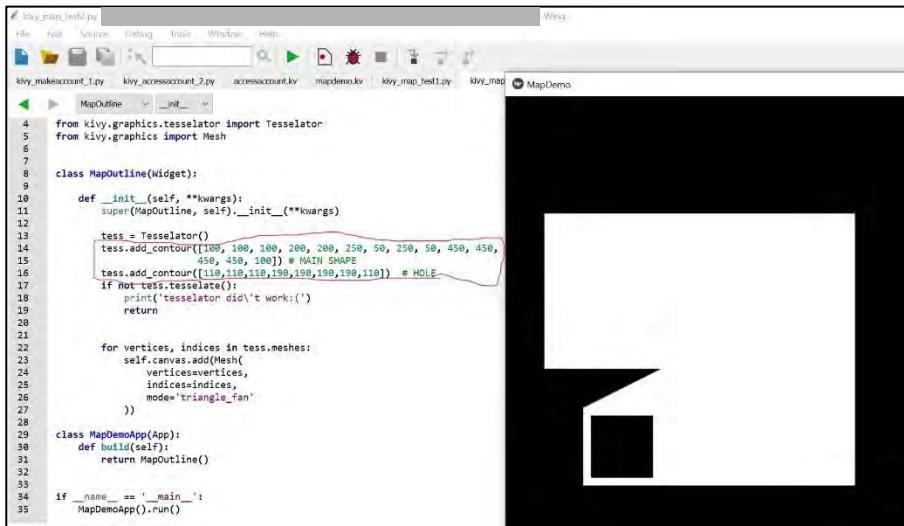
*"For the bare bones of the Museum, not much chance of it changing shape in the near future. Except, if all things go to plan, a new (large) extension to provide space for both a C-130 Hercules and P-3 Orion, in the not-too-distant future."*

From that response, there was confidence that the risk of the museum changing shape in the following year or two is low. If anyone wished to continue with this project, maybe they could introduce an easy way to change the shape of the museum.

There was another aspect to this problem not considered yet. The method must support holes in the shape of the museum. Much like a donut shape, the museum's shape has a big hole in

the middle. In fact, it has multiple. This might seem trivial, but there was absolutely no guarantee the GUI module being used Kivy, could handle this. After diving deep into the internet, a solution appeared in the experimental Kivy feature called the “Tesselator”.

After creating a program using the Tesselation method(seen in Figure 15), there was confidence that this was possible. This method allowed for holes, was fast, took almost no space and maintained its visual quality.



```

kivy_tesselation.py
file Edit Source Debug Tools Window Help
kivy_makeaccount_1.py kivy_accessaccount_2.py accessaccount.kv mapdemo.kv kivy_map.kv kivy_map_test1.py MapDemo
MapOutline MapOutline
4 from kivy.graphics.tesselator import Tesselator
5 from kivy.graphics import Mesh
6
7
8 class MapOutline(Widget):
9     def __init__(self, **kwargs):
10         super(MapOutline, self).__init__(**kwargs)
11
12         tess = Tesselator()
13         tess.add_contour([100, 100, 100, 200, 200, 250, 50, 250, 50, 450, 450,
14                         450, 450, 100]) # MAIN SHAPE
15         tess.add_contour([110, 110, 110, 190, 190, 190, 100]) # HOLE
16         if not tess.tessellate():
17             print('tesselator didn\'t work')
18         return
19
20
21
22     for vertices, indices in tess.meshes:
23         self.canvas.add(Mesh(
24             vertices=vertices,
25             indices=indices,
26             mode='triangle_fan'
27         ))
28
29 class MapDemoApp(App):
30     def build(self):
31         return MapOutline()
32
33
34 if __name__ == '__main__':
35     MapDemoApp().run()

```

Figure 15: Program using the Tesselation method

### How could encryption be executed in Python?

Data security was an important issue to address with this project, because it used a database storing somewhat sensitive information. It was addressed many ways, the main way being with encryption.

Some general research was conducted around encrypting data well. A YouTube video by Computerphile and presented by Tom Scott called "How NOT to Store Passwords!" (Scott, 2013) helped. He mentioned one method which was to simply take the password and store it as it is in the database. He said this first approach has a few advantages. Everything is simpler, there are no complicated method needed for logging in and retrieving passwords. But he said that if someone got access to the database, obviously they would have instant access to everyone's accounts. The second approach is to use a key(s) to encrypt the passwords making them (initially) unreadable and unusable when seen in the database. There would be either be many keys stored in the database to be seen, or one key hard coded into the software used to encrypt and decrypt all passwords. The first main problem with this is that the key(s) might be found, and if they are, then the passwords are easily decrypted. The second problem is that many people might have the same passwords, causing all their encrypted passwords to be exactly the same. If someone saw this, they would know that it is a common easy-to-crack password so they should focus on that one. Then, if they cracked that password, they would have access to all the other accounts. The solution to this is salting. Tom briefly talked about salting, but more information was needed. Also, having more sources would improve the chances of having reliable information.

An article on auth0.com (Arias, 2018) discussed salting. Salting adds an extra step to the encryption of data, but this part is not generated from the plain password, instead randomly. This means that when two identical passwords (e.g. "Password123" and "Password123") are

encrypted, their encrypted forms (hashes) are different because of the extra randomness from the salt. The website described it well:

*"Different users, same password. Different salts, different hashes. If someone looked at the full list of password hashes, no one would be able to tell that Alice and Bob both use the same password."*

This method would have added some serious security benefits. It meant someone could not see which accounts have the same passwords, it generally added more complexity to decryption, and it protected against something called rainbow tables.

A proof of concept was made. There was a test program and database (seen in Figure 16) for both making accounts and logging in. These were the functions that required encryption and decryption.

*Figure 16: Test database for holding accounts*

***What could have gotten in the way of the project?***

The risk of something interfering with the completion or quality of the product had to be considered. Possible roadblocks and restrictive occurrences were considered.

## COVID-19

On March the 25th NZ moved into Alert level 4, meaning the entire country would be in lockdown. This was because of the international viral outbreak of SARS-CoV-2. This was expected to last for at least 4 weeks (until 23rd April). During this phase I could only leave my home to go to work or go for a walk etc. Only essential businesses were open and I would not go to school.

I was working from home, which at that stage was fine. I could do research, think about things, email Mr D [REDACTED] and make progress just as I would at school. But, later on I knew I would need to leave my home for this project. In hindsight, I needed to take photos, look at the structure of museum, gather details on exhibits, and more. Because there was uncertainty of how long the lockdown phase would last, I needed to think about how this phase would affect the project.

The project would not be stopped by a pro-longed alert level 4 in NZ, even if for the entire duration of the project, which is unlikely. Within level 4 I could still research, email Mr D [REDACTED], program and plan. These are the main things that needed to continue with the project. I knew that at times it might have been useful for me to visit the museum or talk with my teacher in person. It might have been desirable to check things at the museum or take photos. These things could not happen with level 4 lockdown. Although there are things that I could not do during this period, they would do nothing more than inconvenience my project. Therefore, even if the lockdown was extended, it was clear the project would continue.

## Time & Scope

The project had an enormous scope. Development began on the 4th of May and was to end on the 3rd of July. That gave me 2 months. It was not unrealistic that I could run out of time. I

needed to make sure that each part of my project would not take too long. This is why I needed to plan out my project better and really think about how I would do things. For example, I required the ability for the user to move the map and zoom. I knew this was possible, but I did not know how long it would take to develop.

After the inquiry was done, I would have a much better idea of how capable I was of completing the project before the due date. Of course, I would also use planning tools to help me manage my time and resources so that the project stayed on track.

### **Losing Data**

If my PC broke for example, I would not have lost the data stored on it, possibly including progress on my project. For this reason, I stored my files for the project in the cloud. For the project, I stored all my work on OneDrive. This way if hardware malfunctioned with the latest version on it, the progress would not be lost.

In addition, I would save my work as versions. This way if somehow, I did lose my work, I would only be set back to my last version, rather than to the very start again.

### **Loss of Internet**

If there was a temporary loss of internet, for the most part, work could continue. Although my work was stored on One Drive, it could be synced and stored locally on my PC and laptop. The same is true for my notes on OneNote. I made sure my OneNote and OneDrive data automatically syncs onto my PC and my laptop.

There are however things I could not do. I could not email Mr D [REDACTED], save work in the cloud, research, or message [REDACTED]. These things I required to do at times, therefore if there was loss of internet for over a day or so, then my project might have been seriously obstructed. But a temporary internet loss would only have been an inconvenience.

## **The Proposal**

After multiple cycles of research, decision making, testing, communicating with Mr D [REDACTED] and revising, a sharp and promising vision of TIMM had been developed. I produced a document outlining what TIMM would be and gave it to Mr D [REDACTED] for approval. This document outlined everything from what promotions would be shown, to the ‘quick find’ buttons, to the mechanics of the search engine envisioned. This document is included in the submission as evidence.

Mr D [REDACTED] was very happy with the proposal and accepted it (his emailed response to the proposal is seen in Figure X). Development was to begin on the 11<sup>th</sup> May.

Good morning [REDACTED]
Thanks for the info. I had a read through the proposal yesterday and it looks pretty comprehensive. To a layman like me, it looks like it could work, but I'm sure that [REDACTED] will have a better idea of the intricacies and its efficacy.
Good luck with the coding and progress, going forward. We look forward to seeing what you come up with.
Ngā mihi mahana, [REDACTED]

Figure 17: Reply email to the proposal from Mr D [REDACTED]

## Project Plan Section

---

### Project Management Methodologies

A structure was needed to how the project was managed as the prototype was created. Using a methodology helped by defining that structure. A methodology is a system of procedures and mannerisms that are methodically followed while managing a project. I read through various websites looking for possible options. I came down to three options.

#### Waterfall

Waterfall follows a linear, logical series of steps. First, the stakeholders discuss the requirements of the final product with those who are making it. Then the development stage commences. For this whole stage, the stakeholders do not interact with the developers. Only once the development of the product is complete is it shown to the stakeholders. In this methodology there is no revision by the stakeholders or changing of plans. If the product does not meet the requirements, then either the product will be changed (increasing time and cost) or the stakeholders will accept the product which they are unsatisfied with.

#### Rapid Application Development

First, everyone (including the stakeholders) discusses the requirements of the product and any problems that will be encountered. After the vision for the product is agreed on development begins. There are prototypes for each component of the final product. Many iterations of the prototypes are made. After each iteration, the prototype is tested, and it is made sure that (so far) the requirements are being met. If issues are found, they are fixed in the next iteration. Once all the content is made, building starts. All the now working parts of the product are put together to create the working build. Because the prototypes were carefully tested before, there should not be much friction in the final building, and it should happen quite quickly.

#### Agile

This approach is performed in chunks called sprints, each of which are identical in structure. Each sprint is planned prior, then the tasks for that sprint are designed. After the designing stage building starts, then it is tested and then reviewed. After the review (end) of one sprint comes the planning (start) of the next sprint. The chunking of the project means the plan can change, which is very useful in certain circumstances where it is very difficult to plan the entire project and follow that plan exactly. It also means that after each sprint there is a working prototype that can be tested and reviewed and shown to the stakeholder.

### Selecting a Methodology

First, the benefits and detriments to each methodology were considered, without considering how they would relate to this situation. Then I thought about how they would apply to my project in order to choose one to use.

#### Waterfall

Waterfall is certainly the simplest methodology of the three. It would be easy to implement and understand. Since everything is planned at the start, no time is spent changing plans down the line. This is only true however, if the planning is done properly. Progress is quite easily measured because the track of development is entirely planned in advance.

In waterfall, testing only occurs at the end of the project. Unnoticed weak points in the fundamental design of the project might have been found at this point. If something like that happens so late into the project, it would likely require massive work to change things or a crude solution. With only testing at the end, the quality of the product will probably be lower. There would likely be many small imperfections that would require large changes to fix. User feedback and stakeholder interaction is not present until late in the project. The stakeholder might see that the final product is not at all what they expected, or even wanted. At this point it may be too late to fix any issues, and it would probably be difficult to change. It is useful to have a perfect plan of the whole project upfront, but that is very hard to do sometimes. Stakeholders often do not know exactly what they want, which makes it difficult.

All the steps in waterfall have their own stage and only occur once with no opportunity to go back to a stage. I thought that this would not work well for me because I want to be able to do different stages at different times. This method is very restrictive. Waterfall works well if the plan is made perfectly, because nothing will go wrong then, and it will all happen smoothly in a linear fashion. But I knew that this would not happen and there would be issues in my project. I decided that my project is too complicated to plan out in such detail. I wanted Mr D [REDACTED] to be at least somewhat involved in the production, so that I knew I was doing what he wanted. Otherwise, when I showed him the final product, he might have told me it would not work. That kind of issue can easily be prevented with proper communication. For these reasons, I ruled out waterfall.

### Rapid Application Development

Using RAD, in theory, there would be a high chance of the stakeholders being satisfied with the final product, therefore no extension of project, therefore lower costs and time. Just like with agile, I realised that the stakeholder would likely be more satisfied during the development stage. In theory this methodology is a very fast way at getting a product.

As with agile, RAD requires regular communication with the stakeholder. I thought that issues with stakeholders not understanding the process of development may have come up with the frequent communication. The stakeholder may have thought the developers should do it one way, but the developers (who better understood what they were doing) knew that the best way to do it was another way. This could have caused the product to have ended up being low quality because, without the demands of the stakeholder the product would have been made a different (and better) way. I remember thinking how complicated RAD seemed. This affected my decision. RAD works well with projects that have components that are more independent and that once put together, make the final working build. I knew that for other kinds of projects however, RAD might not work so well with.

At the time of deciding, I wrote "This methodology is quite confusing to me and I find it difficult to picture how it would work for me. Furthermore, I have no experience with RAD.". I felt that RAD was risky to choose because I did not fully understand it. The issue of communication (as with agile) would not have been an issue because Mr D [REDACTED] would probably be engaged in the process. I felt that the potential issue of the stakeholders not understanding how things run, would not be a problem with Mr D [REDACTED]. On this small scale with just two people working together communication should not be a problem. RAD works well for projects with parts that can be developed separately, and the assembled later. I decided that my project is not like that. I saw it having layers built on layers with each stage being a working prototype. RAD would not have fit well with my project. For these reasons, I ruled out RAD.

## Agile

I realised that, in agile, issues are more likely to be resolved early on due to the frequent reviewing and working prototypes that are tested each sprint. Frequent revaluation of plan meant that the plan didn't go stale further on in the project. I realised that the stakeholder would likely be more satisfied during the development stage, since they can see what is happening. The project timeline could easily be added to or made shorter by adding or removing sprints. I realised that if time was running short the project can be changed to meet a smaller scope in a shorter time. This is far better than not having a working product. With lots of small chunks of work, progress is more easily predicted. This is because it is harder to predict how long all the work will take, than it is to predict how short parts of the work will take.

In agile, clear communication must be made regularly. I considered the fact that this might not have been able to happen which could have slowed down or disrupted the process. I knew that a lot of time would be spent on planning and reflecting on sprints. If too much time is spent on planning and admin tasks, then not enough actual work will be done. This is crucial.

Coming into this project I had used agile before to manage a previous project. This meant the agile was familiar and likely easier to get going with. I saw that the potential issue that communication could have slowed down the process, likely would not have been an issue in my situation. I knew that Mr D [REDACTED] was enthusiastic about the project and communication probably would not be an issue. Because my vision of the product was not very clear, this methodology worked well because it did not need to be very clear. I liked that the plan could change down the line. The sprints made things easier to plan, because things were taken step by step making the progress simpler. I had to be able to manage time. I thought that agile would work well for that because if I was running out of time, I would easily reduce the scope and a working product would still be made. I had to consider that there would be a lot of time spent on planning and reflecting on sprints. However, there would be lots of time saved from other ways by using agile. Agile was the methodology selected for the project. It was decided it was a very safe option and would likely work very well.

It was an easy choice after I thought about how it would apply to my situation Agile will work very well for me because this methodology is familiar and (as the name suggests) adaptable at any time. I am certain that this methodology would work just fine for my project, making it a very safe option.

## Project Management Tools

For the project to be successful, all the resources, the tasks, and the plan needed to be managed. More specifically, these were, the time and where it went, the scope of the project and how the end product was imagined, the communication with stakeholders and how we made decisions, the planned periods of work called 'sprints' which divided the project into manageable units, the ever so important planning of the project, and the tasks, because without tasks nothing would get done. To help manage these things, project management tools were used. There were certain prerequisites for these tools. The tools had to be free and available for enough time for the project to make use of them. Also, these tools needed to be available wherever I worked. If it was a digital tool, it needed to be accessible on my desktop PC at home, my laptop which I brought everywhere, and the school computers. If it was a physical tool, how I would always have access to it needed to be considered.

## Trello

Trello is a free customisable online Kanban board. Located at [trello.com](https://trello.com), Trello is made for managing tasks. You are able to make cards (representing tasks) and move those cards between different columns (such as "to-do", "doing" and "done"). Everything is customisable meaning you can name the columns and cards anything you like, change colours, and add details to cards.

## Burndown Generator

This is a totally free website that allows you to generate burndown charts. Located at [burndowngenerator.com](https://burndowngenerator.com), this service, although quite restrictive allows a PDF to be generated of an empty burndown chart. A burndown chart is a 2D graph with "work to-do" plotted against "time remaining". It helps the user visualise if they are on track, whether it's for a 1-week sprint or an entire year long project.

## Development Journal

A development journal is simply a text document (like on Microsoft Word) which is added to as a project goes on. It can be used to record many things, like when versions are completed, reports on progress, issues encountered, communication with stake holders, plan changes and sprint progression. The great thing about a development journal is that it is extremely dynamic and can be used to record anything. Its main functionality comes when needing to refer to something that has been recorded in the journal.

## DBDesigner

DBDesigner is a free online database designer. Located at [dbdesigner.net](https://dbdesigner.net), DBDesigner allows the user to make visual representations of databases by using components like tables and fields, as well as concepts like keys, auto-incrementation and data types.

## Casual

Casual is a website that allows you to manage tasks in a different way. Located at [casual.pm](https://casual.pm), casual allows multiple members of a team to organise the tasks in their project. Tasks can be made, deleted, marked as completed or uncompleted, moved and renamed. You can layout the tasks in an order so that a task can only be completed once previous ones have. The service is paid for, but there is a 7-day free trial.

## Quire

Quire is a free online task manager. Located at [quire.io](https://quire.io), quire allows two different views of the same tasks within a project. You can view your tasks in a list or in a Kanban board (just like Trello). You can make sub-tasks, add due dates, and change priorities of tasks. It even supports multiple people on one project. There are also some built-in graphs to visualise the progress of a project, as well as a phone app.

## Comparing Tools

Just as with the methodologies, the benefits and detriments to each project management tool were considered, without context of the project. Then the functional context was considered to help select an arsenal of tools to use.

## Trello

Trello is customisable and allows the user to adjust it to work for them. This creates a somewhat versatile environment. I realised that trello specialised in helping the user manage their tasks, and it does its job well. I saw that the aspect of being online allows trello to support multiple people to work on the same group of tasks (or 'board') at once. One important thing with big projects is dividing tasks into small tasks. Trello supports a couple levels of sub-tasks to do this. I considered how trello allows multiple boards to be made, which could be used to divide a project up. Trello has an interesting optional 'Butler' feature

which automates many operations saving time and hassle. I also saw that trello allows addition of complementary tool plug-ins. For example, a calendar, a burndown chart, and google drive.

Trello did have apparent negatives, however. There are minimal time management features available. The most there is, is due dates for tasks. Essentially, trello only manages tasks to-do, doing and done. I realised how this is very specialised. Unfortunately, the premium features such as the ‘Butler’ and the plug-ins were paid for.

Trello met the requirements of being free to use indefinitely and available online and therefore everywhere needed. Trello was familiar to me. I had used it to manage previous projects, and my experience with it made it more of a safe choice. The feature of allowing a team of people to work on the same plan was made redundant due to the number of people working on the project. The area trello specialises in clearly applied very well to the methodology of the project: agile. However, I thought it might have been too specialised. I considered how trello didn’t have much time management features but realised that didn’t matter because I would be using multiple tools which specialise in other areas such as time management. Not only were the flash features of AI and plug-ins paid for, I also did not think they would help my project all that much.

### **Burndown Chart**

It is simple to use the burndown chart website to generate a template and wouldn’t be too difficult for most people to fill in the chart as time progresses. Using a burndown chart simply helps with knowing if a project is on track or not. It gives an easy to digest visualisation of the project timeline. It can also help a team be motivated to get the job done.

Unfortunately, this tool was not the perfect option. I saw how restrictive the website was. For example, you cannot change the font, the colour of anything, or the origin point, and the axis can only have predetermined numbers on it, and not dates or specific numbers. Although burndown charts are easy to understand they can only show some of the picture. Because of the crude way it projects the future, potential problems and obstacles can be hidden from sight. Because the chart will be filled in by human judgement alone, it could be very inaccurate.

The burndown chart website was always free to use, and available when I would have needed it. I thought that using a chart like this would genuinely help motivate me to meet the mark at each checkpoint. And I thought it would work very well with the agile methodology. The website is very restrictive; however, I would only use it once, and I could manipulate the template to my liking without much trouble.

### **Development Journal**

A development journal would be very useful when needing to recall details from a previous day. A journal like this would also keep workers accountable, if it was made public, and help them stay aware of everything they are doing. The journal has no rules. It can be used for anything at all. For example it could be used to planning and reviewing sprints, or to record communication with stakeholders. It is such a versatile platform to use.

However, when using a journal like this, one would have to consider the risk of ‘holes forming’ from it becoming unstructured. Depending on how it is executed the journal could be an unattractive wall of text, which would defeat the purpose of the journal.

Of course, this tool would be free to use, and accessible everywhere depending on how it is executed. I had previous experience with a development journal in another project, so I was better equipped to use the tool correctly. I knew that so long as I define a rigid, functional structure to the journal, there would be no issues, and the journal would be a great benefit. I realised that because of how flexible this tool is, it would be perfect for ‘filling in’ the gaps left by the other tools I chose. Overall, I thought that a journal would be a great tool to help keep me on top of my project.

## **DBDesigner**

DBDesigner is simply able to design any database imaginable with their simple tool. This is very helpful when making a database because it makes sure everything runs smoothly. There is ease of sharing database designs and exporting them to a file. Because it is online, multiple people can edit a design at once from anywhere in the world.

I think the only negative to this tool is how specialised it is. It is only good for designing databases.

The DBDesigner website is free to use, which is required. It is irrelevant how specialised this tool is, because it would do its job well, and other tools would cover everything else needed.

## **Casual**

Casual does so many of the same things as trello, but in a different way. It seemed easy to use, and very customisable. Casual supports multiple boards, multiple people working on it at once and due dates, just like trello. The main difference to trello is in how it presents the tasks in an organic and graphical way. There is also the ability to store files on the platform.

This tool is quite basic and unappealing, which is important, and in effect, could have a serious impact of how it is used. A potentially significant downside to casual is in how there is no support for sub-tasks. Also, there is minimal time management, just as with trello.

Casual is online which would have worked well for the project. But it is a paid product with just a 7-day free trial period. I simply could not select a tool that costs a subscription.

## **Quire**

Quire has all of the features that both casual and trello have. It appeared easy to use, very customisable, and it supported due dates, for example. On top of these features, quire offered a few attractive features. For example, quire automatically generates graphs representing the progress of the project. This would have been similar to what the burndown chart would have done. Quire shows tasks in both a Kanban board, and a list. You can make more lists and more Kanban boards with different tasks on. This allows user to effectively manage tasks being completed. Unlike casual, quire supports endless sub-tasks of tasks. These features come together to produce a tool that supports better time management compared to trello and casual. Quire also has a phone app.

Quite possibly the only negative I found in quire was how there were just two options for themes (colour schemes) for the app.

Quire is free and online so I knew it would be able to be used how I needed. Quire offered me precisely what I wanted and needed when it came to task and time management. I saw all of the features Quire offers being very useful for my project within the agile methodology. I knew I could use multiple boards and lists for different sprints, for example. Additionally, the seemingly endless sub-tasks would have been very useful for increasingly complex tasks. I thought that the visualisation of the project could give a very easy way to manage time and see how I am going, especially when compared to the burndown chart option. I considered how the phone app might just be a gimmick, but I did see it being handy.

## **Selecting Tools**

After considering all the options carefully, I found the decision fairly easy.

### The Tools:

1. Quire
2. Burndown Chart
3. DBDesigner
4. Development Journal (a .docx file saved in the cloud)

Quire would serve as my main task manager. It would help organise my sprints and of course all of my tasks. I picked Quire over Trello and Casual because, essentially Quire offered everything they do, and more. Overall Quire seemed like a very smooth app which would allow me to do so much.

My other three tools would fill in the gaps that Quire had left open.

The burndown chart would be the main tool that managed my time. I would make a chart for the whole project. It would allow me to forecast my progress and make sure I was on track.

DBDesigner would help me design my database. Although it would only be used for about a week or two, it would still save me time and resources.

Essentially, I would use a development journal to record what I did, what I would do and what I was thinking. It would help me be aware of what I needed to do.

## ***Plan of the Development Process***

How the selected methodology and tools would be incorporated to effectively develop the outcome had to be planned. Agile provided the structure to the development of TIMM. At the same time, the tools such as the development journal and quire were there for the main reasons of helping manage resources and plan. But it was not clear how these elements would be incorporated.

### **Agile & Sprints**

Each of the 4 sprints was to be 2 weeks in duration. Each sprint was to have the same steps as listed below.

#### Process of a Sprint

1. Planning
  - o The tasks to be completed in the sprint are decided.
  - o The plan is recorded in the development journal and the tasks are put on Quire.
  - o This is dependent on how long I think these tasks will take, and whether my development is on track or not.
2. Designing
  - o Some of the tasks will require thought and design before they are carried out, these tasks will be designed.
  - o For example, the structure of the database, or how encryption will work.
  - o Designing might look like sketching the UI, or using DBDesigner.net, or writing pseudo code on some paper.
  - o The designing can be recorded in the development journal, or by saving it as a file.
3. Building
  - o The tasks are carried out.
  - o If issues found from testing (next step), building is carried out again to fix them.
  - o Quire tasks are moved around as they are completed.
4. Testing
  - o The work done is tested to see if it is on track to meet the project requirements.

- Testing could be performed by showing the product to people who are less familiar with the product.
  - Testing could look like seeing if functions individually perform as they are meant to.
  - Results of testing are recorded in the development journal.
  - If issues were found in the testing step, then the sprint will return to the building step to fix these issues.
5. Version is built
- After all tasks are completed and issues are ironed out, then the version is built ready for demonstration.
  - When versions are built it is recorded in the development journal.
6. Demonstration
- The build is demonstrated to stakeholders, to classmates and my teacher Mrs Davey.
  - This will most likely involve screenshots and videos, with annotation.
  - Feedback is taken.
7. Review
- The demonstration will be discussed in the development journal.
  - The feedback given from the demo will be considered and may influence my next sprint's planning.
  - The work completed in the sprint is looked over.
  - Reflection on whether the project is on track or not is made.
  - Burndown chart is filled in. It is also filled in halfway through (1 week into) the sprint.

### **The Development Journal**

This .docx file was to be used to record information across development. The document was divided by sprint, then date of entry. I could make a journal entry for any given day during development. Recording some types of information was required, whereas recording other types of information was optional. The information recorded in the journal is below.

#### **Mandatory Information Recorded**

1. Plan for sprint
  - (Step 1 of the sprint)
2. Testing results
  - (Step 4 of the sprint)
3. When versions are completed
  - (Step 5 of the sprint and 'smaller' versions throughout each sprint)
4. Review of demo
  - (Step 6 of the sprint)
5. Communication with stakeholders
  - (Mostly step 6 of the sprint, but whenever it occurs)
6. Sprint review
  - (Step 7 of the sprint)
7. Burndown chart
  - (Step 7 of the sprint, and every other week)

#### **Optional Information Recorded**

1. Designing

- (Step 2 of the sprint)
- 2. Screenshots of Quire board
  - (Mostly Step 3 of the sprint, whilst moving tasks around)
- 3. Issues encountered
  - (At any point that issues are encountered)
- 4. Plan changes
  - (At any point that plans are changed)
- 5. Reports on progress during sprint
  - (At any point of the sprint)
- 6. Stats from Quire
  - (At any point of the sprint)

## Quire

The main purpose of quire was for planning tasks and their due dates. I used the list view (seen in figure 18) of all the tasks to plan the development schedule and all the tasks and sub-tasks of each sprint. A Kanban board in quire was made for each sprint (seen in figure 19). This was used to visualise what tasks were done, doing, and still to do.

Figure 18: Quire list view of tasks

Figure 19: Example of quire Kanban board

## DBDesigner

I intended to use DBDesigner (example seen in figure 20) to design the database before using it.

Figure 20: Example of DBDesigner

## Burndown Chart

I was to fill in a burndown chart each week (the original template is seen in figure 21).

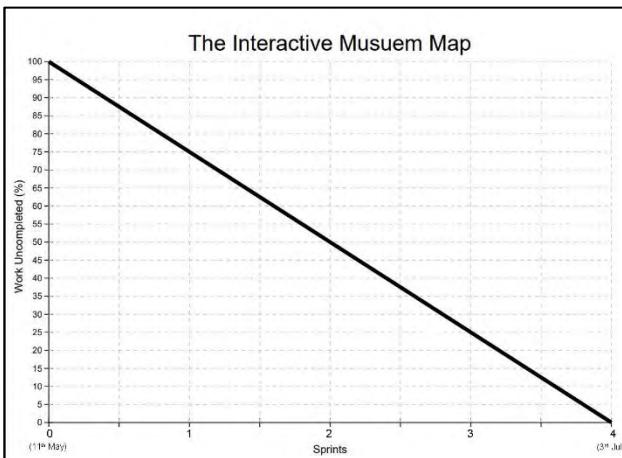


Figure 21: The burndown chart template

## Versions

Towards the end of every sprint there are 'main versions'. These were to be called 1.0, 2.0, 3.0 and 4.0. This way 4.0 will be the final version of TIMM. There were also 'sub versions'. These were to be called 1.1, 1.2, 1.3, etc.

The main versions are the ones which will be demonstrated. For this reason, I will focus on making the main versions perfect more than sub versions. However, every version will be a 'complete' build.

Every time a version is built it will be recorded in the development journal.

## The Development Schedule

To a large extent, the entire project was planned out before it started.

### Sprints & Main Tasks

The development was to begin on the 11<sup>th</sup> May, and it was to end on the 3<sup>rd</sup> of July. That gave 8 weeks of development, which were divided into groups. There were planned to be 4 sprints, each 2 weeks long. Each sprint was planned from the start to have 2-4 main tasks to be completed.

Quire was used to plan this development schedule (seen in figure 22). The main tasks were planned out from the start and given dates to be started and completed.

↑	Build app with shape of the museum	Sprint 1	11 May - 15 May
▶	Add feature to allow zooming and panning	Sprint 1	16 May - 20 May
▶	Add feature to allow viewing both floors	Sprint 1	21 May - 23 May
▶	Build database	Sprint 2	25 May
▶	Connect database to program and show items on the map	Sprint 2	
▶	Add the quick find feature	Sprint 2	
	Add the pages for map items	Sprint 2	6 Jun
▶	Add the help menu	Sprint 3	9 Jun
	Add the admin section	Sprint 3	20 Jun
	Add the search feature	Sprint 4	23 Jun
	Add advertisements	Sprint 4	3 Jul

Figure 22: The development schedule on quire

## Sub-Tasks

At the start of each sprint I would divide my main tasks of that sprint into sub tasks. For example, at the start of sprint 6 (there were more than 4 sprints because the project schedule changed part way through) I planned out all the main tasks (seen in figure 23).

Finish the map item management section	Sprint 6	Jul 20 - Jul 26
Allow removal of items	Sprint 6	Jul 20 - Jul 22
Allow editing of items	Sprint 6	Jul 22 - Jul 26
Improve aspects of data storage in the app	Sprint 6	Jul 27 - Jul 29
Automatically compress images submitted to the app	Sprint 6	Jul 27 - Jul 28
Convert all submitted images to .jpg files	Sprint 6	Jul 27 - Jul 28
Implement backing up of the database	Sprint 6	Jul 28 - Jul 29
Add protection against SQL injection	Sprint 6	Jul 30 - Jul 30
Add advertisements	Sprint 6	Jul 30 - Aug 2
Allow a (now blank) promotional screen to appear at anytime on the map screen	Sprint 6	Jul 30 - Jul 31
Decide which promotions/adverts to make	Sprint 6	Jul 31 - Aug 1
Build advert 1	Sprint 6	Aug 1 - Aug 1
Build advert 2	Sprint 6	Aug 1 - Aug 1
Build advert 3	Sprint 6	Aug 1 - Aug 2
Build advert 4	Sprint 6	Aug 1 - Aug 2
Make adverts appear automatically	Sprint 6	Aug 2 - Aug 2
Fix all visual issues in the app (make everything look at least decent)	Sprint 6	Aug 3 - Aug 4
Go through all comments in the program (make very readable)	Sprint 6	Aug 3 - Aug 4
Improve the shape of the museum	Sprint 6	Aug 3 - Aug 4
Make the admin screen dark	Sprint 6	Aug 4 - ...

Figure 23: Planning of sub-tasks in quire

# *Project Section*

## **Communication with Stakeholders**

## Emails

Every sprint I would email Mr D [REDACTED] giving him an update as well as a demonstration video.

Mr D [redacted] would of course reply with his thoughts (an example is seen in Figure 24).

These emails have been included in the submission for evidence.

Hi [REDACTED]

This is looking great, and [REDACTED] was very impressed with your work when he saw you on Friday. The ability to add items to the map looks very user-friendly and intuitive.

Yes, I agree that the search bar feature can be left out for now – the map covers the basics and, worse-case-scenario, visitors can ask a Museum guide or staff member about specifics.

Keep up the great work, and all the best!

Nqā mihi mahana,

*Figure 24: Example of an email to Mr D*

## Demonstration Videos

Every two weeks, towards the end of every sprint, a video was produced to demonstrate the product at that point. Each video was sent with that sprint's email to Mr D [REDACTED] for review. These videos have been included in this submission for evidence. The video would be a screen capture of me using the product in a way to show all the new features. This process doubled as a way to test the product.

## *Testing TIMM*

## Text Input

I tested for how my app responds when entering intentionally ‘dangerous’ text into textboxes. For example (seen in Figure 25) I entered a string of many slashes, speech marks and ‘\n’ characters. Thanks to my algorithms my program gave the correct responds and did not throw any exceptions. I tested all the text boxes in my app this way.



**Figure 25:** Testing text input

## Valid Image Type Function

I isolated and tested a function designed to determine whether a file is of an image type in a list VALID\_IMAGE\_TYPES. I gave the function (seen in Figure 26) a variety of string inputs to see if it produced the correct response.

```
1775 def valid_image_type(image_loc): [INFO]
1776     """returns whether the image has a file type in VALID_IMAGE_TYPES"""\n1777     # get the file type (just the '.jpg' part for example)\n1778     file_type = image_loc[image_loc.rfind('.'):]\n1779     # check if is an image file is in VALID_IMAGE_TYPES\n1780     if file_type in VALID_IMAGE_TYPES:\n1781         # valid file type\n1782         is_valid_type = True\n1783     else:\n1784         is_valid_type = False\n1785     return is_valid_type\n1786\n1787 print(valid_image_type(''))\n1788 print(valid_image_type('.'))\n1789 print(valid_image_type('.jpg'))\n1790 print(valid_image_type('....jpg'))\n1791 print(valid_image_type('lol.'))\n1792 print(valid_image_type('lo.lol.lol.lol'))
```

**Figure 26: Testing the valid image function**

## Double Movement of Markers

In testing of the app, I found that after reloading the map background there was an issue. The markers would move out of sync with the background (seen in Figure 27). After debugging for a while, I found that I had forgot to unbind the old on\_motion event when reloading the background. What was happening was the event would be bound again every time the background was reloaded and there would be multiple calls to on\_motion of the markers (seen in Figure 28). This caused the markers to move twice (or 3, 4, 5... times) as fast as the background.

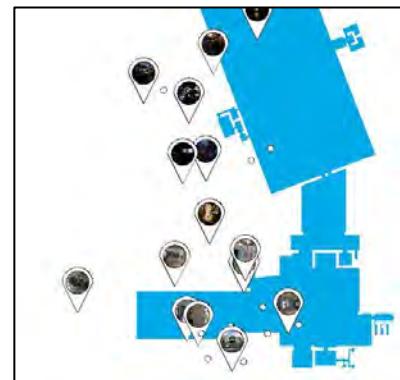


Figure 27: Screen capture of bug

```

100     def reload_background(self):
101         """Closes the background, then reopens it."""
102         # get a list of all child widgets that won't change when removing them
103         child_widgets = []
104         for child in self.children:
105             child_widgets.append(child)
106         # remove the marker_layout widget from this list
107         for child in child_widgets:
108             if isinstance(child, self.marker_layout.__class__):
109                 child_widgets.remove(child)
110         # remove the background widget from this list
111         for child in child_widgets:
112             if isinstance(child, self.background.__class__):
113                 child_widgets.remove(child)
114         # unbind on_motion callback before removing the background widget
115         window.unbind(on_motion=self.background.on_motion)
116         # remove all child widgets from the app_layout
117         self.clear_widgets()
118         # add the background again
119         self.open_background()
120         # reopen all other child widgets (overtop of the background)
121         for child in child_widgets:
122             self.add_widget(child)

```

Figure 28: Reload background function with bug

## SQL Name Not UNIQUE

I was testing the making map item section of the app and I found that you could easily cause an SQL error. This was possible because the inputted name was not cleared after making an item. This meant the name was not checked again before trying to insert it into the database. I simply made sure the name was cleared when an item was made.

## No Attribute ‘button’

I was testing inputs to the app such as pressing unexpected keys on the keyboard and mouse. I also tried using my laptop's touch screen. As soon as I used the touch screen an error occurred: “WM\_MotionEvent” object has no attribute

‘button’”. This was because my program assumed that all ‘motion events’ (which are clicks, scrolls, drags, etc) has a button attribute. Of course, a touchscreen event doesn’t have a button associated with it, so the error occurred (seen in Figure 29). I fixed this issue by checking there was a button attribute before checking it (seen in Figure 30).

```

def on_motion(self, window, etype, motionevent):
    """Will receive all motion events (clicks + movements)
    motionevent.dpos is the delta movement of this event"""
    if not self.app_layout.mapitem_is_open and not self.app_layout.helpscreen_is_open:
        # if the mouse button is a left click
        if motionevent.button == 'left':
            # if the user moved their mouse while clicked down
            if etype == 'update':
                # respond to the mouse drag by moving shape that distance
                self.move_floors(motionevent.dpos, self.shapes)
            # if the user just released their click
            elif etype == 'end':
                # respond to the mouse drag by moving shape that distance
                self.move_floors(motionevent.dpos, self.shapes)

```

Figure 29: The on\_motion function with a bug

```

def on_motion(self, window, etype, motionevent):
    """will receive all motion events (clicks + movements)
    motionevent.dpos is the delta movement of this event"""
    # if not in the map item screen or on help page
    if not self.app_layout.mapitem_is_open and not self.app_layout.helpscreen_is_open:
        # if the mouse button is a left click
        if (not ('button' in motionevent.profile)) or motionevent.button == 'left':
            # if the user moved their mouse while clicked down
            if etype == 'update':
                # respond to the mouse drag by moving shape that distance
                self.move_floors(motionevent.dpos, self.shapes)
            # if the user just released their click
            elif etype == 'end':
                # respond to the mouse drag by moving shape that distance
                self.move_floors(motionevent.dpos, self.shapes)

```

Figure 30: Adjusted on\_motion function

## Fake Image Files

I wanted to see what would happen when a non-image file disguised as an image file was imported. I made a .txt file and renamed it to “text\_file.jpg”. I tried to import it and it crashed (seen in Figure 31). This was a part of a collection of tests I did on inputting image files into the app.

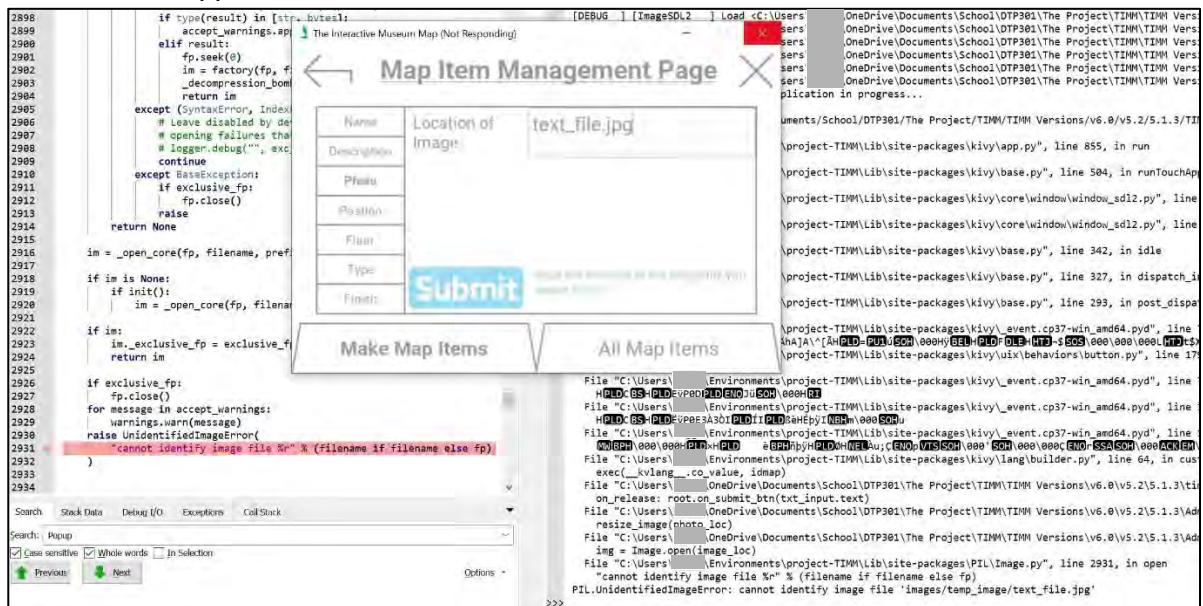


Figure 31: App crashing due to fake image file

## Strange Dots

Near the beginning of the development, I tested with unexpected inputs. I found a strange occurrence when using the right-click or middle mouse button in the app. Dots would appear (seen in Figure 32) when I pressed these buttons. I assumed this was something Kivy does by default because there was no way I accidentally programmed that in. I was right and I just had to change some settings (seen in Figure 33).

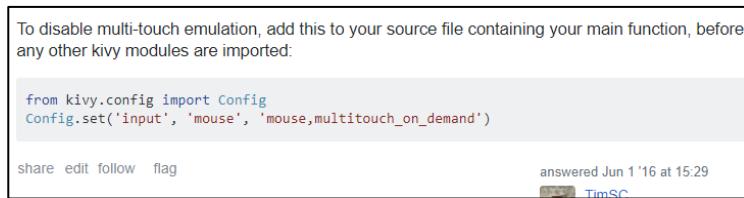
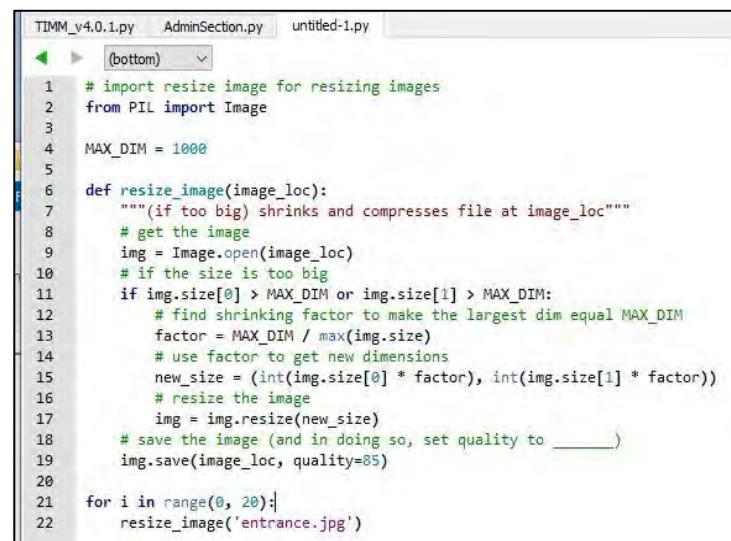


Figure 32: Strange dots appearing

Figure 33: Resolution to strange dots

## Resizing Images Multiple Times

I used compression and image resizing to reduce size of files and speed up the app. When editing a map item, the image would be removed then inserted again into the app. In this process it would be re-compressed. I wondered if doing this many times would cause an image to lose quality more than one compression would cause it to. I tested the resize function by using a loop (seen in Figure 34). I resized the same image 20 times. There was no quality lose or even decrease in size compared to the same image after just one compression.



```

1 # import resize image for resizing images
2 from PIL import Image
3
4 MAX_DIM = 1000
5
6 def resize_image(image_loc):
7     """(if too big) shrinks and compresses file at image_loc"""
8     # get the image
9     img = Image.open(image_loc)
10    # if the size is too big
11    if img.size[0] > MAX_DIM or img.size[1] > MAX_DIM:
12        # find shrinking factor to make the largest dim equal MAX_DIM
13        factor = MAX_DIM / max(img.size)
14        # use factor to get new dimensions
15        new_size = (int(img.size[0] * factor), int(img.size[1] * factor))
16        # resize the image
17        img = img.resize(new_size)
18        # save the image (and in doing so, set quality to _____)
19        img.save(image_loc, quality=85)
20
21    for i in range(0, 20):
22        resize_image('entrance.jpg')

```

Figure 34: Testing the resize\_image function

## Decision Making

### Not implementing the search bar

On the 17<sup>th</sup> of July, I started to consider to scrap the plan to create a search bar in the app. With limited time, and other higher priority tasks, there was pressure to remove it.

The search bar would have taken a lot of work to implement for only a couple improvements to the app. It would have allowed users to easily find items by searching by name. And it would have given a platform for other smaller features. Whereas, with the same time, I could have done many other tasks that would have increased the quality of the app far more. I made a list of these tasks.

### Alternative Tasks

- Add high quality advertisements and promotions
- Finish the admin section
- Thoroughly test the app
- Protect against SQL injection
- Implement backing up of data
- Compress images automatically
- Convert all submitted images to jpg
- Improve the shape of the museum
- Make the app look better (maybe dark admin screen)
- Allow editing of the information in the help menu
- Allow quick find buttons to be customised
- Allow changing of item types
- Improve commenting of code

Before making such a big change, I emailed Mr D [REDACTED] about this topic (seen in Figure 36). In his response (seen in Figure 35) he agreed to leave out the searching feature for now. We realised the this feature could be easily implemented later on.

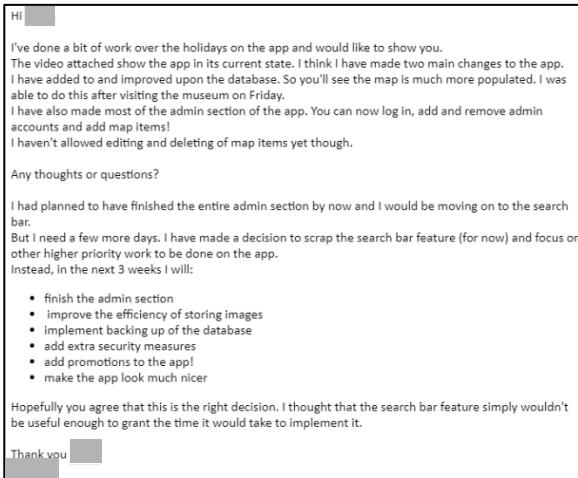


Figure 36: Email to Mr D [REDACTED]

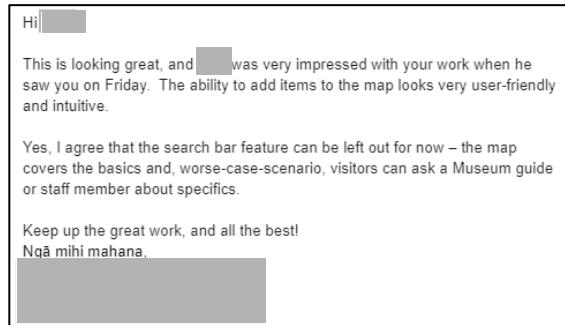


Figure 35: Reply email from Mr D [REDACTED]

## Username Length

There was the option of including a minimum username length to the admin accounts in the app. I had seen this in other applications and wondered what the advantage was. A web forum (Why is there a minimum username length?, 2013) had a lot of information on why applications do and do not have username length restrictions. Forcing everyone to have usernames of length of at least 6 for example, reduces the chance that users will try select a username already in use. Short usernames are more liable to being attacked by spam bots because they are more easily randomly generated. (Google, 2012) Many said that in applications with a small userbase, there is no use for a minimum username length. Because my app did not have a large database, there was no reasons to restrict minimum username length to more than one character.

## Reflection Section

### The Final Product

On the 10<sup>th</sup> of August, I sent an email to Mr D [REDACTED] (seen in Figure 37) announcing the completion of TIMM. He was to come to see the product in real life, so I did not include a demonstration video as usual.

Hi [REDACTED]

I'm very happy to tell you that the app is complete!  
I will do some testing of the app to make sure it works as intended, but I won't be implementing anything new.  
Rather than sending you a final demo video, I think it would be best that you see it when you come to Lincoln.

Thank you for this opportunity, Hope to see you soon!

Figure 37: Final email to Mr D [REDACTED]

Kia ora [REDACTED]

That is good news – well done. We look forward to seeing you all in October.

Until then, all the best with your exam/assessment preparation, etc.  
Ngā mihi mahana,

Figure 38: Final reply email from Mr D [REDACTED]

The final product was, as envisioned, a prototypical interactive map of the Wigram Air Force Museum. The Windows app was written in Python with numerous modules included, most notably Kivy. The application files were converted into an easier to run version which has been included in this submission for evidence.

### Use of the Methodology

Agile served the project tremendously well. Without the frequent communication and review of the product with the stakeholders, the product would have likely gone in wrong directions. This communication also kept motivation high throughout the entire project. It is difficult to imagine the project without the sprints that made it up. It made projection of the development a breeze and it produced a feeling of progression even when progression was slower than normal. The cyclic process of the sprints worked extremely well to produce a worthy product. At every sprint's end, there was a working product ready to be shown off.

## Use of Tools

### The Development Journal

I used the journal (a small part is shown in Figure 39) for a variety of purposes, and it served me very well. Included in the submission is a copy of the journal as evidence.

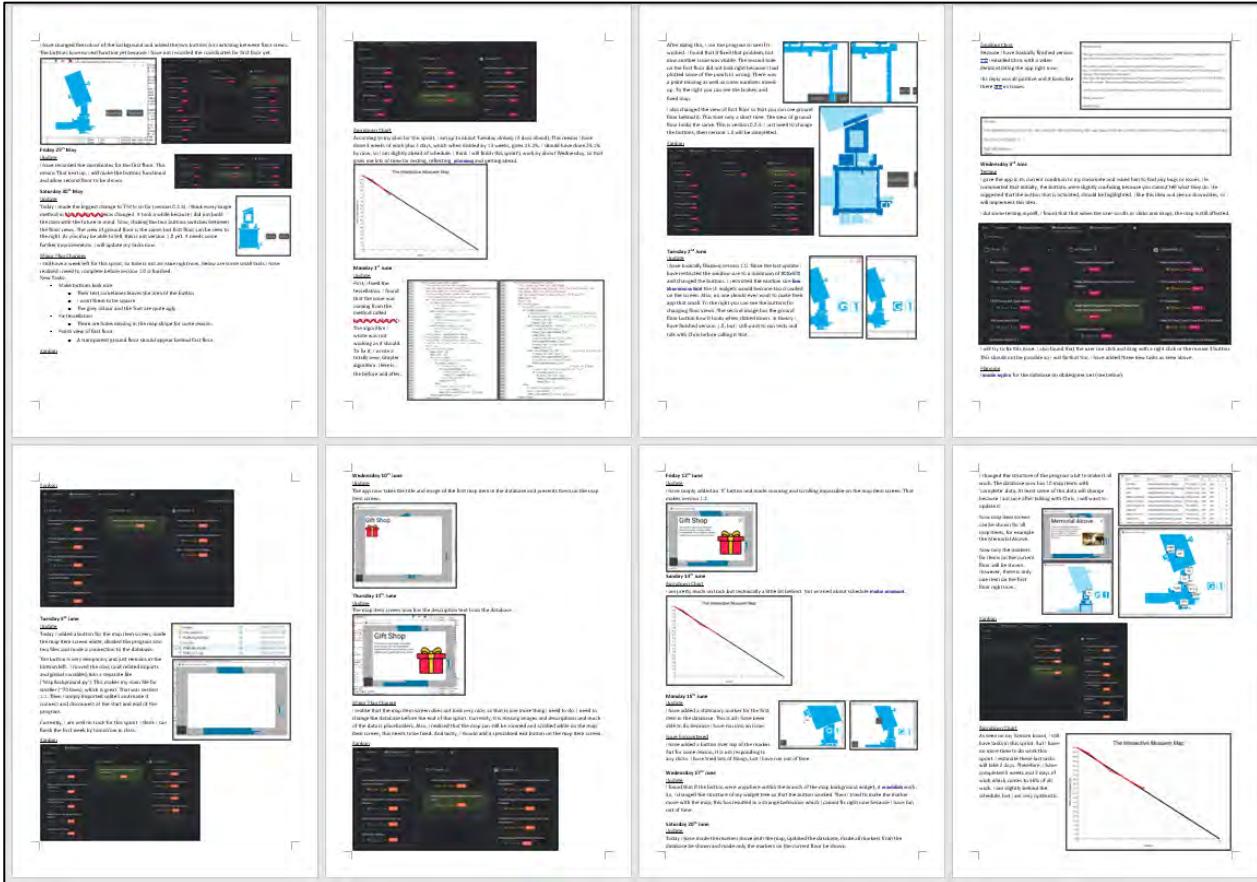


Figure 39: Some pages from the development journal

### Quire

I used quire to keep track of tasks throughout the project (examples shown in Figures 40 & 41). It successfully helped me stay on track and more. Included in the submission is a folder of screen captures of the Kanban boards.

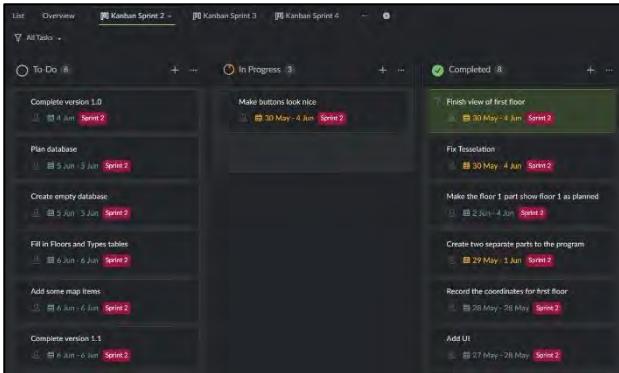


Figure 41: First example of Kanban board

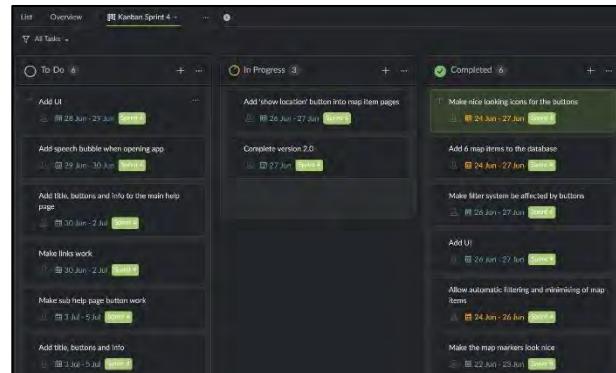


Figure 40: Second example of Kanban board

The overview of tasks in quire (seen in Figure 42) was extremely helpful to the project.

<input checked="" type="checkbox"/>	Build app with shape of the museum	Sprint 1	11 May - 15 May
+	Add feature to allow zooming and panning	Sprint 2	16 May - 20 May
<input checked="" type="checkbox"/>	Test how inputs work	Sprint 1	16 May - 17 May
<input checked="" type="checkbox"/>	Implement zooming	Sprint 1	18 May - 19 May
<input checked="" type="checkbox"/>	Implement panning	Sprint 2	25 May - 26 May
	Complete version 0.2	Sprint 2	Tomorrow
+	Add feature to allow viewing both floors	Sprint 2	27 May - 4 Jun
	Add UI	Sprint 2	27 May - 28 May
	Create two separate parts to the program	Sprint 2	29 May - 1 Jun
	Make the floor 1-part show floor 1 as planned	Sprint 2	2 Jun - 4 Jun
	Complete version 1.0	Sprint 2	4 Jun
+	Build database	Sprint 2	5 Jun - 6 Jun
	Plan database	Sprint 2	5 Jun - 5 Jun
	Create empty database	Sprint 2	5 Jun - 5 Jun
	Fill in Floors and Types tables	Sprint 2	6 Jun - 6 Jun
+	Connect database to program and show items on the map	Sprint 3	8 Jun
+	Add the quick find feature	Sprint 3	21 Jun
	Add the pages for map items	Sprint 4	22 Jun
+	Add the help menu	Sprint 4	5 Jul
	Add the admin section	Sprint 5	6 Jul - 19 Jul
	Add the search feature	Sprint 6	20 Jul
	Add advertisements	Sprint 6	7 Aug

Figure 42: Quire's overview of tasks

Quire offered an 'Overview' page (seen in Figure X) to look at graphs of the project. I thought this would be very helpful, but it did not turn out helpful at all. Though, you can see how gradual the progress I made was.

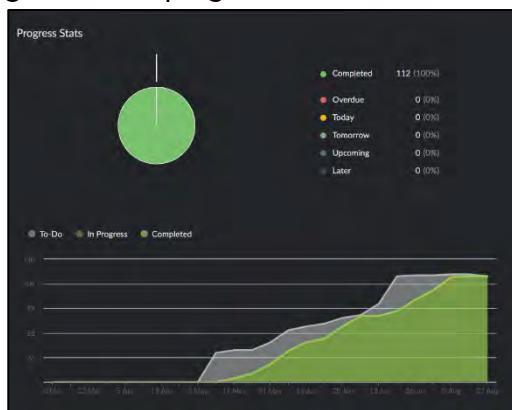


Figure 43: Graphical overview in quire

### Burndown Charts

Filling in a burndown chart every week (examples in Figures 44 & 45) helped me know if I was on track and keep motivation high.

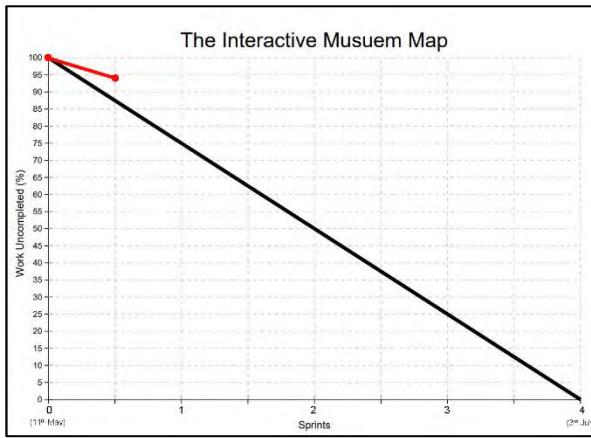


Figure 45: First example of a burndown chart

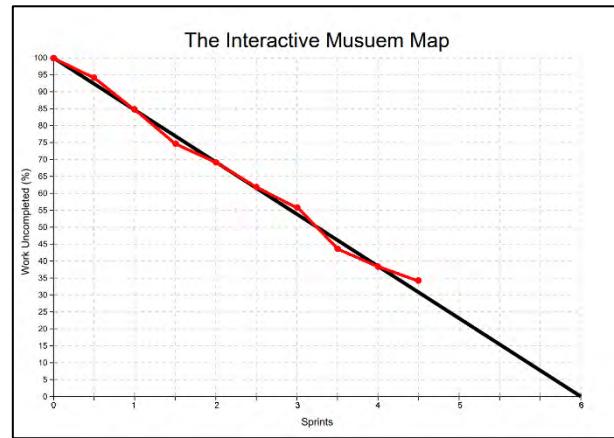


Figure 44: Second example of a burndown chart

## DBDesigner

When I designed the database, it was done with DBDesigner (seen in Figure 46). It helped me visualise the design very well.

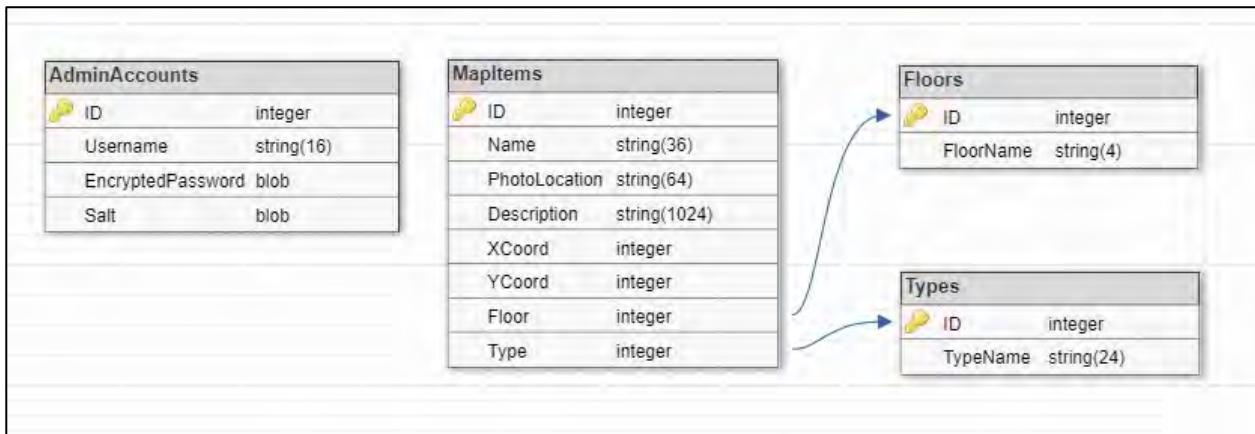


Figure 46: DB design

## Meeting of Proposal Guidelines

Many statements were made in the Proposal of TIMM. How many of these statements were made true? This will help to tell whether or not the final product met the proposal well.

### What issues was the product to provide solutions for?

Statements were made such as “My product will present advertisements/reminders to donate to the museum... and hire the venue for a party.”, and “I will include links to websites inside the app so that people can find out more.”. Whether it was helping disabled visitors to enjoy the museum, or promoting revenue sources of the museum, TIMM provided solutions to all the issues it set out to.

### What features was the product to contain?

The app was planned to contain features such as quick find buttons, a help section, encryption of data and a search engine. Every single feature discussed in the proposal was included in the final version of TIMM, except of one. The search bar and its engine were not an included feature in the final product. Since Mr D [REDACTED] agree with the decision to pass on this feature, this cannot be seen as a failure.

### What specifications was the product to meet?

Specification in the proposal were intentionally kept open to adjustment, so that justifiable changes could be made later on. Because of this, the final product meets the specifications set out for it to meet in the proposal.

### Did the final product meet the guidelines of the proposal?

Yes, with the justifiable exception of the search engine.

## ***The Stakeholder's Thoughts***

On Wednesday the 16<sup>th</sup> of September, Mr D [REDACTED] Mr H [REDACTED] and Ms S [REDACTED] visited to see the presentation of the product. The presentation was a success and all three of these stakeholders said they were impressed. Unfortunately, no comments were recorded from this interaction.

## ***Future Opportunities***

### **The Admin Section**

It is important for the admin users to have flexibility adjusting aspects of the app, to meet the way the museum changes. There are many things in the app that an admin user might want to change. The map items are one of them, which has been addressed, but there are many more.

One of the things an admin user might want to change is the map shape. Digitally, the map shape is simply a collection of coordinates for the corners of the shape. An interface could be added which allows admin users to intuitively edit these points in order to change the museum's shape.

Each map item is given a type such as 'eatery', 'gallery', or 'toilet', taken from a fixed list. Someone could implement a way to edit the list of map item types. This would not take long to implement.

There are three groups of item types with buttons for on the main screen. A feature allowing an admin user to add, remove and adjust these buttons would be useful. One issue with this is that maybe the admin user would also want to change the button icons, this part could be difficult.

The information in the help section being fixed could be a problem. The people at the museum may want to add, edit, or remove information in this section. This idea might be difficult to implement because the program would have to work well for any information given to it.

The app creates backups of the database when it is edited. However, there are some problems with this. There is system to swapping between databases from within the program. So, if an admin user wants to go back to an old version, this would not be as easy as it could be.

### **Making TIMM Mobile**

Ultimately, the app was meant to be able to run on mobile devices and it would be put onto mobile app stores. There are a few things one would have to do in conjunction in order for this to work.

One would have to put the database on a web server so that it can be accessed by anyone in the world. This means that an admin user could edit the map from another country via the

internet. This could be done fairly easily, but possibly at some monetary cost. There are many services available for web hosting.

The app would have to run on mobile devices. Kivy allows for this. But that does not mean it is not without difficulty. There are many differences in how the app would work on different devices. For example, zooming with a scroll wheel would not work on an iPhone.

Lastly, the app would be put on the App Store, and/or the Google Play Store. There are a number of restrictions to both platforms, that would have to be addressed.

### The Search Engine

The search engine envisioned was not implemented. Someone could implement this feature just as it was planned.

Even then, the search engine that was planned was quite rudimentary. For example, it would not have been able to handle simple spelling errors (e.g. “aircarft” instead of “aircraft”), or the use of synonyms (e.g. “plane” instead of “aircraft”). someone might improve the engine to allow it to handle these kinds of issues.

### Map Markers

All the markers of map items look similar. This has been an obvious was that the aesthetics of the app could be improved.

It might not look right for items like stairs or toilets to be shown with the same pointer shape as exhibits. I use these examples because of the map I was given by Mr D [REDACTED] (seen in Figure 47). The toilets, stairs and elevators are displayed differently to the rest of the items. It could be a good idea to display special items like these differently to the rest.

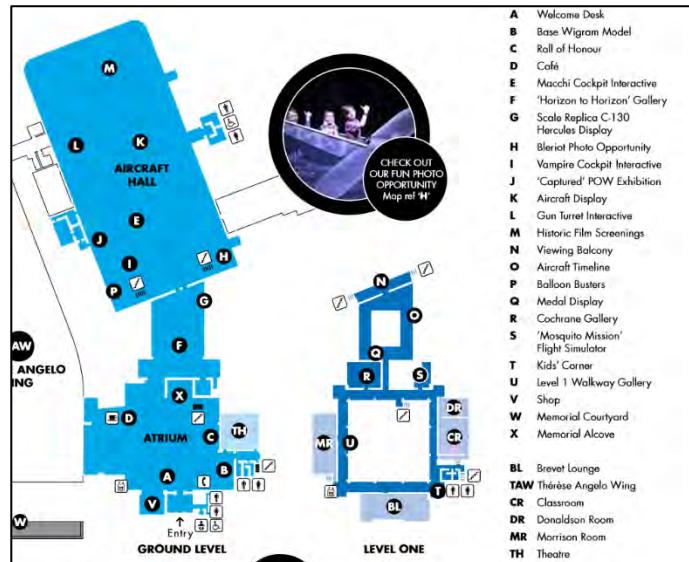


Figure 47: Map given by Mr D [REDACTED]

## References

---

- Accessing The Collection.* (n.d.). Retrieved from Air Force Museum: <https://www.airforcemuseum.co.nz/collections-research/research/accessing-the-collection/>
- Amos, D. (2020, January 22). *Python GUI Programming With Tkinter*. Retrieved from realpython: <https://realpython.com/python-gui-tkinter/>
- Arias, D. (2018, May 3). *Adding Salt to Hashing: A Better Way to Store Passwords*. Retrieved from auth0: <https://auth0.com/blog/adding-salt-to-hashing-a-better-way-to-store-passwords/>
- best python GUI frameworks.* (n.d.). Retrieved from <https://blog.resellerclub.com/the-6-best-python-gui-frameworks-for-developers/>
- Best way to store images.* (2013, March 9). Retrieved from sql server central: <https://www.sqlservercentral.com/forums/topic/best-way-to-store-images-1>
- Eric. (2017, February 17). *Motivating Donations Into Your Museum’s “Digital Donation Box”*. Retrieved from cuberis: <https://cuberis.com/motivating-donations-into-digital-donation-box/>
- Google. (2012, October 16). *Why can't I have a shorter username?* Retrieved from Google Support: <https://web.archive.org/web/20130316014921/https://support.google.com/mail/answer/7993>
- Hanson, C. (2018, October 31). *By such deeds. Honours and awards in the Royal New Zealand Air Force 1923-1999*. Retrieved from natlib: <https://natlib.govt.nz/records/34896681>
- how to save images.* (2010, August). Retrieved from stackoverflow: <https://stackoverflow.com/questions/3309957/pysqlite-how-to-save-images>
- Ramos, L. P. (n.d.). *Python and PyQt: Building a GUI Desktop Calculator*. Retrieved from Real Python: <https://realpython.com/python-pyqt-gui-calculator/>
- riverbankcomputing. (n.d.). *What is PyQT?* Retrieved from riverbankcomputing: <https://www.riverbankcomputing.com/software/pyqt/intro>
- Scott, T. (2013, November 23). *How NOT to Store Passwords!* Retrieved from YouTube: <https://www.youtube.com/watch?v=8ZtlnClXe1Q>
- Solo Learn.* (2017, September 22). Retrieved from Can anyone help me how to store images in python SQLite3 database and read back from it: <https://www.sololearn.com/Discuss/732103/can-anyone-help-me-how-to-store-images-in-python-sqlite3-database-and-read-back-from-it>
- USA Goverment. (2020, April 22). *US GPS Info*. Retrieved from GPS: <https://www.gps.gov/systems/gps/performance/accuracy/>

*Why is there a minimum username length?* (2013, December). Retrieved from stackexchange:  
[https://security.stackexchange.com/questions/46875/why-is-there-a-minimum-username-length#:~:text=In%20some%20\(web\)%20applications%20there,miiverse%20\(Nintendo%20social%20network](https://security.stackexchange.com/questions/46875/why-is-there-a-minimum-username-length#:~:text=In%20some%20(web)%20applications%20there,miiverse%20(Nintendo%20social%20network)

*Wikipedia.* (n.d.). Retrieved from Donate to Wikipedia: <https://donate.wikimedia.org/>

## Scholarship Exemplar 2020

<b>Subject</b>	Technology (Digital)		<b>Standard</b>	93601	<b>Total score</b>	18
<b>Q</b>	<b>Score</b>	<b>Annotation</b>				
Synthesis and Integration-	06	<p>This project developed an outcome for an authentic issue: an updateable interactive map for the Christchurch Air Force Museum. A well thought out and developed program is underpinned by complex knowledge as well as regular effective testing. The project demonstrates the required elements of synthesis, polish and ingenuity.</p> <p>The candidate came into the project with an established skillset that complemented the project requirements.</p> <p>Requirements and attributes were well researched to establish the parameters for the project, meaning the candidate had a very clear idea before beginning development of what the outcome would look like and the complexities involved.</p> <p>The candidate still needed to troubleshoot and extend their knowledge, but they were not reliant on learning the whole skillset to deliver the outcome. Additional knowledge was sourced and reflected on in a concise and efficient manner. It was evident from their practice that the candidate was able to identify and resolve problems independently without being overly reliant on downloadable solutions.</p> <p>The candidate demonstrated a high level of skill and successfully addressed potential issues such as scalability of the map, security through encryption and salting, and the need for the client to be able to update elements on the map.</p> <p>The final program was successfully presented to the stakeholders.</p>				
Justification	07	<p>There is thorough evidence of systematic development. Markers were clearly able to see the process and understand why decisions were made. Throughout the process, clear next steps and improvements were identified. Relevant evidence is provided and there is minimal repetition of content. (The candidate has removed irrelevant content associated with other Achievement Standards that fall outside the Scholarship criteria.) This allows the candidate to communicate convincingly and enhances the technological practice taken.</p> <p>Issues faced and their solutions are illustrated using code snippets and screenshots from the program. Approaches to solutions are well-reasoned and clearly justified. The candidate worked around the issue of getting in-person feedback by sending videos of the latest developments in the program.</p> <p>The candidate had a clear understanding of their capabilities and consistently thought ahead, and so the project was never threatened by an inability to deliver because of a lack of unidentified skills late in the project.</p>				
Critical reflection	05	<p>It is evident that the candidate has critically reflected on their own technological practice. The report demonstrated a clear narrative from start to finish. There was consistent, clear evidence of the candidate's thinking about the process and outcome, and of regular meaningful interactions with stakeholders throughout the process. The candidate considered and reflected on stakeholder feedback.</p> <p>The reflective process enabled the candidate to make logical next-step decisions, informing the development of their technological outcome.</p>				