Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Materials and Processing Technology RAS 2023

92014 Demonstrate understanding of sustainable practices in the development of a Materials and Processing Technology design

EXEMPLAR

Excellence

TOTAL 08

To be completed by candidate:

NSN **School Code**

1

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 1 Materials and Processing Technology RAS 2023

92014 Demonstrate understanding of sustainable practices in the development of a Materials and Processing Technology design

Credits: Four

PILOT ASSESSMENT

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of sustainable practices in the development of a Materials and Processing Technology design.	Refine sustainable practices in the development of a Materials and Processing Technology design.	Evaluate sustainable practices in the development of a Materials and Processing Technology design.

Enter your 9-digit National Student Number (NSN) and School Code into the space at the top of slide 1. (If your NSN has 10 digits, omit the leading zero.)

Answer ALL parts of the assessment task in this document.

Your answers should be presented in Verdana font within the text boxes. You may include only information you produce during this assessment session. Internet access is not permitted.

Save your finished work using the following naming convention: **SchoolCode-YourNSN-92014.pptx**.
If you submit your report orally, embed the single file into this document.

If you open this document using software other than PowerPoint:

- save your slideshow as a PDF, using **SchoolCode-YourNSN-92014.pdf**
- if submitting oral responses with a PDF report, submit a separate file for the audio, using **SchoolCode-YourNSN-92014.mp3 or wma**

By saving your work at the end of the assessment session, you are declaring that this work is your own. NZQA may sample your work to ensure this is the case.

INSTRUCTIONS

Respond to the following task about how you **applied sustainable practices** in the development of a design.

You may support your answers with images, which can be inserted into the report where image boxes have been provided. *Do not use video files.*

You should aim to write no more than **800 words** in total. Where audio evidence is used, the total duration should not exceed **4 minutes**.

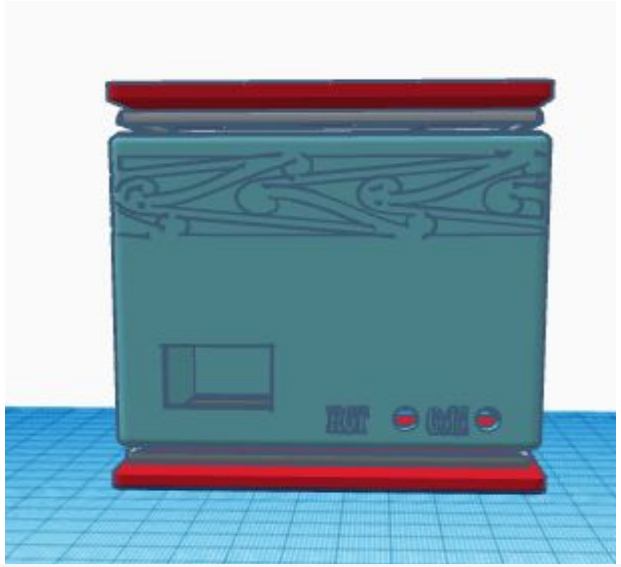
(a) Your design – what it is

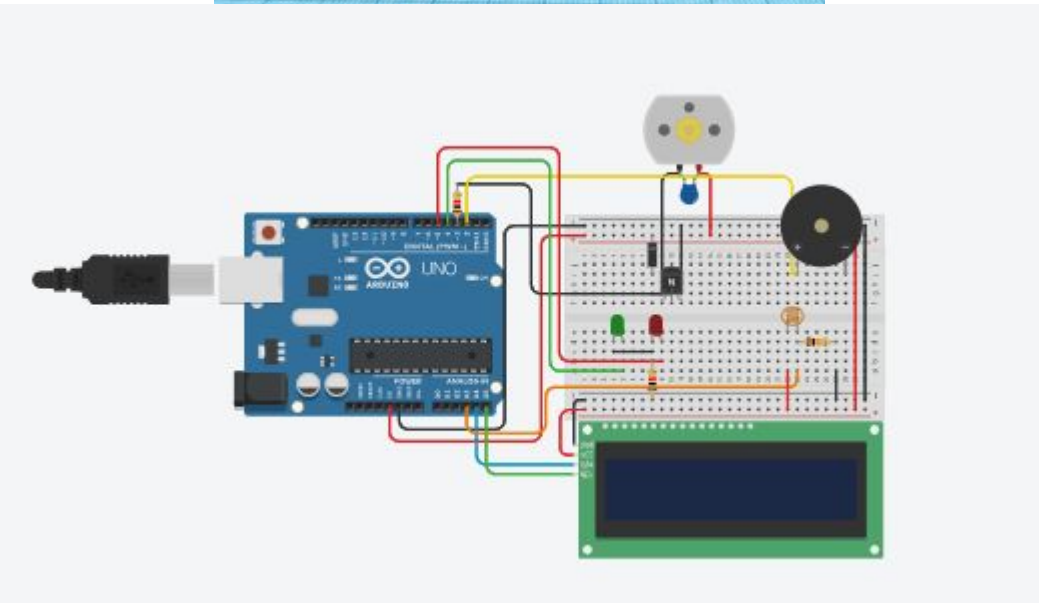
(i) Who is your design for (i.e. person, whānau, or community)?

My Fish bait box is being developed for [redacted] a Keen fisher in my class who requires a new fish bait box for taking on his boat for when his family goes out on fishing trips.

(ii) What are the specifications of the design?

My design is a 92x95x76.30 PLA(Polylactic acid) 3d Printed box. The box has 2 TPU(Thermoplastic polyurethane) seals to entrap any moisture or liquids inside the box. The box has a buzzer to ensure that any time the box overheats you are alerted so that your bait doesn't spoil in the heat, it also includes a temperature display and LEDs that show you the current temperature and whether or not it is too hot inside of the box.

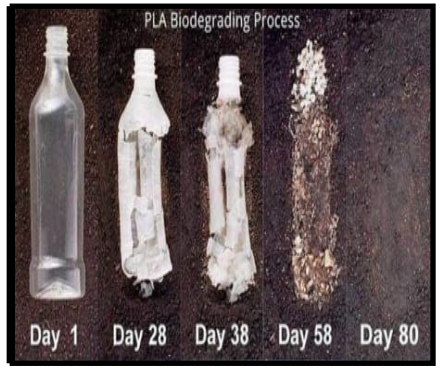
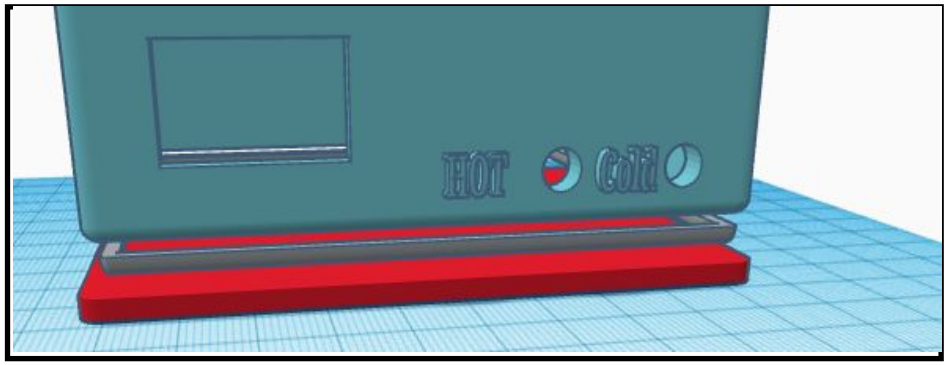




(b) Key phases timeline

(i) Insert images of the different research you undertook at key phases of the design process.

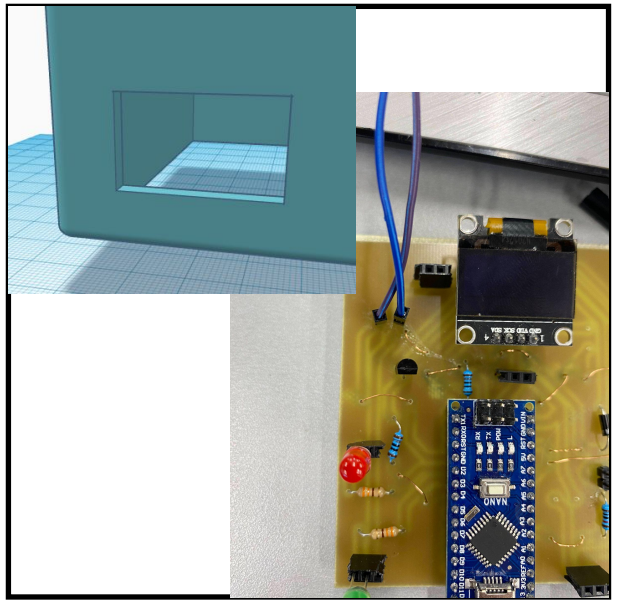
(ii) Explain how these key phases (images) helped you to develop your design.

Initial research	Research into potential sustainable practices	Research related to concept designs	Other evidence that helped you to develop your design
			
Explanation My initial research has led to thinking about initial factors that are important for the bait box eg; the size of the box, the materials to be make it out of, and ways to design the innards of the box.	**Explanation** Through my research I have discovered that not all plastics are created equal, some of them like ABS can take up to 500 years to break down whereas PLA plastic can take 80 years to break down wildly or in a composting situation can take as little as 12 weeks to break down.	**Explanation** One of the most important things I considered was separate compartments like the above design however I decided that it would be better to have one large compartment with the possibility of adding an external divider into the compartment	**Explanation** This is the lower section of my box, I chose to have a detachable piece at the bottom this allows for me to have the electronics separate from the rest of box, this helps to protect the electronics and components from liquids and spillages that could short circuit the wiring registering the box useless.

(c) Sustainable practices in the development of the design – decisions about materials / components

(i) When you were planning your design, what materials and / or components did you decide to use?

The materials that we used for our box as PLA 3d printing plastic filament to ensure that our box is not only food safe(as some alternatives are not safe to store food in) but also cheap and strong. We also used TPU for the seals as it is a flexible and bendy plastic that works well as a seal. The Components that we used for our fish bait box were; OLED screen that displays the name of the bait box as well as the current internal temperature of the box, buzzer to alert nearby people of the lid being open or exceeding internal temperature limit which may cause the bait to spoil or go bad resulting in less attraction for fish, we used two LED for hot and cold indicators, these allow other people to know if the box is too hot as the average person might not be aware that 30 degrees celsius is too hot for the box, we also used a fan to pull the chilled air from the ice compartment to the other compartment with the bait insuring it stays cool, and we used a thermistor to record the internal temperature of the box and send it to the arduino to be converted into celsius. The arduino we used is an arduino nano, this is a small, cheap and cost effective arduino that only requires output up to 5 volts whilst taking in a minimum of 5 volts.



(ii) What other materials / components could you have used?

We could have used a non conductive outer shell for our box with a conductive inner shell, we then could have turned the space between them a vacuum removing most ability for heat loss/gain which would help keep the box at a very similar temperature much like how reusable drink bottles are made. We could have used added a wifi compatible arduino which would have allowed for remote temperature measuring which would help keep track even when the box is far away. We also could have implemented a cooling plate in the bottom of the box to chill the bait directly and keep the ice cold however this would have drastically increased the size, weight, and energy consumption of the product.

(iii) How did you make the decision to use your chosen materials and / or components in (c) (i)?

The decision to use PLA plastic after some research, according to this website PLA is a food safe plastic which means it will be non-toxic to store food inside of which is very important as it is storing bait which will be consumed by fish that customers eat, if the bait becomes contaminated that could impact the health and wellbeing of our stakeholder. PLA plastic is also marginally cheaper to produce which is very useful if we are planning on producing these on a larger scale. ABS(Acrylonitrile Butadiene Styrene) plastic filament is $29 from this website. My design will take 276 grams of generic ABS filament according to Ultimaker Cura. Which if you turn that into a percentage, is (276/1000)*100=27.6%. 27.6% of 28.99 is $8 per box. In contrast PLA(Polylactic acid) plastic filament is only $32.77 from this website. My design will take 276 grams of generic ABS filament according to Ultimaker Cura. Which if you turn that into a percentage, is (276/1000)*100=27.6%. 27.6% of 32.77 is $7.87 per box. This is $0.13 cheaper than if I was to use ABS plastic which sounds insignificant but if this product were to be produced on a larger scale without swapping to injection molding an order of 1000 units would save us $130. According to this source PLA plastic is 4x heavier than ABS plastic, as they are the same size but the weight is different this means that the PLA plastic is more dense than ABS which makes it quite strong.

(iv) Discuss how you made improvements to your design during the development process.

You might consider:

- improvements to better meet the needs of the person, whānau, or community the design is for
- improvements in sustainable practice (materials, economy of use, waste disposal potential, or other aspects of kaitiakitanga).

You may support your response using images on the next slide.

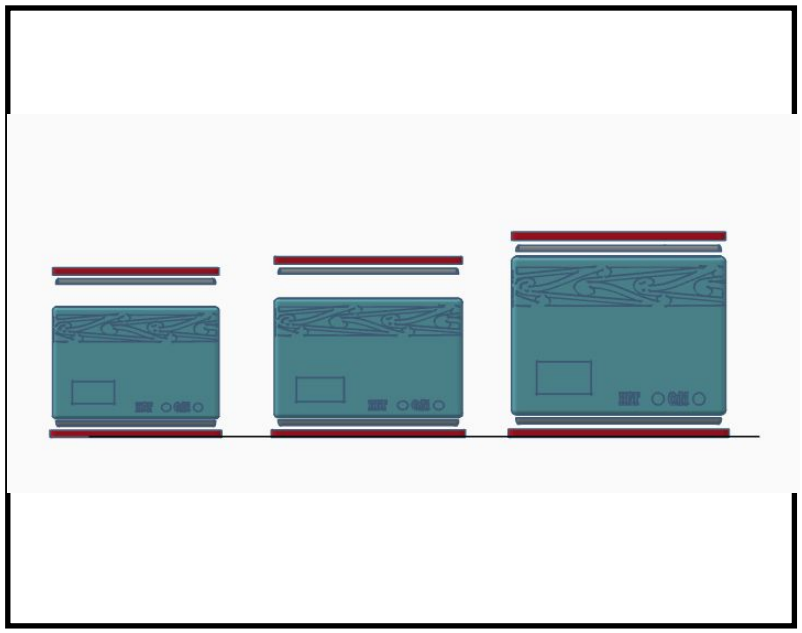
My first design had no separate ice compartment and instead had the electronics where the ice compartment is now. This would have been logistically easier to wire the fan however without an ice compartment we would have to put ice in the main compartment which would result in less bait being able to be stored as ice is quite an irregular shape especially compared to bait that is all relatively the same, having these different shapes would make packing bait and ice efficiently into the box very challenging whilst having the least amount of negative space and having the ice circulated enough throughout the boxes innards. By adding a third compartment it severely increases the amount of bait that can be kept and then length that the bait will be kept cold all by just moving the electronics below the bait.

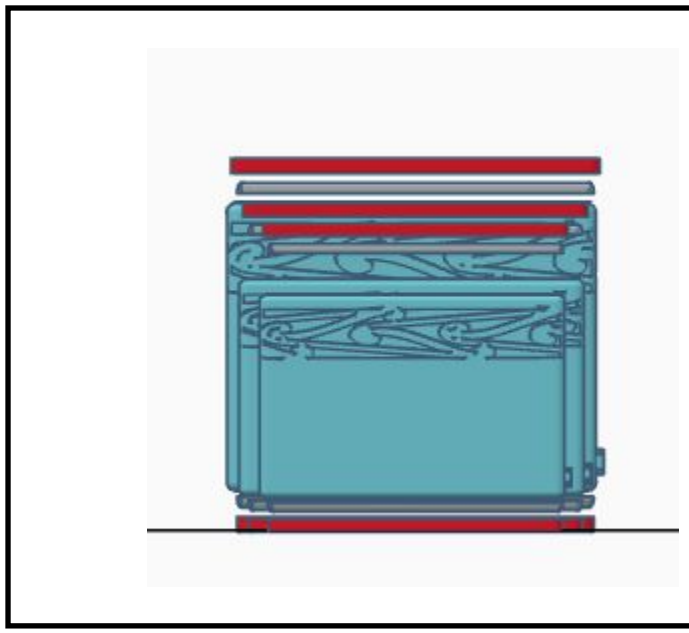
My second design for my box featured a whole in the compartment of the box that stores the bait for the wire for the fan to go through. The fan is very important as it pulls the cold air from the ice compartment into the main bait compartment. As the bait may be small fish ie dead anchovies, the fish juices could leak through the wire hole causing a short circuit as the port would be used as a liquid drain which would put the boxes functionality at risk. To solve this i have added a small cylindrical tubing around the hole. This blocks the liquid from flowing down into the drain, alternatively it also means that the wire will be protected from jostling and bumping of the bait that could damage the connection between the fan and the arduino.

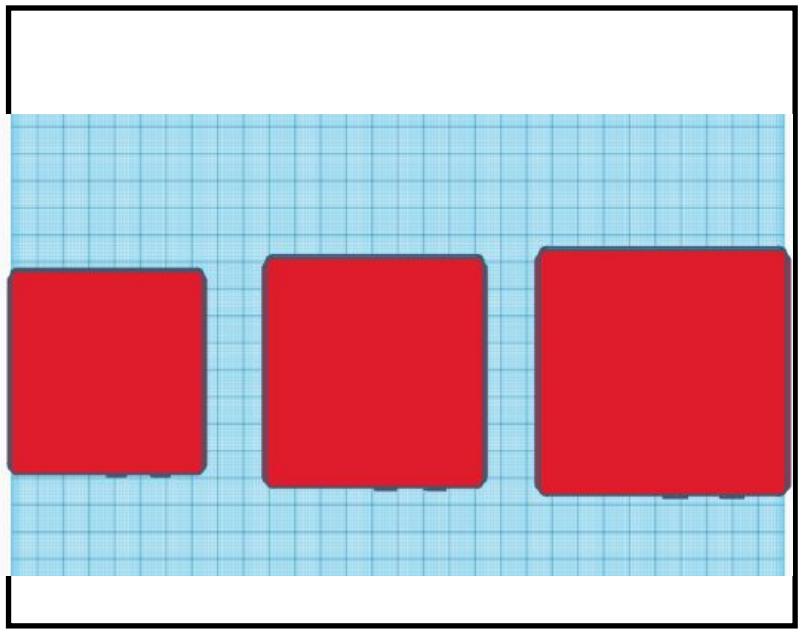
My third design contains 2 hinges which are added onto the box, this not only holds the lid on the box which prevents the lid from being lost or misplaced away from the box but also extra internal support on the roof as the hinges can help hold the roof against any pressure becoming to the top of the box, this increases the sturdiness and durability of our design. These hinges are both made from the same two pieces, those pieces being one flat block with a protruding loop at one end in the middle. The second piece is very much the same except instead of one protruding loop there are two at the sides of the block that the first one can slide inbetween. Once assembled a rod or potentially piece of dowel can be slotted through all three loops creating the pivot.

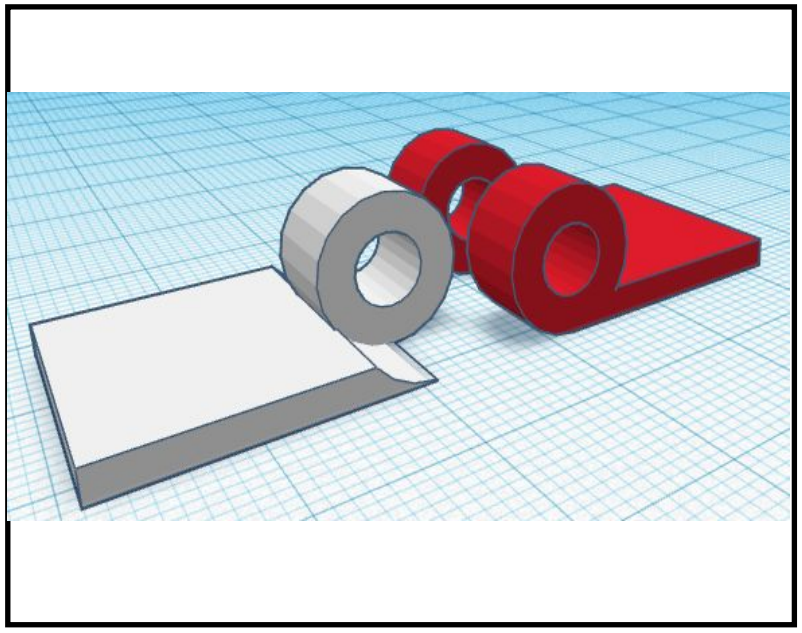
One of the main issues my stakeholder faced with their current bait storage box. His current storage box is not very large which makes fishing on extended trips rather difficult so making a box large enough to hold a significant amount of bait was always crucial in my design with my upscaling from 75x75x50 to 80x80x60 all the way up to 92x92x70. This was done so that my stakeholder could have a reliable way to transport as much bait as he needed and they’re input was always crucial and oftenly received throughout the process.

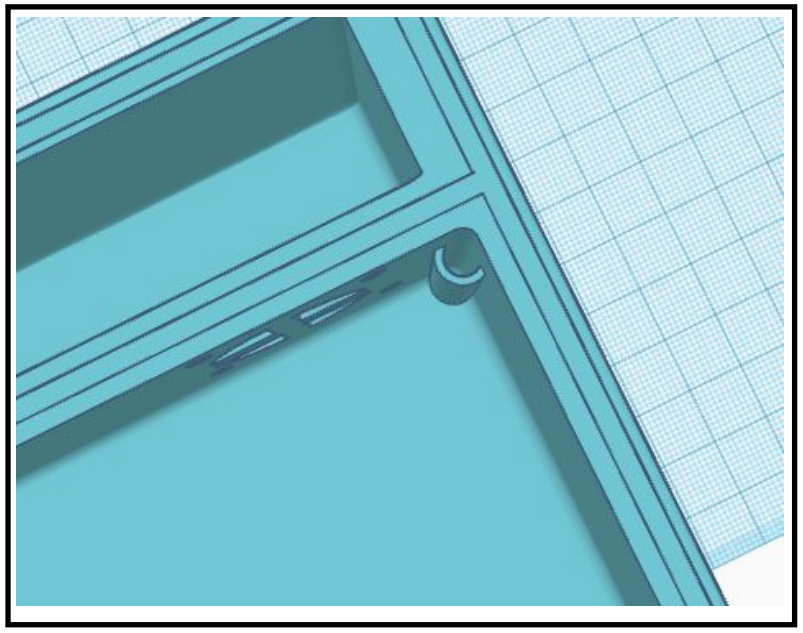
You may include clearly labelled images to support your response to part (c) (iv).

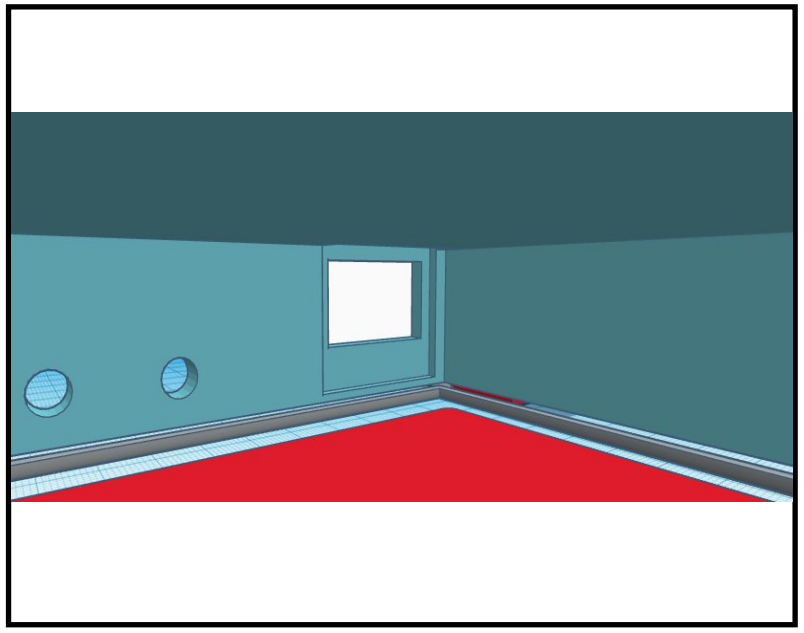












(d) Stakeholder feedback during the development of the design

Use feedback from TWO different points in the design development process. Use this slide for feedback (1) and the next slide for feedback (2).

Feedback (1)

(i) At what point in the design process did you ask for this feedback? Type an 'X' in the box that best describes the point in the process.

- [x] Initial research
- [ ] Research related to potential sustainable practices
- [ ] Research related to concept designs
- [ ] Research related to material exploration
- [ ] Research related to waste disposal options
- [ ] Refinement of designs
- [ ] Chosen design

(ii) Who provided the feedback?

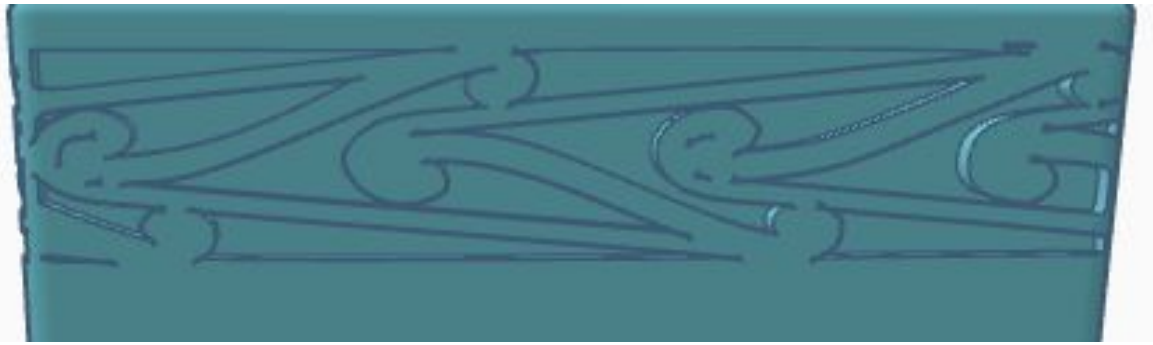
The stakeholder I used to provide my feedback was [redacted] an avid fisher in my class

(iii) What was their feedback?

Culture is really important to my stakeholder, so he was really passionate about having links to cultural aspects. He wanted to feel the history and language come to life as he fished just like his ancestors did.

(iv) Explain how you used the feedback to develop your design? You may support your response with a relevant image.

To ensure that my stakeholder, [redacted] feedback was incorporated into my design, I found culturally significant patterns and symbols on the internet, and evaluated them based on their ties to the maori culture and also how difficult it would be for the printer to produce a high quality outcome. Once I had hand selected my pattern for my bait box, I carefully molded the pattern in blender using my initial image as a reference I traced out the design and imported it into tinkercad where I duplicated several times and placed them strategically around the bait box.



Feedback (2)

(i) At what point in the design process did you ask for this feedback? Type an 'X' in the box that best describes the point in the process.

- [x] Initial research
- [ ] Research related to potential sustainable practices
- [ ] Research related to concept designs
- [ ] Research related to material exploration
- [ ] Research related to waste disposal options
- [ ] Refinement of designs
- [ ] Chosen design

(ii) Who provided the feedback?

The stakeholder I used to provide my feedback was [redacted] an avid fisher in my class

(iii) What was their feedback?

[redacted] was very importunate about his need for a way for the system to remind him about when the box is too hot so he can replace the ice. He needs to do this as he is rather forgetful.

(iv) Explain how you used the feedback to develop your design? You may support your response with a relevant image.

To ensure that my dear friend and stakeholder [redacted] wouldn't forget about his temperature sensitive bait, I installed a thermistor and buzzer into my boxes circuitry. This buzzer will be activated upon the bait boxes temperature surpasses 30 degrees celsius, or upon the boxes lid being opened. This exquisite feature of this state of art bait box helps those who suffer from memory retainment issues as a constant beeping is very useful at keeping this information at the tip of their mind. This makes fishing with our bait box very accessiable.

Excellence

Subject: Materials and Processing Technology

Standard: 92014

Total score: 08

Q	Grade score	Marker commentary
1	E8	The end user is identified and explained. Specifications are clearly identified. Thorough research into sustainable practices is evident. Material choices were evaluated comparing possible choices. Determination of chosen material was based on impacts of kaitiakitanga (care of people and land) / sustainable practices. 3D mock-up was used in the design process, also a sustainable practice. Clear improvements to the design are explained with detail and based on stakeholder feedback.