



National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TĀEA

Exemplar for Internal Achievement Standard Science Level 1

This exemplar supports assessment against:

Achievement Standard 91920

**Demonstrate understanding of a science-informed response to a local
issue**

An annotated exemplar is a sample of student evidence, with a commentary, to explain key aspects of the standard. It assists teachers to make assessment judgements at the grade.

New Zealand Qualifications Authority

To support internal assessment

Grade: Merit

For Merit, the student needs to explain a science-informed response to a local issue.

This involves explaining:

- the science-informed response to the issue
- the science idea that informs the science perspective
- another perspective relevant to the issue.

Students must show understanding of tiakitanga in the context of responsible science practice, as outlined in Explanatory Note 2.

This student has explained a possible solution for removing plastics from the ocean. They have explained the general structure of plastics and polymers. A perspective of Pacific Island people was also explained.

For Excellence, the student could discuss the importance of the science informed response and the other perspective.

Merit

NZQA Intended for teacher use only

What's the problem with Plastic Pollution in the ocean

One of the most impactful environmental issues currently facing our planet today is marine plastic pollution. Us humans are solely the ones to be blamed for this problem. Many of the plastics we use today are difficult to degrade, meaning that it is chemically near impossible to decompose. Given this information, this is why they are progressively filling up our oceans and causing serious problems for marine life and ecosystem, and human health. Marine animals are a common victim of plastic pollution. Mistaking them as food, marine animals ingest the piece of plastic. This can lead to subsequential health problems and internal suffocation, therefore decreasing the amount of marine animals in the ocean. Plastic debris can release harmful chemicals into the ocean environment which can also lead to health problems for sea life and humans.

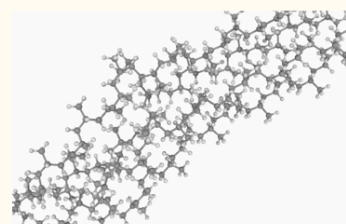
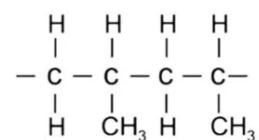


What are the chemical structures of Plastic? [Link](#)

Plastics are like other substances, they consist of molecules and the matter is made up of small particles. Plastics have both large and small molecules called Polymers. Polymers consist of many identical small particles that are strung together like chains. These small individual particles are called monomers. The length of the polymer chains regulate the properties of plastics. For example, the length of the polymer chain for polyethylene determines the solidity of this type of plastic. The chemical formula for Polypropylene plastic is $(C_3H_6)_n$.

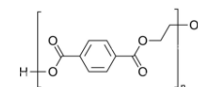
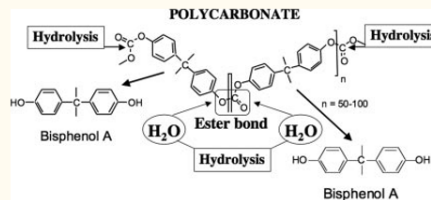
Polypropylene Plastic

Chemical Structure



Why isn't plastic biodegradable? [Link](#)

The problem with decomposing plastic is that plastic isn't organic. Most plastic in the world we use today are made of polyethylene terephthalate, also known as PET. This polymer is what makes plastic near unbreakable. It is strenuous to decompose PET because most bacteria cannot break it down. PET consists of long chains of repeating units of ethylene glycol and terephthalic acid, these are all linked by strong ester bonds. Ester bonds are extremely stable and require specific enzymes to break them down. Unfortunately most bacteria do not possess the amount of enzymes needed to break the bonds of PET.



PET
Polyethylene terephthalate
($\text{C}_{10}\text{H}_8\text{O}_4$)_n

A perspective on an aspect of this issue (with a science informed response)

“There are practically no natural processes that can degrade plastic back into the ecosystem. Some people say plastic might break down after a few hundred years—but we don't know, because we haven't lived with plastic that long. It will stay with us, maybe forever.” - Winnie Lau.

This statement summarizes that the major issue in solving the problem is that plastic is near indestructible. The first few sentences of this perspective say that there are no natural processes that can fully degrade and decompose plastic. This statement is backing up why plastic isn't good for the environment because the person talks about the increase in production of plastics and how it can lead to infinite amounts of plastic on land and sea. The end of the statement summarizes the persons predictions on how long plastic will last for and why it is a problem for humans and possibly marine life.



Another key perspective that relates to the issue by a knowledge system other than science [Link](#)

“For Pacific Islands people, our cultures and ways of life have made protecting and preserving our natural environment of paramount value. Having learnt from generations past that in order to continue enjoying the benefits of our natural world, we must care for, and protect it so it provides for us and our future generations. To address an issue of such magnitude, we need an ambitious instrument that covers the full lifecycle of plastics and implements the aspiration of ‘sustainable’ production and consumption of plastics which we all espouse.”

These statements give us a perspective on marine plastic pollution from Islanders. This statement is essential because it speaks for most and on behalf of the people of the Pacific Islands. This shows that plastic pollution is a real problem for Islanders and there should be more things done to fix the problem and decrease the amount of plastic in not just oceans but also on land. Quoting the highlighted phrase, the Islanders refer to their culture and ways of life, this means that they often rely on marine life for food. Marine plastic pollution blocks the way of their culture by killing off the marine life because of deadly chemicals and misconception for food.

What can be done with a tiakitanga approach to this issue that would demonstrate guardianship?

Together as a community we can demonstrate tiakitanga by stopping the purchase of plastic and alternatively use recyclable materials like paper and cardboard. We must also ensure that we properly dispose of our waste instead of littering and remember the 3 r's - Reduce, reuse and recycle. This means that we dispose of waste in the waste bin and recyclable materials in the recycle bin, leaving smaller amounts of plastic in the ocean. Reusing a certain material as many times as you can is a great way to reduce the amount of plastic pollution in the ocean.

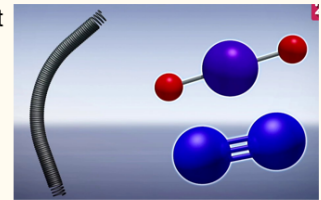


Give reasons for the science informed response that was taken to my issue, why it was taken and how it was related to both perspectives [Link](#)

Magnetic coils have been created by scientists, these scientific inventions are able to target microplastics in the ocean without doing any harm to marine life. These magnetic coils are coated in nitrogen and manganese, - which is a magnetic metal. When these elements react with oxygen molecules, they attach onto plastic and help break it down. It is shown that over a period of eight hours, the magnetic coils have between a 30-50% reduction rate for breaking down plastic.



I chose this science informed response because I felt like it was effective and had a great science idea going on. I like how the elements react with others to form an overall reaction. This can relate to the other perspectives above due to the fact that this can be a possible solution to fix the 'problems' that the different perspectives had. This solution can potentially fix the issue with the Islanders because magnetic coils do not harm marine life therefore not harming and affecting their source of intake. If this idea is considered by more people in the future then this can be a possible solution to reducing marine plastic pollution.



Why is it important for decision makers to consider more than one perspective when making a science-based response?

Decision-makers must consider multiple perspectives when making a science-based response because of many factors. The depletion of bias is essential because the decision-makers can consider just one view and neglect the others. By considering multiple perspectives, decision-makers can identify their preferences. Multiple perspectives can be used to make decisions that meet the needs of the interests of those affected.

Grade: Excellence

For Excellence, the student needs to analyse a science-informed response to a local issue.

This involves discussing the importance of the science-informed perspective and the other perspective in the science-informed response to the issue.

This student's discussion builds on the explanations of the key science idea of indicator species, and the science-informed response of planting along the waterway.

The student discusses the importance of their solution along with other perspectives, most notably the Māori value of tiakitanga.

Excellence

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The Issue

Back in the beginning, before the 1930s, Wainui Te Whara flowed into a biodiverse marshland, filled with blooming plant life and animal life. Sadly, due to human development, much of the marshland's Mauri has been taken away. Nowadays Whakatāne sits on the bones of this marshland. Wainui Te Whara has become a stream that flows straight down a man-made canal in Whakatāne. This part of the stream is facing issues to do with its health because of all the changes it was subjected to over the years. After a double flooding event in may and June of 2010, the Whakatāne council decided to take action in order to prevent the stream from flooding again. They hired PDP (an engineering company) to investigate the problem. PDP came up with two solutions - A: to create a dam for \$ 1.3M or B: to build stopbanks for \$1.5M.

The decision was made for the stopbanks to be built and the stream went through huge change. Sadly, most of the plant and animal life was damaged or destroyed as diggers removed soil from the stream and placed it on the banks. The problem is that the health of Wainui Te Whara and the safety of Whakatāne contradict one another. Wainui te whara would be at its healthiest if we left it how it was naturally, however, this would deem the area around the stream as a big flooding hazard. I agree that on the short term, it is definitely more crucial to take care of the people living in Whaktāne even if this is at the expense of the heath of Wainui Te Whara. Yet I also believe that there are better ways to support the heath of the stream while keeping the community safe.

01.

The science Idea

What does a stream need?

Diagrams

ECOSYSTEMS

Biotic factors

- Producers ← Plants
- Primary consumers ← Animals
- Secondary consumers ← Animals
- Tertiary consumers ← Animals
- Decomposers ← Animals

Abiotic factor

- Air
- Water
- Soil
- Sunlight
- Temperature

X-planation

The health of all streams like Wainui Te Whara Stream depend on the biodiversity of the life in and around it.

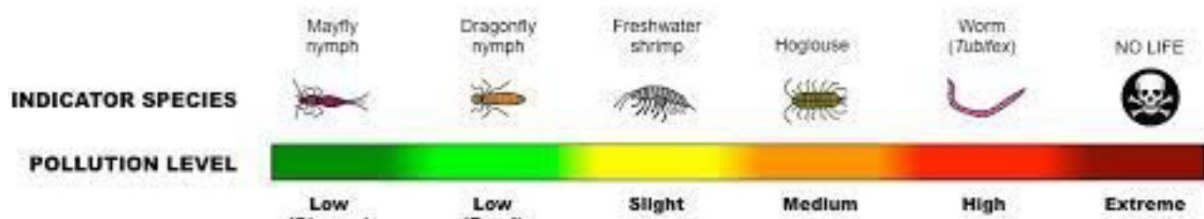
Every stream has a unique climate which is host to thousands of organisms that all inadvertently contribute to the complex and somewhat fragile food chain system around it. If it does not stay balanced, the stream will no longer be healthy. So, in order to have a healthy food chain established around a stream (which means it is biodiverse) there must be sufficient abiotic factors to support this - but what are abiotic factors?

Abiotic factors are (literally) the building blocks of all ecosystems, they are the nonliving parts of a stream like the level of light, the level of dissolved oxygen in the water or even the amount of rocks or boulders in the stream. From the research I carried out alongside three scientific investigations, I can back up how these abiotic factors all affect the biodiversity of Wainui Te Whara stream. For example, I know that if there is good tree cover over the stream it prevents light from reaching the stream and lowers the temperature. This was proved by one of our investigations when we realised that the level of light, and therefore the temperature, was lower at our site where there was more tree cover (lux 3000, and temp 13°C) compared to the other two sites closer to town which had little to no tree cover (lux 100,000, lowest temp 20°C). These abiotic factors, lux and temp, affect the biodiversity of Wainui Te Whara Stream because if the water heats up too much it evaporates as gas, and takes the dissolved oxygen in the water with it (which the organisms rely on). In town, Wainui Te Whara is almost fully exposed to the sun. This deeply affects its health and much of the stream has become very unappealing. Walking there myself, I was faced with realising just how important plants are to the survival of all life in and around the stream and it saddened me to think about all the life lost because of the development of our stop banks.

Indicator species

Often scientists use indicator species to narrow down how much data is needed in order to determine the health of the stream they are surveying. The website LAWA.org uses this system very successfully to survey streams and rivers. We compared the indicator species results we collected for Wainui Te Whara Stream with theirs and found that they were very similar; both data sets told us that the section of the stream in town was not healthy enough to support our species. Using indicator species basically tells us if the conditions the stream are good enough in order for the chosen species to survive and/or thrive.

It is incredibly helpful to be able to focus on just one species instead of all the possible abiotic factors and/or the entire food chain in order to work that out. A good example of an indicator species would be the mayfly. Mayflies work well as indicator species because they cannot survive in unhealthy streams which is due to their low tolerance of changes from standard DO, temp and pollution levels of a healthy stream. If we find lots of mayflies we know that the abiotic factors are good enough for the stream to be biodiverse. It also means that there should be a prosperous food chain and a generally healthy ecosystem.



Māori perspective & Tiakitanga.

Now that I have spoken about the science behind the health of Wainui Te Whara and well as the political reasons for the development of stopbanks along the stream, it is important that I cover some of the Māori perspective on the health and development of the stream. Wainui Te Whara Stream flows through land belonging to Ngāti Awa, a Māori tribe located in the Bay of plenty. Ngāti Awa agreed to the developments on the stream after the 2010 floods, however, I understand that this may have been a difficult decision. This is because I know that maintaining a sense of respect for the land and environment is a huge part of Māori culture, along with balancing what one takes with what they give. Growing up I listened to some Māori stories, passed down through generations of Tangata Whenua for the new generations like us to hear. The stories I heard always shared a common theme that showed how the land, water and sky were powerful forces to be respected and cared for. An excellent example of this would be the well known story of Ranginui and Papatūānuku. The god of the sky and the god of the earth were lovers, split apart by their children - who were gods of their own - so that there could be space for life and light. It was not easy to split Rangi and Papa apart and it caused much havoc, but it was necessary. Because the land and sky were such a powerful part of Māori culture, it is obvious the environment was held in high respect. From where I stand I know that Ngāti Awa wants to protect their lands, but they also must take care of their people and the community.

“Ka ora te whenua, ka ora te tangata.”

- if the water is healthy, the land will be nourished, if the land is nourished, the people will be provided for.

The Response

So the question is: what action can the community take in order to improve the condition of Wainui te Whara Stream? Obviously, some possibilities like bringing back the original Wainui Te Whara marshland or removing the stop banks must be ruled out. Doing either would disrupt the community and put many at risk of flooding. Instead of making such a huge change, I think that the best course of action for both the community and the stream would be to start small. My proposal is to begin reintroducing plants along sections of the stream to reintroduce biodiversity. I would especially like to plant out the banks along the the bottom of the birdwalk down to where the stream turns to flow between the houses. I think we should do this because It is relatively cheap and easy, and replanting native grasses and shrubs would make a very positive effect on more than just the stream. I've already thought about some plants which could be used; including harakeke, raupō, cabbage trees, pūrei and Cyperus ustulatus. (these are all suitable for stream/ marshland conditions. From a scientific view, the plants would introduce some much needed shade, some shelter and some great animal food while also preventing some soil erosion and flooding along the banks.



Analysis

I know that my proposal is not completely optimal for all aspects of sustainability (social, environmental, economic and cultural/ human) but after considering other options I think that planting native greenery along the stop banks does the best job at creating a fair compromise between all the different sides of sustainability. Obviously I have already covered some of the reasons why my action would be great for environmental sustainability, and economically it is also very cheap (i.e sustainable). Sadly I can also tell that my plan is lacking a bit on the cultural and the social side of sustainability. I know that replanting Wainui Te Whara stream could be a way for Ngāti Awa to witness the community giving back to the stream - which is very important culturally - but I think that more could definitely be done in the future to commemorate some of the cultural and spiritual sites along the stream that are important to tangata whenua. Planting natives could, however, set this into motion. This same concept goes for the side of social sustainability; planting greenery along the stream does not directly promote social activity other than the initial group needed to plant the natives, but it is actually a doorway for future developments like pathways and bike lanes when the stream becomes naturesque enough for walks and birdwatching. Overall I think that my action is an important first step towards the future of sustainability for Wainui Te Whara stream and it is the best way of creating a balance between all aspects of sustainability.

SOCIAL

HUMAN

ECONOMIC

ENVIRONMENTAL

The Overview

When making a science-informed decision, it is always crucial to take into consideration more than just the scientific perspective. For example, after thinking about my ideas scientifically, I also took a step back and looked at them from other viewpoints. I.e, the community and the tangata whenua. This caused me to modify my idea in a few ways. For example, I realised that I should use more smaller grassy/ bushy plants (like the ones I listed earlier) rather than big branchy ones, otherwise, having so many branches and logs could cause problems during flooding and put the community into danger. It was also proper for me to acknowledge that Ngāti Awa is important not only for the history of Wainui Te Whara stream but also for its future. This is because I believe that when considering any changes to the land of Aotearoa, we must respect where and who the land came from in order to understand the best way to treat it. All and all, It was very important that I took different perspectives into consideration for my proposal to plant out the banks of Wainui Te Whara. It allowed me to step back and double check that my action wouldn't make a negative impact on any other groups connected to the stream, and it also gave me a wider range of information so that I could make a multifaceted decision.