



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

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: Achieved

For Achieved, the student needs to demonstrate understanding of a science-informed response to a local issue.

This involves describing a science idea – which might be a relationship between things, or a theory or conceptual model about a natural phenomenon (rather than describing an observation or fact). It also requires an outline of a second perspective relevant to the issue that is held by a particular group (rather than an individual or broad group), and identification of a science-informed response to the issue. Students must also show understanding of tiakitanga in the context of responsible science practice in the local issue.

The student has described science ideas relating to population decline due to predator species, biodegradability of 1080, and predation of ground and low-nesting birds by stoats. The student has outlined the perspectives of the Department of Conservation/Te Papa Atawhai (DOC) and of the Society for the Prevention of Cruelty to Animals (SPCA) in relation to the safe use of 1080, and concerns about animal welfare. The student has identified the use of non-lethal methods such as limiting reproductive abilities as a possible science-informed response. There is some evidence of a tiakitanga approach in the context of the impact of 1080.

For Merit, the student could explain why 1080 is toxic, how 1080 is broken down by organisms in the soil or what it breaks down into, or why introduced predators have such a strong ecological effect here in New Zealand. The student could explain why the SPCA views all animal suffering equally or why it is important to DOC to protect threatened native species. Non-lethal methods of dealing with predators could be explained, such as limiting reproductive abilities.

Habitats loss caused by introduced predators have resulted in 50 native birds in New Zealand becoming extinct each year. Rats, stoats, possums, and other introduced predators have killed 50 millions native birds in New Zealand each year. Without taking control and having pest control, many more native species will become extinct faster than two human generations.¹ 1080 is the common name for a biodegradable bait pellet DOC and other organisations use to control rats, stoats and possums. Although it is called 1080, the toxic ingredient in the bait is sodium fluoroacetate. The bait pellets are made up of sodium fluoroacetate (0.15% of each pellet), cereal, sugar, cinnamon flavour (to attract predators), and green dye (to deter birds). 1080 is biodegradable. It can naturally be broken down by the micro-organism, fungi, and plants into harmless materials. It doesn't leave permanent residues in soil, water, plants, or animals.²

The impact that rats have on our native birds can be seen on Big South Cape Island near Stewart Island, which was invaded by hop rats in 1962. Rat numbers have increased and within three years, nine species of birds had declined or disappeared from the island. Stoats are considered the 'perfect predator' for birds. Birds that nest on the ground or in holes on trees have no escape. Up to 60 percent of kiwi chicks are eaten by stoats. Possums are the major cause of the decline of many native trees such as the pohutukawa, rewarewa, kamahi, mahoe, tawa, and rata; they can also change the composition and structure of native forests.³

The department of conservation/ Te Papa Atawhai is the government agency charged with conserving New Zealand's natural and historic heritage.⁴ This group quotes " We use 1080 bait because it's safe and effective for controlling introduced predators and protecting threatened native species." 1080 is backed by science, the use of 1080 is supported through research by independent scientists and other experts. 1080 targets the introduced predators such as rats and possums. Stoats are also controlled through scavenging of poisoned rat carcasses. Decades of monitoring and research have shown that the use of 1080 operation every 2-3 years, on average, can maintain predator numbers at a low level. This allows native species to survive, breed, and increase their population. The use of 1080 is strictly regulated and carefully planned so it is safe and the best result can be achieved for the native wildlife. The key points that the department of conservation states that supports 1080 use is to ensure these operations involve helicopters in distributing biodegradable 1080 bait pellets over large, remote and rugged areas where we can't use traps. Calm weather is required, this ensures that predators consume the pellets before the rain dissolves the 1080. The number of rodents and possums are monitored before and after an operation is completed.⁵

¹ <https://www.doc.govt.nz/nature/pests-and-threats/methods-of-control/1080/why-we-use-1080/>

² <https://www.doc.govt.nz/nature/pests-and-threats/methods-of-control/1080/what-is-1080/>

³ <https://pce.parliament.nz/explore/predator-control/possums-rats-and-stoats/>

⁴ <https://www.doc.govt.nz/about-us/>

⁵ <https://www.doc.govt.nz/nature/pests-and-threats/methods-of-control/1080/how-we-use-1080/>

The SPCA is New Zealand's oldest and largest animal welfare charity. They are dedicated to protecting and improving the welfare of animals through various means.⁶ The SPCA is against the use of 1080 in New Zealand because they believe it is a poison to kill animals due to the level of suffering they cause, as well as the nature of their use. The SPCA quote "These substances cause such intense and prolonged suffering to animals that we believe their use can never be justified." They believe that the welfare of all animals should be viewed equally. The SPCA thinks that there should be a greater emphasis on looking for solutions that would enable species who cannot be completely removed, to co-exist in the environment instead. SPCA also encourages the research and development of humane alternatives to species control, including the replacement of lethal methods with human non-lethal methods, such as limiting reproductive abilities.⁷

1080 can be viewed differently through tiakitanga. Some believe that 1080 is bad because it's an artificial toxicity for our land. They also argue that 1080 prevents access to forestry and this limits the employment opportunity relating to trapping for whanau. Tiakitanga stands by "If you don't take care of the environment, it will noy take care of you. From a tiakitanga perspective, to manage pest animals and to put the needs of the environment above the needs and wants of humans. After all, it was human greed that got us in this mess."⁸ We can help save and maintain the ecosystem by both traditional Māori practices and modern ecological principles like protecting existing forest, planting native trees, controlling pests and many more.

Considering different types of opinions for a subject is vital to help get a better understanding. Our opinions are based on our own life values, experiences and lifestyle. It is important to have more than one voice to have fairness and inclusivity. Not only this, but this can result in a better solution for the problem as this problem will impact not only one but everyone in the community.

⁶ <https://www.sPCA.nz/about>

⁷ <https://www.sPCA.nz/news-and-events/news-article/1080-what-is-it-and-what-can-be-done-about-it>

⁸ <https://thespinoff.co.nz/atea/14-03-2022/is-poisoning-pests-the-maori-way>

Grade: Merit

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

This involves explaining the science idea, the second perspective, and the science-informed response to the issue (including the 'how' or 'why' of the science idea).

The student has explained how human activity disrupts the carbon cycle, and why increased global temperatures are a problem. They have also explained that the Ministry of Transport and car importers are concerned about limited access to minerals, New Zealand's small market size, and high penalty fines for failing to meet electric vehicle import targets.

The student has explained how and why the science-informed responses to transport help reduce reliance on fossil fuels and emissions, including increased use of zero emission vehicles and low-carbon transport choices such as public transport, cycling, and walking. Understanding of tiakitanga in the context of climate change is also evident.

For Excellence, the student could analyse the transport changes identified and discuss the importance of the science-informed perspective around vehicle emissions as well as the perspective of the Ministry of Transport and car importers.

Science 1.1 Report

Issue:

Heat is being trapped on Earth because of the human induced greenhouse gases. This temperature rise is causing global disruption to the Earth's natural climates and eco systems. Some problems include the melting of glaciers, animal loss of habitat, impacts on the health of Earth's plants and wildlife, and extreme weather, potentially causing irreversible damage.

The Science Ideas Relating to the Issue:

The cause of climate change comes from human influence on gases in the atmosphere called greenhouse gases. Greenhouse gases are a collective of gases primarily consisting of carbon dioxide and methane. These gases absorb heat and re-radiate it back onto the planet, preventing heat from escaping so the Earth stays at a regular temperature and doesn't freeze. The name "greenhouse" comes from the fact that it operates similar to a greenhouse, letting in the sun's rays and holding the heat inside like an invisible glass dome. The influence of humans on the natural greenhouse effect is causing Earth's global temperatures to rise at unprecedented rates. The main source of this influence is the mass production of carbon dioxide being released into the air, trapping too much heat onto our planet and irregularly warming the climate.

Over the long term, the Earth has a natural cycle and balance at which carbon is produced, stored and dispersed. This balance must be maintained to prevent too much carbon being released into the air or too much carbon being stored into the Earth. There are many methods used to keep this balance. For example, carbon is released into the atmosphere by the respiration of animals and the evaporation of sediments inside oceans. On the contrary, carbon is absorbed by plants and trees, stored within rocks and deceased organisms. This is a process managed over a long period of time to keep Earth's temperature relatively stable, but because of humans, the amount of carbon being released and absorbed are equal. This creates an imbalance in the Earth's natural carbon cycle, trapping too much heat on earth and causing global warming.

Some of the main factors of many being the combustion of fossil fuels and forests. Fossil fuels are a natural fuel formed over millions of years, this long period of time is why fossil fuels are considered a non-renewable source. Fossil fuels consist of oil, coal, natural gasses, and the carbon of decomposed plants and animals. When burned, it becomes a resource for heat and energy. The energy of these fuels supply an estimated 80% of the world's energy needs, hence the high value and importance of it to humans.

The combustion of fossil fuels is releasing the carbon stored inside, becoming the primary contributor to the build-up of gases in the atmosphere. In addition, the combustion of forests causes even more carbon dioxide to be released into the air. When the remaining parts of a tree decompose after death or burn during fire, the carbon stored inside is then released into the atmosphere, contributing to the Earth's rapidly expanding greenhouse gases. At the increased build-up of greenhouse gases, not enough heat is being released from Earth and too much heat is being trapped inside, globally causing the Earth's climates to drastically increase in temperature over recent years.

This temperature increase is detrimental because of the problems being inflicted on the Earth's ecosystems and the inability for the environment and animals to adapt to the rapid changes. An example of the problems within climate change taking effect are the melting of ice glaciers, ice sheets, and sea ice. This affects all arctic wildlife from beluga whales in the arctic ocean to polar bears on the ice. Polar bears are among the species most affected by the melting of sea ice, because it makes up 96% of critical polar bear habitat. At the melting of sea ice, polar bears face various challenges like reduced hunting success, longer fasting periods, and limits their areas to find a den, negatively impacting their reproductive success and overall survival rates. Along with various other arctic wildlife, polar bears are at risk of

extinction primarily due to the problems of climate change, and if not stopped soon the damage could be irreversible.

Science-uninformed Response to the Issue:

A science-informed response to the issue of climate change brought up in New Zealand is introducing the opportunities to reduce and delay the effects of climate change within transport. The goal is to lessen the reliance on burning fossil fuels as an energy source for transport, and decrease the amount of carbon emissions from vehicles. Some standards set by the government include: "Reaching net zero emissions by 2050, reducing the emissions intensity of transport fuel by 10% by 2035, and increasing zero-emissions vehicles to 30% by 2035." This means the government wants to lower the amount of diesel and petrol cars to decrease the amount of carbon dioxide being released into the atmosphere. Some ideas proposed to minimise the production of carbon emissions and use of fossil fuels is by increasing the use of low-carbon travel choices and new technologies. This includes more fuel-efficient vehicles, improving public transport like buses and light rails, and encouraging cycling and walking by improving urban design. The reasoning behind these objectives is the high rates of vehicle ownership and 99% of transport in New Zealand being dependent on fossil fuels, causing an unhealthy amount of carbon emissions to be released.

Science Ideas That Were Behind the Response:

The transport sector produces about 17% of New Zealand's total greenhouse gas emissions. This is due to the current dependence on gasoline and diesel light duty vehicles for mobility. According to data from the Ministry of Transport in 2022, New Zealand has one of the world's highest rates of motor vehicle ownership with a number of 661 to 817 vehicles per 1 000 people. Only 3.8% of the total vehicle fleet being petrol hybrids, while pure electric vehicles and plug in hybrid electric vehicles combined only making up 1.6%. This proves the heavy reliance on gasoline and diesel vehicles in New Zealand, which is a concern for the use of fossil fuels and greenhouse gas emissions. Research from 2022 says the diesel and petrol car produces between 170-173 grams of CO₂ per km, which is notably a large amount compared to freight movement and electric vehicles. The electric car produces around 47 grams of emissions per km which is on par with the coal powered train at 49 grams per km, but the electric train produces an even lesser amount at 35 grams. The alternatives are significantly more sustainable compared to petrol and diesel cars that produce almost five times the CO₂. The uptake of electric vehicles will need to be increased in New Zealand to meet the government's standard of zero-emission vehicles making up 30% of vehicles by 2035. To further support the decreasing of emissions and fossil fuel use, urban design that would prioritise convenient walking and cycling are being explored, along with the focus on convenient and comfortable freight movement. Emissions from transport continue to rise annually but could be reduced by at least 60% by 2050 if the ideas of mitigation are encouraged.

Ministry of Transport Perspective on the Science-Informed Response:

The Ministry of Transport agrees with the government's response to reduce climate change by increasing the use of more sustainable transport options, but want to lower the amount because they can't supply enough and would be charged with hundreds of millions of dollars in fines. Car importers expressed their opinions, deeming the task of sourcing enough electric and low emission vehicles unachievable. This conclusion was collectively directed by the Motor Industry Association the Imported Motor Vehicle Industry Association, the Motor Trade Association, and the Ministry of Transport.

Ideas Behind the Ministry of Transport's Perspective:

Within the manufacturing of electric vehicles, there are many scientific, technological and economical challenges car importers have to worry about that could make it difficult to bring electric cars to New Zealand, especially with tight deadlines and penalty fines an estimated total of \$800million. The primary problem is because electric vehicles are finite due to how

limited the materials to make an electric battery are. Electric vehicle batteries require rare minerals like lithium, cobalt, nickel and graphite.

These resources are hard to get a hold of because they are limited in availability and shared between countries. New Zealand is low priority in the supply chain due to having a smaller population and smaller economy in comparison to larger countries like USA and Japan. For example, according to 2024 data New Zealand has a population of 5.1 6million while Japan has a population of 1 23million, the USA has a larger population of both countries combined with a population oof 342million. This shows the major size difference in markets, proving New Zealand to be very small market in competition with other countries. This affects New Zealand because countries with larger markets and manufacturing bases get first access to the limited supplies needed to produce the electric battery within electric vehicles. Because of the challenges in constructing electric vehicles, New Zealand relies heavily on Japan's used vehicle market, receiving most of their electric vehicle imports from there.

How does the Response to the Issue Demonstrate Tiakitanga?

The response to the issue of gross greenhouse gas emissions demonstrates tiakitanga because it responds to climate change in a way that upkeeps the people while simultaneously making the effort to protect our climate. For example, rather than just getting rid of vehicles overall, the idea of transitioning to electric cars develops an alternative option to using petrol and diesel cars. This means efficient travel is still here to upkeep the people of New Zealand without leaving toxic carbon footprints in the Earth's atmosphere. Because if the government just got rid of petrol and diesel cars, it would demonstrate tiakitanga and care for the climate but would sacrifice the tiakitanga of the population, hindering the efficiency of transportation which would create a mass of travel problems for the population. This shows that the current response to issue demonstrates tiakitanga for both the people of New Zealand without destructively contributing to the issue of climate change.

Sources

Climate Change/GHG/Carbon

[What Are Greenhouse Gases and Why Do They Matter | NOAA Climate.gov The Carbon Cycle](#)

[The Impact of Melting Arctic Sea Ice on Wildlife - Arctic Ice Project](#)

Transport Information/Gov Perspective

[Transport](#)

[Transition to a low-carbon economy for New Zealand National Taxonomic Collections in New Zealand 2015 NumberOfVehicles24.pdf AnnualFleetStatistics.pdf](#)

[Sources of greenhouse gas emissions from transport | NZ Transport Agency. Walā Kotahi](#)

[Which form of transport has the smallest carbon footprint? - Our World in Data](#)

[Emissions from train travel](#)

Car Company Perspective

[The Impact of Climate Policies on the NZ Car Industry New Zealand's Automotive Industry And The Impact Of Climate Change —The Broadmind Blog REL-EECA-EV-Supply-constraints-report.pdf](#)

Grade: Excellence

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

This involves discussing the importance of both the science perspective and the second perspective in relation to the science-based response to the issue. The second perspective may support, partially align with, or differ from the science perspective.

The student has analysed a science-informed response to the Mangawhero River issue by discussing why both the science-informed perspective and the Ngāti Rangi perspective are important. They have shown how scientific monitoring of clarity, sediment, nutrients, and eutrophication provides evidence for responses such as riparian planting and reducing waste and stormwater entering the river. At the same time, they have discussed how Ngāti Rangi's emphasis on te ao Māori values, and indicators such as tuna, highlights cultural responsibilities for protecting the awa.

By linking both perspectives to the proposed responses, the student has demonstrated the importance of the perspectives in relation to responding to the issue. The student has also provided evidence to show clear understanding of tiakitanga in the context of addressing the Mangawhero River.

In New Zealand, 60% of our freshwater streams and river are polluted by human activities and processes, lowering the water quality and harming the surrounding environment. The health of our rivers is crucial to the life of all other organisms in the country. Without clean water to drink and consume, the ecosystems that rely on our rivers would not persevere. In the Mangawhero River, the snowmelt fed river running from the peak of Mount Ruapehu, the same issues affect it's health, as it passes through Ohakune. The main issues come from runoff, from roads, farms, and industrial developments, affecting the organisms living in the rivers and the characteristics of the water itself, such as clarity, and pH levels. However, to combat this, organizations such as Ngati Rangi and Horizons employing strategies to keep the awa clean and healthy.

The key science ideas that shape the understanding of freshwater ecosystems are biodiversity, as well as macroinvertebrates, which are important for signalling how healthy rivers are, through the variation of species living in the water. By observing the population of "indicator species" which is a category of macroinvertebrates that has a low tolerance for pollution and a high sensitivity to change in their environment. A key example of an indicator species in the Mangawhero River are mayfly species. This is because they are extremely sensitive to pollution and changes in the water's health. According to Horizons scientists, when a river starts to decline in health, mayflies are often the first to disappear, having a adverse impact upon the biodiversity of the river.

Another important perspective to consider when investigating the health of the Mangawhero River is the point of view of the local iwi, Ngati Rangi. They were brought up on the river, and their tupuna (ancestors) relied upon the river to provide them with food and water to sustain their life. They learned that, for the river to continue providing the environment and their people with mauri (life essence) they had to respect it, by not polluting it with waste, and not taking too much from it. From their perspective, for the river to provide for it's people, they had to maintain a balance by caring for and nurturing it. A way that the Ngati Rangi people can determine the balance of the Mangawhero river's health, is through the Tuna population in the awa. When there is no Tuna found in the river, all living things that rely on the river are affected, signalling an imbalance in the river's health. Ngati Rangi's connected perspective influenced by their cultural learnings relating to the health of the Mangawhero River is important to include when looking for solutions to the issues of the river's health.

On an investigation into the river's health on the fifteenth of May 2025, we explored the differences between two sites on the Mangawhero River. Site 1 was situated at the base of the Mountain Road, where the water is largely unpolluted from outside sources. The second site was located at the end of Burns Street, once the river has passed through the urban development of Ohakune and past some of the farms surrounding the town. The results of this investigation show that the Mangawhero River's water quality and health lowers dramatically after travelling 5 kilometers downstream from site 1 to site 2.

To understand this issue and prevent the water quality from degrading further with a science informed response, monitoring of certain aspects of the water and biodiversity in the river is required, to gain insights into what is negatively impacting the health of this river. One of these is the water clarity. At site 1 it was found that the water clarity was upwards of 100 centimeters, whereas at site 2, it was reduced significantly, at 73 centimeters. The method used to acquire these measurements was with a clarity tube. A sample of the water was taken, and a magnet was slid from the near end of the one meter long tube to the far end, while recording at what length the magnet was no longer visible. This was repeated 3 times,

and the average was recorded to get the highest possible measurement. Low water clarity means that the river contains high levels of loose sediment, which blocks sunlight from reaching organisms and aquatic plants that require sunlight for photosynthesis. Another measurement of the water quality was the pH level, which measures how acidic or alkaline a liquid (usually water) is. At site 1, the pH was found to be 8.07. This is on the alkaline side of the scale, but still well within the healthy limits of water. At site 2 however, the pH was 8.12. In such a short distance, this is a fairly large change, especially for the native organisms that live in the Mangawhero. Indicator species such as mayflies were also found in lower quantities at site 2 when compared with site 1. These changes are almost entirely caused by human activity on the banks and surrounding area of the river. As mentioned earlier, this includes farming, industrial use, and roads.

To prevent further degradation of the health of the Mangawhero River, taking actions informed by scientific information is required. Some options to improve water clarity and biodiversity are; Riparian planting, to limit runoff from farms, industry and other human activities that cause reduction in water quality. Riparian planting achieves this by reducing erosion by increasing the bank's stability with roots. This improves water clarity, allowing more aquatic plants to grow and increasing biodiversity in the river. Riparian planting also reduces runoff from farms and roads by binding the bank tighter with the roots, preventing infiltration through the soil, and absorbing the nutrients that could lead to algae blooms in the river. Another benefit of this solution is that it can increase macro-invertebrate indicator species populations by making the water more tolerable and balanced, with the addition of shade from the planting along the riverbanks. Another response to improve the overall health of the river, including water quality and biodiversity in the river is by ensuring that all disposal of waste and sewerage is contained further away from the river. Currently the sewerage ponds are located next to the river, further upstream from site 2 (Burns Street). Due to this, much higher levels of Escherichia coli, found in human faeces, were found at site 2 (140 MPN/100ml) when contrasted to site 1 (12.4 MPN/100ml). This indicates that some pollutants are from the sewerage ponds into the Mangawhero. To stop this, the sewerage ponds can be moved away from the river.

Another way to increase water quality and river health would be ensuring that stormwater is either prevented from draining into the awa, or adding more filtering to the drains before they reach the river. By making these changes, chemicals and pollutants, such as nitrate and phosphorus will not find their way into the river. These pollutants can trigger algae growth through the process of eutrophication, which can cause the choking out of native aquatic plants. This response links back to the perspective of Ngati Rangi, where they are the kaitiaki of the Mangawhero River.

This response to the issues surrounding the health of the Mangawhero River considers both scientific and Ngati Rangi perspectives. These solutions make sure no pollutants make it into the awa, help the native aquatic plants to thrive, and limit erosion, while maintaining the crucial tiakitanga perspective held by local iwi, and employing scientific information and knowledge relating to freshwater ecosystems to understand how to help the river best.

It is extremely important to consider all perspectives relating to taking care of our environment, when formulating a scientific response to an issue. This is because different groups that have responsibility over maintaining the health of, here, the river have different opinions on how to look after and take care of it. For example, Horizons, the regional council and group that monitor the river's scientific attributes, and Ngati Rangi who are the cultural guardians as mentioned earlier. Both are kaitiaki of the Mangawhero, and both have different ways and reasons for protecting the river. Ngati Rangi protect the river because it has always provided for their people and they have to respect the river for it to continue to do so. Horizons, and other scientific organizations that monitor the Mangawhero on the

other hand, maintain and protect the river's health because it is an important part of the ecosystems in and around the river, and can affect the health of people living around the river as well. Between these 2 differing perspectives on keeping the awa clean, there are common goals that are shared by both, alongside their differences. This is why it is important to consider all perspectives when making decisions on the health of the awa, to ensure that all groups that care about it are happy with the methods being used to protect and preserve the river, while maintaining its ecological and cultural balance in the local environment.