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

Exemplar for Internal Achievement Standard

Agribusiness Level 2

This exemplar supports assessment against:

Achievement Standard 91866

Conduct an inquiry into the use of organisms to meet future needs

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

New Zealand Qualifications Authority

To support internal assessment

	Grade Boundary: Low Excellence
1.	For Excellence, the student needs to conduct a comprehensive inquiry into the use of organisms to meet future needs. This involves: • evaluating the findings and considering the implications of the findings using the external influences • prioritising, with reasons, the findings in relation to the external influences predicting what the short and long-term impacts might be • concluding and justifying whether the use of organisms might meet future needs. This student has decided on a specific inquiry focus, and developed questions and gathered information from both primary (a survey with a large sample size and a good range of questions for three age groups), and secondary sources which are located throughout the text (1). They have compared points of view, values and perspectives relating to the inquiry focus (2). The student has evaluated findings and considered the implications of the findings using external influences, particularly: social, environmental and some economic (3). They have predicted what the short-term impacts could be and linked these to the external influences (4). The student has prioritised, with reasons, the findings in relation to the external influences, specifically the social, environmental and some economic (5) and concluded and justified the use of insects for a form of protein meets future needs in New Zealand (6). For a more secure Excellence, the student could also consider the long-term impacts and how there are linked to the external influences.

Student 1: Low Excellence

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Cricket Protein Inquiry

This is report is about whether the use of insects as a form of protein will meet New Zealand's future needs for protein consumption. This is because people are trying to find different sources protein for human consumption that is grown/ produced in ways that is more ethical to the environment. To further explore this idea, I will be basing my inquiry around two questions.

1. Is there a generational difference of opinion about eating insects?
2. What would be the affect this will have on New Zealand businesses and society? (1)

To answer the first question, we made a survey and gave it out to different age groups ranging from primary children, high school students and adults. In addition to opinion based questions the survey also identify age, ethnicity and gender. This enabled us to group into gender and age groups. With the results on whether people would eat insects, it was found that the older the people were the more willing they were to eat insects, it then went students and primary children were least willing to eat insects. When the question was asked: would you eat them whole, this time the children were the most willing to do this followed by the students and then the adult's least willing to do this. When the question was asked: would you eat them in a powdered form, the adults were most willing to do this followed by the students and then the kids. With this information I can say that there is a generational difference between generations as adults are more willing to eat insects followed by students and then children. People were more willing to eat powdered insects over whole possibly as in New Zealand we don't usually eat them and see insects as 'creepy crawlies'. (2) Also from doing this survey I think that elderly people will be the most willing to eat insects as they have seen hardship in their time, as when they were younger they were taught and learned to be resourceful. I think that the children in the newer generations will be less willing to consume insects as they have not seen hardship and they have been given food like packaged food from the shop such as unhealthy snacks that they would prefer to eat.

The effect on farming insects if insects commercially in New Zealand for protein would affect businesses and society. Insects may be farmed and produced for human consumption or even animal consumption. If insects were to be produced and sold, there would be businesses made in order to produce, sell and market the product. This could possibly be a good thing because there will a GST of 15% on the product as there is a GST on products. This means that there may be more money going to the government which is used for schools, roads, hospitals etc. (3)

These are businesses ranging from food, pharmaceutical, farming and even animal feed providing businesses. This is because if insects were produced for protein, it can be used for human consumption as a food source, nutritional supplements, protein bars/protein products can be produced because of the protein content in the insects. Since insects may be used as a food source, insect protein could also be produced to be supplementary feed for animals. (2) This could possibly be a replacement for palm kernel (PK), as PK and insects have similar nutrients. If producing insects for animal food this has effects on the environment and businesses. This is because if insects replaced food such as palm kernel this would reduce the importation of palm kernel therefore; there is less palm kernel trees forested. This would be a long term effect over time because New Zealand imports a lot of palm kernel. (3)

Other ideas in the long term could be that other businesses close down as insects could be used for human consumption and or the production of nutritional supplements (e.g. protein powder, supplement pills) which gives the businesses more competition in the short term which would mean their income would decrease. (3) The businesses may close down in the long term because the way insects are farmed and produced is a more ethical and sustainable way of producing products as they don't take much to be fed and release very little carbon emissions. People may prefer insect products as people care and worry about the environment as they

value it as people in New Zealand see themselves as the guardians of the land therefore they want what is best for the New Zealand environment so they do what they can to help.

In the short term if insect products are sold, businesses will find that they have more competition between those that sell similar products such as snacking foods (nuts- which have protein) and protein products. Although that I believe that insects will not be produced and sold as a full on meal item because they are not palatable and filling as they are very small, they may be better sold as snacking food if they were to be produced for eating. 4

The long term effects of producing insects for protein on society would be that it would be better for the environment. This is because if stock numbers were to reduce to make way for the food made out of insects, there would be less intensification, therefore less waste from the animals that runs- off into the water ways. In the long term you would see an improvement of this because since there is less runoff there would be less pollution to the water which means that more waterways could be used for recreational activities by people in New Zealand. This gives New Zealand a better name as also tourists can see that the water is safe which lives up to the name of New Zealand being clean and green. 2

A short term aspect for people in New Zealand would be that if farming insects were to be farmed on a commercial scale, there would have to be factories made to farm them in. And to farm the insects, there needs to be people doing this. Also if insects end up being sold, they will be a new product but as my survey showed, people are willing to adapt to new ways of getting their protein intake and I think they will adapt to quickly. If people do this, they will find that insects are not at all bad because they don't actually taste that bad from personal experience. 4

I think that it is the thought of eating insects that is the main reason that people would be reluctant to eat insects. This was identified in my survey in that the older generations were more likely to consider it. The environmental influences would be the main reason to eat insects but it may take some time to convince people that insect protein is healthy for themselves and the planet.

If insects were to be produced for human consumption for protein, I think that stock numbers will not be reduced. I believe that the demand for meat will continue. I do believe though if it is looked into and researched, that insects could be fed to animals as a replacement for palm kernel. If this idea is portrayed and continued, businesses that sell animal feed may suffer from this as to produce insects is better for the environment compared to other products. However, farming businesses will continue and businesses that sell protein products may have competition depending on the demand for the products. If insects were put on the shelves for sale for snacking consumptions, there would be mostly a market demand within the adults as they are more open minded. But this is good because since adults are willing to try insects the it will be relatively easy to encourage younger generations to consume the new protein packed product. 2

Insects are high in protein and as my inquiry shows, with some education around the benefits of using insects as a form protein and a palatable way of presenting it as food, people will use insects as a source of protein in the near future. 6

	Grade Boundary: High Merit
2.	For Merit, the student needs to conduct an in-depth inquiry into the use of organisms to meet future needs. This involves: • comparing points of view, values and perspectives that relate to the inquiry focus • evaluating the findings and how the external influences could have an impact on future needs • concluding as to whether the use of the organism might meet future needs. This student has decided on a specific inquiry focus, developed inquiry questions and gathered information and background ideas from primary (a survey and personal experience) and secondary sources (1). They have identified the external influences, specifically, some environmental aspects, economics as to the impact on the farming industry, and ethical concerns and requirements (2). The student has compared different points of view, values and perspectives that relate to the inquiry focus (3). They have evaluated their findings and how the external influences could have an impact on future needs (4). The student has reached a conclusion as to whether the use of insects as a form of protein will meet New Zealand's future needs (5). To reach Excellence, the student could have given more detail on what the short and long-term impacts could be, and prioritised their findings with reasons in relation to the external influences. Furthermore, the conclusion is not comprehensive and the student has not justified the use of insects meeting New Zealand's future needs.

Student 2: High Merit

NZQA Intended for teacher use only

Cricket Protein Inquiry

In this inquiry I will look at whether the use of insects will meet the future needs of New Zealand, specifically if it could have an impact on New Zealand's farming industry and the ethical issues regarding the insects. The surveys were completed by a range of people from all over the country and some from overseas which allowed us to have wide range opinions to help with discussion. 1

Farming Industries

As we already consume a huge quantity of beef as a country and world and farming for beef is how we get our main source of protein, I think that there will always be a demand for beef meat. "Animal protein is a great source of not only protein but also calcium, phosphorous, zinc, iron, copper and omega 3 fatty acids." - The NZ Farmers Weekly, Nov 26, 2016. 2

Cricket farming is carried out in containers that allow for shelter and free movement. They require a heat of about 32 degrees Celsius. They are fed vegetable matter, to help to improve their taste for human consumptions. "They live for about 8 weeks before being harvested at 40-50 days old." - (2). They're killed by dry freezing, packaged and sold to the consumer. Compare this to beef farming where you must wait at least 18 months to get a profitable yield. Cricket farming requires less land to produce high quantities of produce. It seems obvious that lots of profit can be made quickly and efficiently as the crickets use less land, water, feed and time compared to beef farming. Cattle use 12x the amount of feed to crickets to produce the same amount of protein.

As shown above for 0.45 kg of protein crickets consume 3.8 litres of water compared to beef where 0.45kg of protein requires 7571 litres of water.

Also shown is that the products from farming animals are responsible for 18% of greenhouse-gas emissions worldwide. As the world population is expected to rise to almost 9.5 billion by 2050, it's important that we find a more effective and sustainable way to farm for natural protein, which could be done with insects. Crickets produce only 2.2g of CO_2 per 1kg of protein, which is negligible compared to cattle, which produce up to 2,800g of CO_2 per 1kg of protein. It takes 40-50 days before crickets are able to be harvested and processed compared to beef where it's 18 months. 2

From these statistics, if we were to bring insect farming into New Zealand, we would need to consider whether or not this would have a significant impact on the beef industry. 4

From the processed data of the survey (see appendix 1), when asked, people's response was that they rather not eat insects as an alternative source of protein. The majority say we shouldn't bring farming insects into New Zealand, this could be due to their lack of knowledge about how insects are farmed. In the survey people have voiced that they believe beef farming is not something that can be taken over easily by insects. If we were to educate people more about how easy, affordable and fast it would be to set up an insect farm for human consumption compared to starting up a new beef farm, they could have a change in opinion. 3 Next to what type of insects should be farmed is considering whether it would or could be more profitable than beef farming. As already stated above insect farms require less land/space, less feed and water for the same amount or produce to beef and the end result is produce quicker and to the same, if not better quality as there are higher protein levels in crickets than to beef. 4 The 20% of people who believe insects could be more profitable than beef farming could be people who would prefer to see insect farms rather than beef farms as they are anti-killing of animals and may not see killing insects the same way as they see killing cattle. This portrays that they might be open to changing how they get their protein, through insects even.

From my own experience of eating the insects, I wouldn't be hesitant if offered them again as they are not bad tasting rather, it's the texture of them that is off putting. From eating the chocolate coated crickets, I would suggest this may be a good way to sell them as you are still 3

getting the protein from the insects as well as energy from the chocolate. I found that the chocolate made it more appealing.
As you receive such a high amount of protein in a small amount of food, it means that they are not needed to be eaten in bulk. I feel that about 200g per serving would be beneficial enough to have enough protein to grow and develop your body effectively. “For only 1 grill piece of beef fillet steak 28% of the 135g is protein” - (5)

Ethical Issues
When it comes to farming or growing things ethics need to be considered regarding animal welfare eg. feed, treatment, habitat conditions and slaughter. Regarding the insects welfare, in 2015, an amendment to New Zealand’s Animal Welfare Act recognised animals (non-human animals, excluding insects, to be precise) as sentient. This means that insects are not covered in the animal welfare code. But as farming insects is a growing thing; there should be reason to upgrade to the code of animal welfare. This is because the ethics behind farming insects needs to be an ongoing concern just as it is for beef farmers. 2
There is little standardized protocol regarding insect rearing as there are too many types of insects to devise a feasible protocol for treatment. “There are things to consider like diseases therefore sanitary is important, humidity/temperature which needs to be monitored and controlled to be able to allow for the insects to produce to their potential, and cannibalism amongst the insects themselves which relates to giving them adequate space and nutrition to help prevent this” – (8)
If they were covered by a code of welfare under the Ministry of Primary Industries, this could help with people’s idea of consuming them. 4 They would know that they’re not being unlawfully or unnecessarily harmed in the process as some people have strong beliefs that they won’t eat anything that has had a stressful life.
As shown in the ethics survey (see appendix 2) people have a good understanding in relation to ethics regarding animals and their treatment so when asked about the state of the animal when it is consumed, majority of them either chose that they should dead or it is personal preference. This shows that people don’t wish to be eating live insects and they wanted them to be killed humanely. When asked people were almost certain that dry freezing was the most humane choice and from my research this was proven true. 3

In conclusion, I feel that the use of organisms will help to meet New Zealand’s future needs as they have a significantly smaller impact on the environment and can be more economically viable. It would have a minimal impact on the beef farming industry and could also have huge social benefits as it opens up jobs in the agricultural industry and create a market for developing products to farm insects. The code of welfare will need to be amended to include farming insects. 5

	Grade Boundary: Low Merit
3.	For Merit, the student needs to conduct an in-depth inquiry into the use of organisms to meet future needs. This involves: • comparing points of view, values and perspectives that relate to the inquiry focus • evaluating the findings and how the external influences could have an impact on future needs • concluding as to whether the use of the organism might meet future needs. This student has decided on a specific inquiry focus, developed inquiry questions and gathered information and background ideas from primary (surveyed different groups in the community) and secondary sources (1). They have identified the external influences, specifically, some environmental aspects and economics as to the impact on New Zealand economy although this part is a bit weak (2). The student has compared different points of view, values and perspectives that relate to the inquiry focus (3). They have evaluated their findings and how the external influences could have an impact on future needs (4). The student has reached a conclusion as to whether the use of insects as a form of protein will meet New Zealand's future needs (5). For a more secure Merit, the student could have compared a greater range of points of view and perspectives and given more detail on how the economic influences could impact on future needs. Furthermore, the conclusion is not comprehensive and the student has not justified the use of dung beetles for meeting New Zealand's future needs.

Student 3: Low Merit

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Dung Beetle Inquiry

The aim of introducing new species of Dung Beetles is to increase both soil production and water quality. As a class we have formed a social inquiry to ask students, teachers and the wider community what their views are on the introduction of the Dung Beetle into New Zealand and its effects on farming within the country. 1

The Dung Beetles that are being introduced are Tunnellers. Tunnellers are a type of dung beetle that disposes dung sitting on the surface into tunnels underneath. Creating tunnels for the dung to be pocketed in helps decompose it faster as it is more spread out and it also means that the nutrient rich dung is more available to the root systems of pasture. Creating tunnels in the soil also allows water easier access to root systems as well, allowing more water to the plants. 1

As a class we conducted various surveys in groups of 3-4. These surveys were sent out to people we thought would have a relevant opinion about the introduction of dung beetles into New Zealand. These groups included Teachers, students, parents and scientists.

As we can see above ***(figure removed)***, the question "Do you think NZ farms have too much effluent waste?" the number of people stating yes is 60%. This shows us that the majority of people think there does need to be changes on New Zealand farms to improve effluent waste. 3

Another point of interest comes from the question "Do you think bringing foreign organisms into New Zealand is a good idea?". From the data collected, on average 66.7% of people think it is a good idea. This means that people do agree that if foreign organisms, such as the dung beetle. The main problem with introducing new species is if they carry diseases or if they interfere with the already stable ecosystems in place. Research conducted by Dung Beetle innovations states that there is no risk of human health or animal health connected with the introduction of dung beetles. 3

There was also support for the question "Do you think Dung Beetles will be good for our environment". As the results state, 60.9% of people think they will be good for the environment.

Dung beetles being introduced could have both positive and negative effects on the environment. With dung beetles creating tunnels that allows water in that usually sits on top of the soil, runoff is reduced as a result. The nitrogen sitting on top of the soil is no longer carried into the rivers reducing nitrogen leaching. This ultimately increases the water quality of New Zealand rivers. 2

In the short term, introducing Dung beetles would obviously increase the number of dung beetles in the pasture, as a life cycle of the typical tunnelling dung beetle is 1-4 weeks. With the significant increase in dung beetles, dung building up on top of pasture would decrease as more and more dung beetles are available to decompose the dung. This results in a significant decrease in livestock parasites that hatch in dung. This is done when the dung beetles are rolling and burying dung beneath the surface, killing parasite eggs in the process. There would also see a decrease in flies such as the blowfly, stable biting fly and common house fly. The faster burying of dung helps achieve this in the same way as the parasite, by killing the eggs. 2 4

However, if Dung beetles are introduced with diseases and bacteria that could affect the already stable ecosystem in New Zealand. If this was the case, it could affect not just livestock but also humans as well.

In the long term, the reduced nitrogen leaching into New Zealand streams would boost water quality. This would be an adequate step by the New Zealand Government to achieve their goal of making 90% of waterways in New Zealand swimmable by 2040. In the environments case, cleaner waterways would see an increase in native freshwater species such as the various species of Kokopu, whitebait, and Koaro, helping them become a more stable species. When dung is buried below the soil, it reduces the production of methane and nitrogen. This helps the environment by reducing greenhouse emissions from animal waste. 2 4

The application of tunnelling dung beetles will help increase soil productivity and water quality on the various farms around New Zealand. The tunnels that they provide help the root systems have easier access to water sitting on top of the soil. Runoff is also reduced as a result of this, meaning that fertilizers applied to pasture will reach the roots rather than becoming runoff. This is a positive because it will decrease the amount of nitrogen leaching off a farm, improving water quality. 2

Rather than dung sitting on top of the pasture for days, it is stored in the tunnels beneath the surface speeding up discomposing time. An average of 11% of pastures can be unusable due to it being covered by dung. The rich nutrients that dung can provide to soil and pasture is better used as it is beneath the soil, boosting pasture productivity. 2

In the short term, dung beetles being bought by farmers in New Zealand would increase the costs of production. However, in the long term, dung beetles being rapid reproduces (approximately 1-4 weeks for a complete cycle) the pasture (depending on farm size) will be dung beetle rich. This will mean that most of the dung will be turned into tunnels. As a result, pasture will be more productive and grazing recovery time will decrease. Ultimately, more animals will be able to be farmed boosting profit and creating economic growth. 1 4 2

However, a long term negative impact of introducing new species of dung beetles into New Zealand is diseases and bacteria. If the exotic dung beetles do end up having bacteria or diseases attached, they could have detrimental effects on the ecosystems already in place that have been here for hundreds of years. This could mean that farms may become completely unavailable for farming or other agriculture/horticulture businesses. The New Zealand economy being so reliable on the Agriculture and Horticulture businesses could experience catastrophic consequences. The lack of supply would drive prices through the roof for the limited products that are available due to the high demand. Jobs would be lost and businesses may have to be shut down. 2 4

So in conclusion, after researching through various reports and site, in my opinion I think bringing exotic tunnelling Dung Beetles into New Zealand is a good idea. My main concern was if the introduction of Dung Beetles would cause negative environmental effect on the ecosystems here. However, the research conducted by Dan Tompkins reassured me that our quarantine systems are good enough to prevent this. 3

As Dung Beetles are claimed to increase water quality and pasture growth, I think it would be a good step towards increasing our economic growth within New Zealand. Water quality increasing also not only promote our clean green image but for the local population to have swimmable waterways by 2040 would be fantastic. Dung Beetles would not only add economic but also environmental value to New Zealand. It is these key ideas that have led me to believe it is a good idea to introduce exotic dung beetles into New Zealand. 5

	Grade Boundary: High Achieved
4.	For Achieved, the student needs to conduct an inquiry into the use of organisms to meet future needs. This involves: • deciding on a specific inquiry focus and developing inquiry questions • gathering and reviewing information and background ideas • identifying external influences that could have an impact on future needs • presenting the findings that are relevant to the inquiry focus. This student has decided on a specific inquiry focus, developed inquiry questions and gathered information and background ideas using primary (survey) and secondary sources (internet and readings) (1). They have identified external influences (social and environmental) that could impact on future needs (2) and presented their findings. The student has also partially compared points of view and perspectives (3) and concluded that the use of insects could meet future needs (4). To reach Merit, the student would need to give a more in-depth evaluation on how the external influences of environmental and social impacts could have an impact on the future needs.

Student 4: High Achieved

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Cricket Protein Inquiry

With the need for an increased intensification in the agricultural sector, the idea of the use of insects for a future source of protein has been brought up more and more frequently. I investigated the question: "Will the use of insects for protein meet New Zealand's future needs?" Environmental impacts from the farming industry are becoming a bigger issue as the challenge to produce more food off increasingly shrinking agricultural land increases. Insects could potentially be the answer to the growing effects and challenges of intensive farming. The need for humans to consume protein will always be there however, there may be more cost efficient, environmentally friendly and sustainable approaches to produce this protein, such as insects. To help answer my inquiry, my two key focusing questions were: "Is there a generational difference of opinion about eating insects?" and "What would be the effect of using insects for protein on New Zealand businesses and society?"

Is there a generational difference of opinion about eating insects?

The idea of this question came about as we asked ourselves which generation would need to be targeted in order to start converting more people to eat insects more frequently in the place of other proteins like beef and chicken. We conducted a survey on three different age groups of people: adults, high school students and primary school students (Refer to Appendix 1). When we asked the question: "Would you eat insects?" to a group of 35 adult school teachers, their response was surprising. 63% of the adults said that they would eat insects as a future source of protein, leaving only 37% who would not. This was surprising as when we asked the same question to a class of 33 primary school kids, 58% of them said that they would not eat insects while 42% of them said they would. To gather more data, we conducted a survey on a group of 31 high school students, 55% of them said they would eat insects and 45% said they would not. This information suggests that there is a slight generational difference of opinions about eating insects. This may mean that it is up to our parents and our generation as future parents to change the opinion of our children by making insects a more substantial and common part of our diets. If eating insects is seen by children as the normal thing from a young age, then there will undoubtedly be increases in consumption. Changing young people's attitude towards eating insects may mean a more sustainable future for New Zealand. This is why it is up to the adults of our society and our generation of teenagers to pass the right values onto our children as it is possibly the way in which children these days have been brought up that makes them opposed to eating insects. A response from a teacher at North Street School was that he would eat them "If I had to" (1). Many children at the school also made comments like "yuck" and Have you actually eaten insects before?" (2). This shows that the idea of eating insects does not seem very normal to the children of today's day and age. As adults and young adults we may have to change our attitude towards eating insects in order to lead by example and set Zealand up for a sustainable future.

What would be the effect that this will have on New Zealand businesses and society?

Insects are far more efficient feed converters than cows, there is far more waste created by cows than any insect. Crickets produce 80x less methane than cows, they also need 6x less food than cattle 4x less than sheep and 2x less than pigs to produce an equal amount of protein (1). With the world so focused now on environmental sustainability, a new supplement made from insect protein could be a popular option. If this was to be successful, there would be a

large economic benefit available to small businesses and food suppliers who are willing to grow, source and market the insects successfully. There is potential to be able to harvest a new crop of insects up to four times a year (2). Research has shown that it costs significantly less to produce the same amount of edible product from insects as it does from beef, based on a percentage of protein per 100g, beef sirloin had 29% and crickets had a surprising 69% protein. This shows us that an insect such as a cricket could be the answer to the increased needs of protein in peoples' diets. A person would not have to consume many crickets in order to fulfil their daily protein needs. If a person were to get the same amount of protein from beef, they would have to consume over double the amount of crickets to do so. If insects were able to be grown cost efficiently and successfully in New Zealand, this may present a significant business opportunity for new and existing food suppliers, as well as health care stores. People may be attracted to the clean green and sustainable image that could be portrayed by growing the insects right here in New Zealand with minimal environmental impacts. Health stores selling protein products and various supplements could potentially create a product with the use of ground insect flour as the protein element instead of the traditional whey extracted from cow's milk. 3

This new market would also benefit people in the community as there would be a lot of jobs created in both the production and sales of the insects. However, from a farmer's point of view there may be significant negative impacts on the agricultural industry if insects were to become a larger substitute of proteins like beef. If so much food is able to be produced from so little resources it could mean that farming the way, it has always been done will be a thing of the past. This may also cause a severe economic downturn for New Zealanders individually and as a whole, as agriculture is one of our largest industries. "Less demand for beef would affect farmers' profits, they would have to destock and either be forced to diversify or be unable to continue farming" (3). 3

It seems that the use of insects for protein could in fact meet New Zealand's future needs and could potentially do so very successfully. Although there may be limitations to the production and consumption of insects in New Zealand as this inquiry has shown. If insects are ever going to become a popular source of protein, it will take a lot more research and development and a change in attitude towards eating them. Insects may well have to be consumed as a source of protein in years to come and future generations will have to adapt to this change. 4

	Grade Boundary: Low Achieved
5.	For Achieved, the student needs to conduct an inquiry into the use of organisms to meet future needs. This involves: • deciding on a specific inquiry focus and developing inquiry questions • gathering and reviewing information and background ideas • identifying external influences that could have an impact on future needs • presenting the findings that are relevant to the inquiry focus. This student has a specify inquiry focus and questions, and has gathered information from both primary and secondary sources (1). They have reviewed the gathered information and background ideas (2), and identified external influences, specifically environmental and economic, that could have an impact on future needs (3). For a more secure Achieved, the student could give more detail on the background information and the economic influences that impact on using dung beetles in New Zealand.

Student 5: Low Achieved

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Dung Beetle Inquiry

Is the introduction of new Dung Beetle species into New Zealand a sustainable option for the future of farming?

In order to gage the knowledge and get the opinions of different people involved in the Agricultural sector about Dung Beetles, surveys were sent to different groups. The response from Ag Scientists was reasonably positive, as 66.7% of people thought that introducing Dung Beetles would be useful. However, there is still a third that think it would not be. This could be due to lack of information and awareness around how Dung Beetles could be beneficial or maybe they have conducted their own research and found that it would not be beneficial.

1

According to the Ag first survey results, 100% of those surveyed thought that it would be beneficial to introduce Dung Beetles into New Zealand in order to meet future farming needs. These survey results help to understand that there are positive views on introducing dung beetles and the benefits they will have on New Zealand's agricultural sector and the impacts they will have on reducing the pollution of waterways and the atmosphere caused by the dung of farm animals most specifically, cows.

2

Dung Beetles are a species of insects that feed either entirely or partially on the manure of animals. In New Zealand where cattle and other farm animals are no organisms present to break down the animal's dung. This leads to a number of problems caused by excess excretion including surface runoff, reduced water quality, nitrate leaching and degradation of soils. These all have a negative impact on the environment and have lead people to blame extensive farming practices as the cause for New Zealand's tainted 'Clean Green' image. A solution for this could be to introduce new species of Dung Beetle's that are selected based on their ability to break down animal's dung in order to oppose the negative effects of excess dung. Therefore, the dung is no longer just sitting on top of the ground, it is being broken down and used as a fertilizer and nutrients to be put back into the soil.

3

3

Dung Beetles are able to prevent the pollution from this cycle and also use the dung effectively in order to reduce the amount of alternate fertilizer farmers need to use. Introducing Dung Beetles will mean that the dung is broken down so that nitrogen is not leaked into the atmosphere or carried into rivers and lakes via runoff from rain.

Main Benefits of Introducing Dung Beetles.

- Soil Structure and function
- Water Quality
- Pasture Quality
- Reducing Pest Species

2

Removing dung from the pastures surface reduces fly pests that breed in livestock dung. This creates a healthier environment for animals like sheep and cattle to feed in and they are more likely to eat the grass that is not covered in dung resulting in increased pasture productivity.

3

Economically farmers would potentially benefit the most from introducing dung beetles. The increased pasture productivity means they are able to get the most out of their pastures and will not have to move their stock as often because all of the paddock is available to be used as nourishing feed. The increasingly fertile pastures as a result of dung beetles also mean that

farmers are able to spend less on buying fertilizer and methods to spread it. Because dung beetles reduce runoff into water streams farmers are able to stop wasting money on initiatives to reduce the degradation of water quality.
The introduction of Dung Beetles would impact on fertilizer companies because their products would be in less demand due to the natural fertilization of pastures from dung beetles and the dung and urine excreted by livestock. This would have negative impacts on those companies. Scientists and researchers studying the impacts of dung on soil and how to reduces the impacts they leave would find it hard to get funding as there would be a solution for the problem. However, it would be reasonably easy to find other problems to work on in order to increase the sustainability of New Zealand farms.

3

From my findings I conclude that introducing new species of Dung Beetles into New Zealand will most definitely meet our country's future needs. As our agricultural sector rapidly increases and the number of animals on our farms increases we need an organism that is designed to deal with the excretion of stock in positive ways to ensure it has the least effect on the environment as possible. Dung Beetles will be able to cope with the dung left by livestock and ensure it is reused in beneficial ways. However, it will take some time to see noticeable benefits from Dung Beetles so in the meantime farmers will still have to continue using methods in order to deal with the dung of animals on their farms.

2

	Grade Boundary: High Not Achieved
6.	For Achieved, the student needs to conduct an inquiry into the use of organisms to meet future needs. This involves: • deciding on a specific inquiry focus and developing inquiry questions • gathering and reviewing information and background ideas • identifying external influences that could have an impact on future needs • presenting the findings that are relevant to the inquiry focus. This student has decided on a specific inquiry focus, developed inquiry questions and has (weak) primary (themselves and their classmates), and secondary sources (1). They have gathered and reviewed information and background ideas (2). The student has identified one external influence to this level of the curriculum (3). The student has presented their findings, some of which are relevant to the inquiry focus (4) To reach Achieved, the student could be more specific in identifying external influences that could impact on future needs. They would need to provide more detail about the external influences when reviewing the information relevant to the inquiry focus.

Student 6: High Not Achieved

NZQA Intended for teacher use only

Cricket Protein Inquiry

Insects have been a part of human diets in cultures across the world for hundreds of years and currently about 2 billion people consume insects today, insects also have a lot of protein. For example, crickets, contain about 65% protein whilst chicken only contains about 25% protein and beef about 33% protein. We have been researching insects as a possible viable food source for New Zealand in the near future and learning different aspects and points of views that will be presented throughout this report. The following questions are what will be answered in this report for example: Are people who have travelled, more open to eating insects? And Are younger people more open to eating insects as oppose to the older generation? To answer these questions, we used primary sources such as ourselves and secondary such as the internet and books. We also surveyed people to see how they feel towards insects.

2

1

One question we used was: Are people who have travelled more open to eating insects? To find out if this was indeed true we launched a survey. After looking at the survey results we found that the majority of people (about 90%) who had travelled were defiantly more open to eating insects. We found that people who hadn't travelled were not as open to eating insects and that it was 50/50. I believe people who haven't travelled generally aren't open to eating insects because they have been in a bubble such as New Zealand without venturing out into the wide world and seeing what other cultures eat and the delicacy's they have to offer. Being in a small first world, highly developed country where we don't have to live off insects and where there is a lot of meat to go round people seem to think "Why should I eat that, when I can just have a juicy steak instead" or "I'd rather die than eat that" but really if it came down to the crunch would you really rather starve yourself and die or would you adapt yourself to a new food source such as insects.

2

4

One other question we used was: Are younger people more open to eating insects as oppose to the older generation? To find out if this was indeed true we launched another survey, people who completed the survey were asked one question: Would you eat insects? They then had three options: Yes, No and Maybe. After looking at the results we found that generally people over fifty years old were not as open to eating insects as the younger generation (under thirty-five). For example, twelve people between twenty-one and thirty-five said yes to eating insects while only two out of the twelve said yes to eating insects in the age range of fifty to sixty-five, this shows older people aren't as open as young people to eating insects. I thought this may be due to being 'stuck in old ways' as in when they were younger they were influenced by society to believe that insects were something to stay away from and that they are disgusting probably being due to being associated with mud. I also believe that particularly older people are more conservative in their food choices by this I mean that older people generally have already figured out the foods they like, dislike and foods they just stay away from, in this case being insects. I myself when given the chance to eat insects in class chose to try them, I found that I didn't really like the feeling of eating the insects whole especially the crunch but am more than happy to consume a cake made with cricket flour.

2

4

Some political impacts of eating insects could be the way they are killed, meaning if the way they are euthanized is considered too harsh this may cause a rise in anti-insect eating activists or animal welfare groups interfering in the insect companies. This then brought me to ask: How are insects really euthanized. Some slaughter methods I came across when researching were:

3

- Termites are either eaten alive directly where their found or are brought home to be roasted over coals or fried.

- Cicadas are boiled, fried or sautéed.
- Water bugs may be eaten whole, steamed, fried, roasted and canned.
- Scorpions are skewered alive and fried in oil.
- Tarantulas are fried in oil or roasted over a fire.
- In Brazil, residents pluck the wings off ants and then either fry them or dip them in chocolate.
- In Thailand, crickets are gathered fresh in the morning and then fried.

Most insect companies put insects like crickets for example into the freezer for 24 hours. The low temperatures cause insects processes to slow down and eventually dyeing therefore being one of the most humane way to kill insects.
This then lead me to believe can insects really feel pain?
After doing some research on the internet I found that insects don't actually experience pain but something akin to pain which means this other feeling helps them to learn to avoid or stay away from something that could potentially kill them.

2

In conclusion, our two questions we used were: Are people who have travelled, more open to eating insects? And Are young people more open to eating insects, as oppose to the older generation? After researching these two questions and the topic of eating insects I believe insects has big potential to become a possible viable food source for New Zealanders.