**Internal Assessment Resource**

Agribusiness Level 2

This resource supports assessment against Achievement Standard 91866

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

**Credits:** 4

Resource title: The control of methanogens – the answer to methane?

**Resource reference:** Agribusiness 2.8B Version 1

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| This resource:* Clarifies the requirements of the achievement standard
* Supports good assessment practice
* Should be subjected to the school’s usual assessment quality assurance process
* Should be modified to make the context relevant to students in their school/kura environment and ensure that submitted evidence is authentic
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| Date version published by Ministry of Education | December 2017 Version 1To support internal assessment from 2018 |
| Authenticity of evidence | Teachers must manage authenticity for any assessment from a public source, because students may have access to the assessment schedule or exemplar material.Using this assessment resource without modification may mean that students’ work is not authentic. Teachers may need to change figures, measurements or data sources or set a different context or topic to be investigated or a different text to read or perform. |

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Teacher guidelines

The following guidelines are supplied to enable teachers to carry out valid and consistent assessment using this internal assessment resource.

Teachers need to be very familiar with the outcome being assessed by the achievement standard. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing students against it.

**Context/setting**

This activity requires students to conduct a comprehensive inquiry into whether the control of methanogens will meet New Zealand’s future needs for reducing methane emissions.

New Zealand has the largest methane emission rate in the world at 0.6 tonne per person per year, this is 6 times the global average. Ruminant (sheep, deer, goats and cattle) methane emissions amount for 1/3 of New Zealand's total greenhouse gas emissions, and it is our largest contributor. Ruminant methane primarily comes from the fermentation process in the stomach and sheep are the greatest single source. Methanogens are the bacterial microbes that generate the methane in the fermentation process.

Before beginning this assessment, you will need to provide opportunities for the students to gain understanding of:

* the inquiry process
* different views, values and perspectives
* New Zealand’s future needs.

**Conditions**

Where a group approach is used, the teacher needs to ensure that there is evidence that each student has met all aspects of the standard.

A student can present their information in a format of their own choice. For example, written paragraphs, tables, graphs, videos and/or diagrams, which could form part of a poster, slideshow, a blog or website. You may want to give students guidance on the appropriate style and format for their findings. This achievement standard does not assess format or style.

As a guide, this assessment should reflect approximately 40 hours of teaching, learning and assessment in and out of the classroom.

Conditions of Assessment related to this achievement standard can be found at <http://ncea.tki.org.nz/Resources-for-Internally-Assessed-Achievement-Standards>

**Resource requirements**

Access to the Internet and to relevant sources of information.

This resource could be useful for the inquiry process <http://bit.ly/2d8AB5A>

**Resources to support or to provide guidance for the students:**

<https://en.wikipedia.org/wiki/Methanogen>

<http://bit.ly/belching-cows-and-a-tiny-bacterium>

<http://bit.ly/methane-emissions>

<http://bit.ly/rummaging-in-rumens-for-methane-clues>

<http://bit.ly/Reduce-methane-emissions-from-livestock>

<http://bit.ly/kiwi-scientists-leading-the-world>

<http://bit.ly/NZ-Grassland_Publication>

<http://bit.ly/breakthrough-in-methane-research>

<http://bit.ly/RadioNZ-Audio_reducing-methane-emissions>

**Additional information**

Other possible contexts could include:

* Microorganisms (bacteria, fungi, viruses)
* Marine organisms
* Insects

If you are choosing an agribusiness context for this assessment, there is no expectation to cover all seven primary industries.

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Student instructions

**Introduction**

This assessment activity requires you to conduct an inquiry into whether the control of methanogens will meet New Zealand’s future needs for the reduction of livestock methane emissions. You will present the findings in a format of your choice such as a web page.

Your inquiry will aim to show the different views, values and perspectives and justify whether the use of the methanogens might meet New Zealand’s future needs.

You are going to be assessed on the depth and comprehensiveness of your inquiry.

Teacher note: Insert due dates and timeframes

**Task**

Read the information in the box as an introduction:

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| New Zealand predominantly relies on the agricultural sector for producing meat, milk and fibre, however, ruminants (sheep, deer, goats and cattle) belch methane which contributes to global warming. Ruminant methane emissions amount for 1/3 of New Zealand's total greenhouse gas emissions, and it is our largest contributor. Ruminant methane primarily comes from the fermentation process in the stomach, and sheep are the greatest single source. The control of the bacterial microbes called methanogens (due to their production of methane), could be the way to reduce methane emissions to help mitigate problems associated with agricultural production and achieve more environmentally sustainable production in the future. |

Conduct an inquiry into whether the control of methanogens might meet New Zealand’s future needs for the reduction of livestock methane emissions.

Follow these steps:

* **Establish the framework for your inquiry**
* Decide on the focus for your inquiry.
* Develop two or more research questions to guide your inquiry.
* Identify external influences that could have an impact on future needs.
* Plan where you will obtain the information you need.
* **Carry out your research**
* Gather and record information from a range of sources to reflect a variety of relevant views, values and perspectives.
* Review your information and background ideas.
* **Present the findings of your inquiry** in the format of your choice such as a poster or newspaper front page. Your presentation must compare points of view, values and perspectives. This should be no longer than 2000 words. Your presentation will:
* report on the findings that are relevant to the inquiry focus
* compare points of views, values and perspectives that people hold
* reflect on and summarise the findings in relation to future needs
* evaluate the findings of the inquiry using external influences that could have an impact on future needs, such as ethical, economic, political, cultural, social, environmental, technological, biological, legal, or scientific. NB: There is no need to cover all these – you should focus on those relevant to your inquiry.
* consider the implications of the findings using the external influences
* prioritise, with reasons, the findings in relation to the external influences
* predict the short term and long term impacts of the use of methanogens
* conclude and justify your findings as to whether the use of methanogens might meet New Zealand’s future needs
* include a bibliography that identifies your sources.

**Assessment schedule: Agribusiness 91866 – The control of methanogens – the answer to methane?**

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| **Evidence/Judgements for Achievement** | **Evidence/Judgements for Achievement with Merit** | **Evidence/Judgements for Achievement with Excellence** |
| The student conducts an inquiry into the use of organisms to meet future needs. In their presentation, the student:* decides on a specific inquiry focus and develops inquiry questions
* gathers and reviews information and background ideas
* identifies external influences that could have an impact on future needs
* presents the findings that are relevant to the inquiry focus

**For example: (partial evidence)**The student conducts an inquiry into whether the control of methanogens will meet New Zealand’s future needs of reducing livestock methane emissions. Inquiry questions could be: * What are New Zealand’s future needs?
* What do methanogen microbes do and why are they needed?
* What are the external influences?
* What are the benefits of manipulating methanogens?
* Will the use of methanogens meet New Zealand’s future needs of reducing livestock methane emissions?

The student uses a range of primary and secondary sources to gather and record information.New Zealand's position in terms of global warming is unique due to the high proportion of emissions that are contributed by livestock. One third of the country's greenhouse gases are from livestock which is quite difficult to solve, without vastly affecting livestock production and its economy.The external influences that possibly affect the decision are: Environmental - is about maintaining the integrity of life support systems within ruminant production. It incorporates the important notions of maintaining and sustaining biodiversity and ecosystem services while producing ruminants in New Zealand.Economic - means that resources used to produce, and distribute ruminant products that will be used for the present generation without compromising the ability of future generations to do the same, while making a profit.  Social - is about being inclusive of people’s mental and physical wellbeing and the cohesion of their communities based on a fair distribution of natural resources. The findings show that the research being done by AgResearch, is seeking compounds that will inhibit or slow down methanogen function, or kill the methanogens, but leave the rest of the rumen digestive system unaffected. This has big implications for vaccine and inhibitor development. If a new vaccine or inhibitor targets and knocks out the major methanogen groups, it has a high likelihood of working across all New Zealand species. This research into methanogens and the resulting action will meet New Zealand’s future needs, as it is based on livestock consuming a grass-based diet (which is New Zealand’s predominant livestock production) and has shown in the short-term trials, very positive results in reducing methane emissions.*The examples above are indicative samples only.* | The student conducts an in-depth inquiry into the use of organisms to meet future needs.In their presentation, the student:* compares points of view, values and perspectives that relate to the inquiry focus
* evaluates the findings and how the external influences could have an impact on future needs
* concludes as to whether the use of the organism might meet future needs.

**For example: (partial evidence)**In addition to the evidence for achieved:There are many differing viewpoints, values and perspectives on whether the control of methanogens will meet New Zealand’s future needs.AgResearch scientist and project leader Dr Graeme Attwood, says “Understanding the microbial composition of a low methane animal and how its rumen works will enable us to focus on targeting the methanogens directly using complementary approaches such as drenches, slow release boluses, or specialised forages and supplements”. “Methane produced by rumen methanogens represents about 9% of the dietary energy in the forage consumed by the animal,” says Principal scientist Dr Peter Janssen, AgResearch. “If some of that energy can be redirected to the animal, it may lead to an increase in the animal’s ability to produce meat, milk or wool. This would be a real win-win for farmers.”Environmental influence – New Zealand has the largest methane emission rate in the world at 0.6 tonne per person per year, this is 6 times the global average. Ruminant methane emissions amount for 1/3 of New Zealand's total greenhouse gas emissions, and it is our largest contributor. Economic influence – There is currently no price on emissions, so there is no incentive for the New Zealand farmer to adopt methane reducing actions, unless these practices are profitable in their own right. Solutions need to be practical to implement and economically viable. Scientific influence – By understanding the bacterial methanogens involved, scientists are able to reduce methane emissions. There are opportunities to reduce methane emissions by changing ruminant’s diets and to identify specific plant chemical characteristics that influence methane formation in the gut. Social influence – Reducing methane emissions is a social issue that discerning consumers will purchase products on, so New Zealand producers need to be seen to be acting on. Political influences - There are fears that other countries will use our high methane emissions as an excuse to enforce trade restrictions, such as refusing to buy our meat exports, if we are not seen to be doing something about them.Various organisations are working together such as the government-funded NZAGRC and the Pastoral Greenhouse Gas Research Consortium, to find practices that enable farmers to reduce greenhouse gas emissions from livestock. These practices are; the identification of naturally lower emitting animals for breeding, and the development of animal-safe compounds that can stop the production of methane in the rumen of animals. The use of methanogens is required if New Zealand is going to reduce its methane emissions from livestock. However, further trials are required to ensure that breeding naturally lower emitting methanogens or the development of animal-safe compounds can reduce emissions in the long term, have no adverse effects on productivity and leave no residues in meat or milk.*The examples above are indicative samples only.* | The student conducts a comprehensive inquiry into the use of organisms to meet future needs. In their presentation, the student:* evaluates the findings and considers the implications of the findings using the external influences
* prioritises, with reasons, the findings in relation to the external influences
* predicts what the short term and long term impacts might be of the organism use
* concludes and justifies whether the use of the organism might meet future needs.

**For example: (partial evidence)**In addition to the evidence for achieved and merit:Environmental, social, and economic influences are the key priorities in determining whether the control of methanogens might meet New Zealand’s future needs.Social influence - The world is demanding that methane emissions are reduced so New Zealand ruminant producers need to be doing something about it. Environmental influence – New Zealand has high methane emissions due to the large numbers of ruminant livestock in agricultural production. Economic influence – as New Zealand relies on the agricultural sector for its economic wellbeing, if we are to implement solutions, it needs to make economic and business sense. In the short term, mitigation opportunities have limited applicability for grazing ruminants or they involve actions such as reducing livestock numbers, which affect negatively profitability. In the medium to long term use of methanogens such as using a vaccination, or producing low methane emitting livestock offer cost effective solutions for the farmers. Improvements in reducing agricultural methane emissions in livestock production are crucial but they are not enough on their own to decrease New Zealand’s total greenhouse gas emissions, due to the increasing population and associated demand for food. However, producing practical solutions that can be actioned on farms are worth pursuing and will help to meet New Zealand’s needs to reduce methane emissions. The most beneficial solutions currently been pursued to reduce methane production in the rumen are: * Investigating the ecology of the rumen system and genetics of methanogens.
* Exploring the natural variation in ruminants and different types of feed to identify animal lines and pasture grasses that produce less methane.
* Developing vaccines and inhibitors that will specifically knock out methanogens but leave the rest of the rumen microbial community intact.

These may be a part of the solution but not the whole answer to reducing methane emissions.*The examples above are indicative samples only.* |

Final grades will be decided using professional judgement based on a holistic examination of the evidence provided against the criteria in the Achievement Standard.