Science activities – Levels 4 and 5

A science lens on the animal welfare, biosecurity and food systems

CORE EDUCATION
Tātai Aho Rau

Ministry for Primary Industries
Manatū Ahu Matua

Animal Welfare – the science of animal behaviour

Our economy depends on animals. They provide us with food and fibre, income, companionship, entertainment and research models. Many New Zealanders expect our farm animals to be well looked after and animal welfare is a factor taken into account when we compete for access to international markets. Animal welfare is determined by how animals behave in particular contexts and how they are treated, housed and fed. Societal concern and expectations can contribute to the acceptability of certain practices when we use animals (for food, fibre, entertainment, etc.). See the MPI **Animal welfare overview** for more information.

The science of animal behaviour

All living things behave – the science of animal behaviour under natural conditions is called ethology and includes a focus on evolutionarily adaptive traits, while behaviourism refers to measured response to a stimulus in a laboratory environment.

1. Have students discuss the connection between animal behaviour and their concept of animal welfare. Use leading questions such as:
    - Do animals have emotions and are they sentient? How do you know?
    - What behaviours do your pets display? What behaviours do animals exhibit on farms?
    - What behaviours can be observed in the animals we eat?

2. Look at the **Five Freedoms** and the **Five Welfare Domains**. Have your students examine and try to summarise this **scientific article by New Zealander David Mellor**. This **video from Massey University** may be useful for understanding. Have your students discuss the different between the two concepts.
    - What are the arguments for moving from a 'Five Freedoms' to a Five Domains model?
    - How has increasing scientific knowledge influenced this shift?

Animal welfare in the food system

3. How do our expectations for animal welfare influence New Zealand food system practices? How does science inform New Zealand animal welfare?

- Students can link scientific information about animals to the animal welfare legislation and regulations that apply to the primary industries.
- Students present their findings in a table format.
- Examples from New Zealand and overseas may include:
  - raising chickens for egg production in different contexts – caged, colony, barn raised, free range;
  - different farming systems for pork production, and use of sow crates (not in New Zealand) and use of farrowing crates;
  - indoor and outdoor farming systems for cattle.

Animal	Aspect of legislation or requirements ensuring their welfare	Relevant research	Does research support welfare legislation Y/N
_			
_			
_			

4. In the Level 1–2 and 3-4 animal welfare resource activities students investigated personal and national responsibilities for the welfare of animals. Students can now extend their knowledge by comparing and contrasting their responsibilities with those of a farmer who produces animals for food. Encourage thinking and discussion around the following:
   - What the responsibilities producers have to protect the welfare of their animals.
   - What does 'ethically farmed' food mean? What examples or case studies of ethically farmed food can students discover?
   - The following resources may be helpful. Here: **teaching ethics** and **ethics in sheep breeding**.
   - What organisations lobby for the welfare of farm-raised animals? Find out about any statutory powers they have. Read a summary of **New Zealand animal welfare laws** and investigate the **Animal Welfare Act**.

Extension activities

1. Putting it all together and making connections. What connections can they find between the concepts of animal welfare, biosecurity, and food systems in our primary industries? Students work collaboratively to brainstorm their ideas and then present a summary of the outcomes of their discussions. They could, for example, use a Venn Diagram to present their findings.
2. Who cares? An animal welfare case study. Students produce a case study about a person or an organisation who locally, nationally or internationally works in the field of animal welfare. Who are they? What do they do? What have they done?

Possible people/organisations could include:

- the **Australian and New Zealand Council for the Care of Animals in Research and Teaching**
- the **National Animal Welfare Advisory Committee**
- the **Ministry for Primary Industries**
- the **SPCA**
- **Massey University Animal Welfare and Bioethics Centre**

Biosecurity – keeping watch

Our primary industries lose millions of dollars each year due to damage from a wide range of pests and diseases that damage or even kill crops or livestock and reduce production levels and can greatly restrict our access to international markets for our products. Such incursions can also pose threats to native species of significance to Māori. We are all responsible for being vigilant about potential risks and hazards posed by diseases and pests. We need to protect our plants and animals and be aware of agencies and networks that support producers to keep our land, plants and animals healthy.

What is biosecurity?

1. What does biosecurity mean? As an introductory activity view the video **Biosecurity – protecting to grow New Zealand**.

    - Whose responsibility is it to keep the New Zealand biosecurity system functioning well?
    - What is the role of science and scientists?

2. New Zealand has a list of almost 15 000 unwanted plant, animal and marine pests and diseases.

    - What are some examples? How did they get here? Explore students' prior knowledge.
    - Discuss whether all non-native species are unwanted. When does a non-native species become unwanted? What criteria might be used to decide this? Consider examples of cute animals or beautiful scenery, such as those shown here.
    - These organisms can severely damage our economy, our environment, and our way of life. Using **Keeping Watch** students investigate how these aspects can be put at risk and the different forms in which biosecurity threats can appear.

3. New Zealand's isolation provides us with a high level of security against pests and diseases. However when people, cargo, and mail cross our borders there are inherent biosecurity pressures, including the movements of wind, rain and tides.

    - Discuss how each of these can present risks and what can be or is being done to mitigate these risks.
    - Using a range of different sources students produce a table to show the measures New Zealand takes across our biosecurity systems to reduce the risks created by pests or diseases.

Pre-border risk management activities	Border risk management activities	Post-border risk management activities

Natural and cultivated ecosystems

4. Revisit the idea of natural and cultivated ecosystems. Have the students brainstorm to come up with definitions and examples for what these mean. How are natural ecosystems and cultivated ecosystems the same and different?

5. Explain **monoculture to the students**. What are some similarities and differences between monocultures and diverse ecosystems? You can find out more about biodiversity in New Zealand from the following websites:

- **Department of Conservation**
- **Statistics NZ**
- **Science Learning Hub**

6. Is there a link between cultivated ecosystems, monocultures, and biosecurity risks, hazards, and opportunities for our primary industries? Why do some plants or animals pose more of a risk in some regions of New Zealand than in others?

Using a range of scientific tools and techniques, students collect and interpret primary and secondary data and evidence to support the above points. For guidance on building students' data collection skills, see Science Learning Hub **Delving into Data** (part of an ongoing professional development series linked to the Science Capabilities).

Trophic levels, food chains and food webs

7. Organisms within any ecosystem are connected by the **flow of energy**. Each level of this energy flow is called a trophic level. All ecosystems contain different trophic levels. Have students use the terms below, used by biologists to categorises trophic levels within an ecosystem, to construct a mind map.

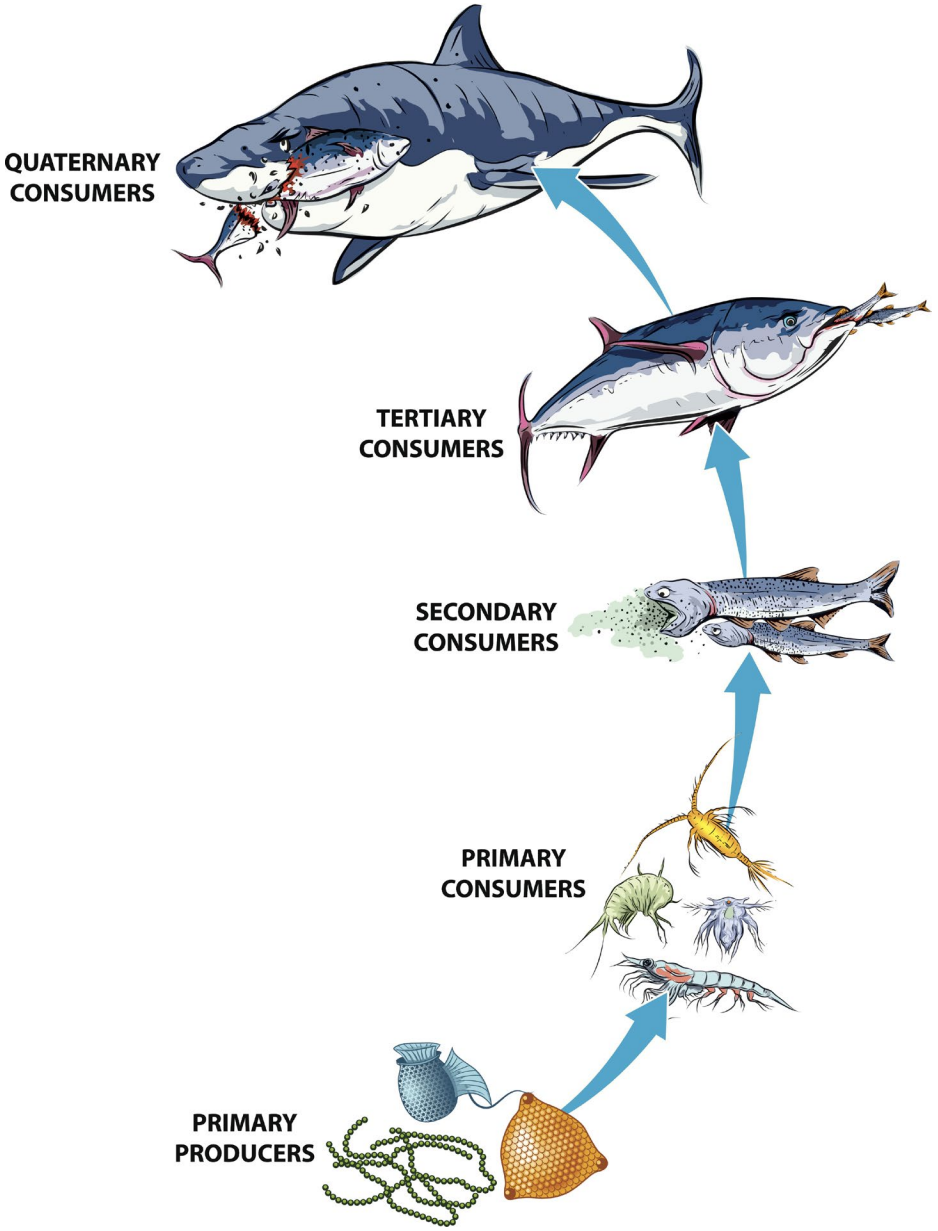
    - The connections in the mind map need to demonstrate an understanding of why different terms are connected.
    - Students support their explanations with examples from a cultivated ecosystem and/or a natural ecosystem, such as a forest, a sheep farm, an apple orchard, a vineyard, a pine forest, a river, the ocean or a mussel farm.

Autotrophs	Consumers	Decomposers	The sun
Food chain	Food Web	Herbivores	Heterotrophs
Producers	Second order carnivore	First order carnivore	Trophic levels

8. Students brainstorm a range of possible food chains that are relevant to specific regions, considering both natural and cultivated ecosystems. They then collate similar ecosystems to produce food webs. See **Food chains and food webs** for more information.

    - Ask students: how does the biodiversity of a cultivated ecosystem compare to that of natural ecosystems?
    - For a bit of fun, direct students to this **Food chain game.**

9. Many of our cultivated ecosystems are monocultures dominated by one species of plant or animal and have a limited number of trophic levels. Most natural ecosystems contain a range of different plants and animals connected through a more complex system of trophic levels. This is biodiversity. For activities about monoculture in cultivated ecosystems, see the resource **Kiwi protection through diversity**.



Biosecurity incursions

10. Students research the effects of disruptions to local and national ecosystems caused by biosecurity incursions. Examples could be the impact of kauri dieback, myrtle rust, pea weevil, or velvet leaf. They investigate what is being done to address the risks that these pests or diseases pose to New Zealand, for example on the environment, the primary industries, or tourism. This knowledge can also be used in a later learning activity to explain the impact of some pests and diseases on business and trade.

11. Students consult local producers, vets or farming organisations to find out about pests or diseases that pose a biosecurity risk in their region including those that: are already established; have been a problem in the past but are now eradicated; have surveillance programmes; and/or have the potential to establish. They can phone, visit, arrange virtual meetings or invite an expert to talk to the class. Students collate the information they have collected.

12. Students investigate the establishment of the **National Māori Biosecurity Network**. What is the purpose of this network? Why is this network important? What might a bicultural approach to biosecurity look like in your region?

13. Students investigate a pest or disease that impacts on the sustainability of a local primary industry in their region. The aim is not only to raise awareness in their local community about that pest or disease, but to also provide options and strategies for members of their community to take action against that pest or disease. Their investigation must include appropriate and relevant scientific concepts and knowledge, such as taxonomic classifications, ecological niche, etc. What biosecurity measures, including technological developments, have helped to reduce or eliminate the impact of these pests or diseases? What groups are involved in managing this pest? How is this pest or disease managed or eliminated?

    - Students may be able to generate their own list, based on their prior knowledge and experience. Here are some resources that will help generate your lists: **MPI pest and disease search; Arable farming pests and diseases; Diseases of sheep, cattle and deer; Insects pests of crops, pasture and forestry**; Dairy NZ's **Pests and weeds; Agpest** website, the **Biosecurity Notifiable Organisms Order; DOC's War on Weeds** and **DOC's Predator Free NZ**.

Further resources:

- MPI website:
  Finding and Reporting Pests and Diseases;
  Keeping Watch;
  Responding;
  Biosecurity Surveillance Guide;
  Biosecurity 2025.

- MPI Youtube channel:
  Meet Phil – Professor of Plant Biosecurity;
  In-flight video; cruise ship video
  It's not just fruit;
  Pawder Control – declare or dispose.

- Landcare Research **Identification tools for plants and animals** and **Restoring taonga**;

- Invite a Futureintech ambassador into your classroom: **Biosecurity officer**.

Food – microorganisms: friend or foe?

Ministry for Primary Industries
Manatū Ahu Matua

Food – microorganisms: friend or foe?

Within our food systems microorganisms such as bacteria, fungi and viruses (microbes) can provide both opportunities and risks. They may be an essential part of food processing, for example, in cheesemaking. As decomposers they are responsible for recycling key nutrients, such as nitrogen, throughout the ecosystem. As pathogens they can present huge food safety risks during production and processing, for example, *campylobacter* in chicken.

Revisit the basics

1. Have students undertake research to create a list of bacteria, fungi and viruses. Sort them into 'helpful' or 'harmful' organisms.

   - Science Learning Hub is a good place to start investigating microbes.

2. What conditions are required for optimum growth of bacteria and fungi? Have students draw on their prior knowledge, then conduct a practical investigation to put this into context. Activities could include:
   growing bacteria on Petrie dishes;
   making yogurt also see (science behind yogurt);
   making bread;
   letting food go mouldy.

   How can this knowledge be used to inform different aspects of the food system?

Microbes in the food system

3. List the situations where bacteria, fungi and viruses may grow during the cycle of food production – during processing, storage, transport and sale. Explore what past, current and potential future practices or technologies have been/are/could be used to mitigate risks.

4. Visit MPI's website to explore what foods are particularly high risk. Why is this? How could you take extra care when preparing, cooking and storing foods these foods?

1. Explore what additional things you need to think about when cooking food for a large number of people to keep to keep them safe from food poisoning. For example, cooking on the marae (check out **Marae Kai Masters** for some inspiration), fundraisers, celebrations and community events. How does this change when using 'high risk' foods such as kaimoana and poultry? Transporting food to and from New Zealand for use in celebrations?

Friend or Foe

2. Students investigate two contexts where a microbe is involved in aspects of the food system – one helpful and one harmful microbe.

    - What is it called? What does it look like?
    - What does it affect? What does the affected food look like?
    - Why is it helpful/harmful? If it is helpful, what is it used for?
    - Using their prior knowledge about the optimum conditions for microbial growth, have them explain what can be done to either enhance the opportunities these organisms provide for food industries or inhibit their influence as risk factors to these industries.