Moo to You

Teacher Manual

Manual Contents

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Kit Contents

- Teacher manual
- 10 student worksheets – Pasture Pick and Mix
- 10 student worksheets – Mixture or Solution? Part A: Shake It Up
- 10 student worksheets – Mixture or Solution? Part B: Milk Shake
- 10 student worksheets – Supermarket Scavenger Challenge
- 5 student worksheets – Is All Milk Created Equal?
- Plastic jug
- Concept map and 'Start with Science' posters
- How Are We Related?
- 5 sets of animal sorting cards

Pasture Pick and Mix

- 10 plastic trays
- 20 black growing trays
- 10 scissors
- 10 teaspoons
- 10 spray bottles
- selection of pasture seeds
- tissues
- set of 'Rosie's Recipe Cards'
- 20 bio-degradable trays
- roll of aluminium foil

Digestion Part A: Monogastric Digestion

- monogastric stomach with plastic bag
- saliva
- stomach acid
- cracker biscuits
- microbes
- plastic tray
- tights / scissors
- plastic cup / polystyrene cup
- set of 'Monogastric Digestion' posters

Digestion Part B: Ruminant Digestion

- bag of forage
- ruminant stomach
- ruminant microbes
- saliva
- stomach acid
- magnet
- teaspoon/tablespoon
- latex gloves
- set of 'Ruminant Digestion' posters

Mixture or Solution? Part A: Shake It Up

- sand/salt/sugar
- 10 teaspoons
- 10 containers labelled 'salt'
- 10 containers labelled 'sugar'
- 10 containers labelled 'sand'

Mixture or Solution? Part B: Milk Shake

- milk powder
- cooking oil
- 10 pipettes
- 10 50mL beakers
- 10 containers labelled 'milk'

Is All Milk Created Equal?

- 5 Mammal Milk sets
- wooden cubes
- 5 'Milk Nutrition' posters

Supermarket Scavenger Hunt

- stopwatch

Environmental Hoofprint

- 10 poster A
- 10 poster B

Handouts

- Monogastric Digestion
- Ruminant Digestion
- Mixture or Solution?
- Supermarket Scavenger Hunt

CONCEPT MAP Moo to You

BIG IDEA: All our energy comes from the Sun.

Transfer of solar energy occurs in, and between, organisms when humans and animals eat plants and food made from plants.

Food production has an impact on the environment – greenhouse gas emissions, deforestation, water usage and pollution.

A growing global population needs access to high-quality nutrition.

Dairy products such as milk, cheese and yoghurt are a source of balanced, healthy nutrition.

The dairy industry is an important contributor to the global food supply.

Milk is a nutrient-rich fluid made up of water, protein, fat, lactose and vitamins and minerals.

Ruminant animals have a unique digestive system that that allows them to maximise energy from plant material and convert it into nutrient-rich milk for their young.

Digestion is the process which allows a body to get the nutrients and energy it needs from the food it eats.

The stomach mixes and prepares food for digestion.

Domestic cows are ruminants.

Pasture plants are a valuable source of food and energy.

All ruminants are mammals. Mammals produce milk for their young.

All living things are classified according to their similarities and differences.

STARTING CONCEPT: All living things need food as a source of energy.

Curriculum Level: 4 3 2 1

The Nature of Science and the Science Capabilities

"Science is a way of investigating, understanding, and explaining our natural, physical world and the wider universe" (Ministry of Education, 2007, p.28).

The core strand of science in NZC is the Nature of Science (NOS) strand. The NOS strand is about how science knowledge is created, validated and used. Understanding the discipline of science helps students to engage with science in their lives.

Five basic capabilities in the science learning area have been identified from the Nature of Science sub strands. These capabilities contribute to a functional knowledge of science and are to be used as a guide for adapting teaching and learning in the classroom.

<table>
<tr><th>Nature of science sub strands</th><th colspan="3">Understanding about science
When the focus is on scientists' work</th><th colspan="3">Investigating in science
When the focus is on student investigations</th><th>Communicating in science
Make meaning of scientific representations</th><th>Participating and contributing
About taking action</th></tr>
<tr><td>Matching science capabilities</td><td>Gather and interpret data</td><td>Use evidence</td><td>Critique evidence</td><td>Gather and interpret data</td><td>Use evidence</td><td>Critique evidence</td><td>Interpret representations</td><td>Engaging in science</td></tr>
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NOTE: this is a generic overview, please see the **Learning Objectives and Curriculum Links** document on the kit booking page for details on how the activities in this kit link to the curriculum document.

The boundaries between the capabilities are blurry. Each of the student activities in this resource provide opportunities to strengthen more than one of the capabilities. As a guide for planning, teaching and assessment purposes examples of the science capabilities have been identified throughout the text.

Assessment Tools

Science Engagement Survey (Years 0-4 & Years 5-10)

A free, online tool to help teachers find out how students perceive their science learning in class. There are two versions of the survey.

Junior Science: Thinking with Evidence (Years 4,5 & 6)

A standardised science assessment designed for use in New Zealand schools and available for students to sit through a subscription with NZCER Marking. Junior Science: Thinking with Evidence is explicitly linked to two aspects of the New Zealand Curriculum: The Nature of Science strand of the science learning area (which embeds the science capabilities), and one of the key competencies–thinking.

Assessment Resource Banks (ARBS) (Years 1-10).

Free assessment tasks that focus on both NOS and the science capabilities.

Cultural link

Miraka

Miraka is New Zealand's only Māori majority-owned and controlled dairy company, located in Mokai, 30km northwest of Taupō in the central North Island.

Miraka produces high-end milk powders that are exported worldwide.

Miraka is well established in the New Zealand dairy-processing industry with strong values founded on the cultural beliefs of its owners. Protecting the environment is of paramount importance to Miraka shareholders. They have a long-term shared vision of sustainable business practices to ensure that future generations can continue to enjoy the benefits of the land.

Renewable geothermal steam from the Mokai geothermal field is used to run its processing operations – a world first for the whole milk processing industry. Monitoring bores set up around the property ensure that there is no impact on the ground water.

Biological waste from the milk drying process is composted at the nearby Tuaropaki Trust worm farm. The worm castings in turn go into a local native plant nursery and these plants are used for riparian waterway planting.

Use of geothermal steam and composting biological waste lowers the greenhouse gas emissions produced by Miraka. This is important in their role of kaitiaki (guardians) of the environment. It is also important to consumers around the world who look to buy products with a low carbon footprint.

Miraka is Māori for 'milk'.

Teacher Background Notes

Introduction

All our energy comes from the Sun. Plants capture and store light energy from the Sun as chemical energy, by a process called photosynthesis. Energy is stored in the roots, fruits, and leaves of plants. This energy feeds every living thing on Earth.

Transfer of solar energy occurs, in and between organisms, when humans and animals eat plants and the food made from plants.

The 'Moo to You' resource kit follows the transfer of energy from the Sun to pasture plants, to cows and its release during the digestive process in the form of carbohydrates, protein and fat from milk and other dairy products.

How are living things classified?

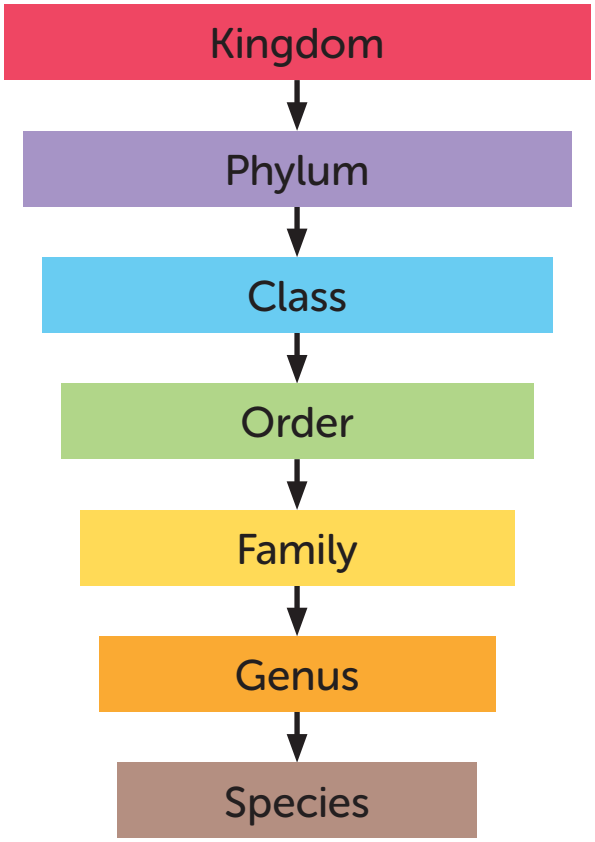
There are billions of different kinds of living things on Earth, and ways have been devised to name and classify them according to their similarities and differences.

The system scientists most commonly use puts each living thing into 7 main groups (or taxon), organised from most general to most specific. These groups start out large and get smaller until unique characteristics are identified, and a species name is given.

Each species belongs to a genus, each genus belongs to a family, each family belongs to an order, and so on.

Living organisms are first placed into kingdoms. The 6 kingdoms are Plants, Animals, Protists, Fungi, Archaebacteria and Eubacteria.

The animal kingdom *(Animalia)* is the largest of all the kingdoms and is made up of more than one million species.



Mammals

A mammal, class *Mammalia,* is a member of the group of animals, within the kingdom *Animalia,* in which the young are nourished with milk from specialised mammary glands of the mother. They are also vertebrates (possess a backbone), warm-blooded and have hair or fur.

Ruminants

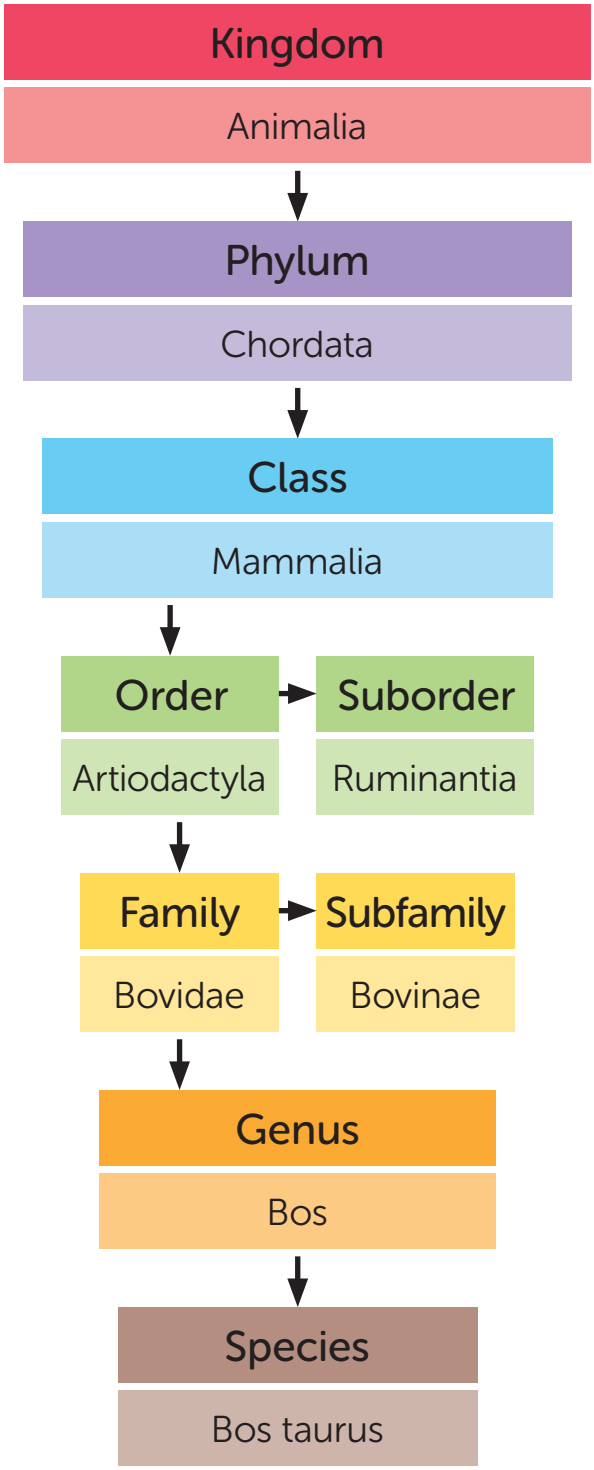
A ruminant is any mammal of the suborder *Ruminantia* (order *Artiodactyla*). All ruminants are mammals, but not all mammals are ruminants.

Ruminant animals acquire nutrients from plant-based food by fermenting it in a specialised stomach prior to digestion.

There are approximately 200 species of ruminants, both domestic and wild.

The family *Bovidae,* within the suborder *Ruminantia,* includes cattle, goats, sheep, and antelope.

Cattle, cows (female) and bulls (male), are a prominent modern member of the subfamily *Bovinae* and are the most widespread species of the genus *Bos*. *Bos taurus (B. taurus)* is the species name given to the domestic cow.



Grass

All living things need food as a source of energy.

Grass, like all green plants, captures energy from the Sun and converts the energy into food (sugars and carbohydrates) which it eventually uses for growth. This process is called photosynthesis.

Grass is a valuable source of food and energy for all sorts of animal life.

From pasture grasses for animal consumption to food crops such as oat and barley for human consumption, grasses make up the world's most significant food source. Grasses make up 26% of plant life on Earth. There are many varieties of grasses (approximately 10,000 species). They have a wide range of sizes and growth rates.

Many types of animals eat grass as their main source of food including sheep, cattle, horses, rabbits, deer, and invertebrates such as grasshoppers and caterpillars. Grasses are also eaten by omnivores or even occasionally by carnivores.

A graminivore is a herbivorous animal that feeds primarily on grasses and seeds.

Pastures

Pastures are fields growing plants for grazing animals. Pastures are not just grass but are made up of many different plants. They usually include a mixture of different types of grasses, legumes, and herbs chosen to suit the conditions and livestock. With a diverse range of plants, animals can enjoy a varied diet and a healthy intake of vitamins and minerals.

Pasture plants must be able to regrow quickly several times a year after they have been eaten by grazing animals.

All pasture plants that are eaten by grazing animals are collectively described as forage plants. Forage is the basis for a cow's diet. A cow must have a good diet to ensure she remains healthy and can produce a strong calf and top-quality milk.

New Zealand farmers have developed systems for efficiently grazing large numbers of animals in open pastures all year round. This includes pasture grass in the summer months and, when pasture is scarce, silage and hay is used to supplement grazing animal's diets. Silage is pasture plants cut at their prime quality and then fermented to lock in their nutrient content.

Bales of silage are tightly wrapped in plastic. This creates an anerobic environment (one without oxygen) inside the bale which is required for the pasture to ferment.

Hay is pasture that has been cut and dried.

Digestion

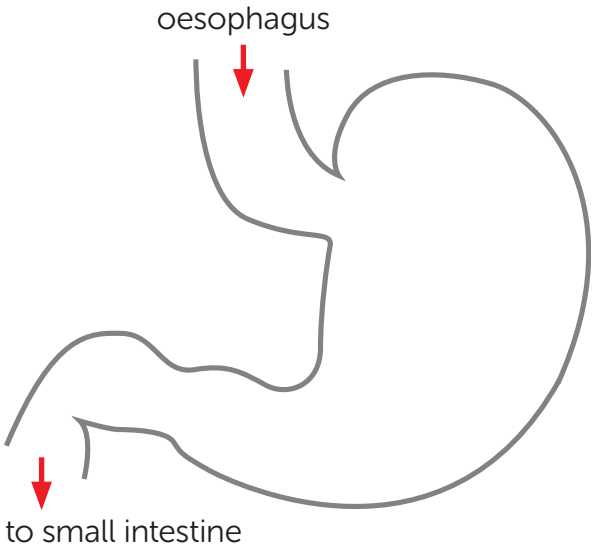
Digestion is the process which allows a body to get the nutrients and energy it needs from the food it eats.

The digestive system extends from the mouth to the anus and is made up of the parts of the body that work together to turn food and liquids into the building blocks and fuel that the body needs to grow properly and stay healthy.

The stomach is a muscular organ that is part of the digestive tract. The main function of the stomach is to store food and release it to the intestines at a rate whereby the intestines can process it. The stomach mixes, grinds and prepares food for digestion.

Monogastric digestion

A monogastric organism has a single chambered stomach.

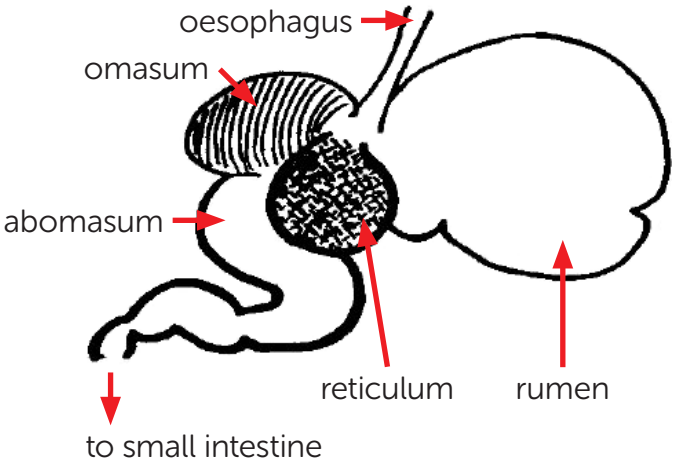


Examples of animals with monogastric digestive systems include humans, dogs, pigs, horses, rabbits, and cats.

Ruminant digestion

The primary difference between ruminant and non-ruminant animals is that ruminants have a four-compartment stomach.

Ruminants have a specialised way of digesting food where they move food from one compartment in the stomach to the next.



Examples of animals with ruminant, digestive systems include cattle, sheep, goats, and deer.

Difference	Monogastric digestive system	Ruminant digestive system
Number of stomach compartments	1	4
Number of times food is chewed	Once	Several times
Efficiency in digesting plants and plant by-products	Limited	Highly developed

What is milk?

Mammals are the only group of animals in the entire animal kingdom that produce milk for their young.

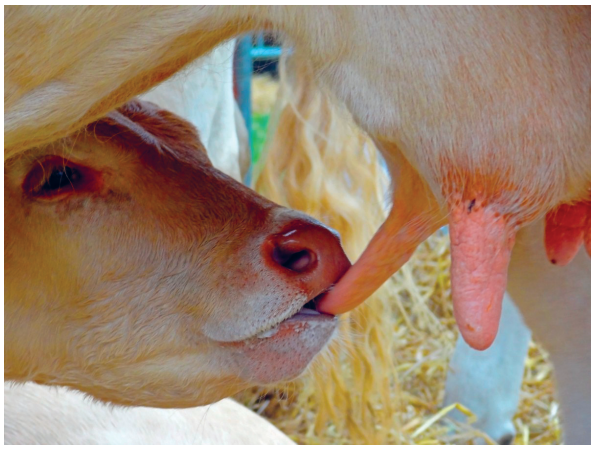
Milk is a complete source of nutrition for new-borns. It is a nutrient-rich fluid consisting of fat, protein, lactose (sugar) and water and containing a wide array of nutrients, including vitamins and minerals.

The composition of milk varies depending on species, diet, and location. Reindeer in the Arctic Circle produce a nutrient dense milk that is 20% fat (5 times more than human or cow's milk) to help their young survive the freezing climate.

Milk has been enjoyed as a nutritious food source throughout the world for thousands of years. The most commonly consumed types of milk come from cows, sheep and goats.

How and why do cows produce milk?

A cow has a four-chambered stomach with the ability to digest forage for nutrition. She is a ruminant.



A cow must give birth to start producing milk. Pregnancy causes the cow's body to produce the hormones required to prepare her body and udder to produce milk. Nutrients absorbed from the bloodstream circulate to the mammary gland in the udder where special cells combine the nutrients to create milk. Once the cow calves, she is ready to supply milk to her calf.

Dairy cows are good at lactating (producing milk). When a farmer milks a cow, it is sending the message to the cow's body that it needs to keep producing milk and the necessary hormones within the cow stay at the required levels.

The amount of milk the cow produces decreases as the months go by and farmers eventually 'dry off' the cow. The cow has three months off before she calves again and the whole process continues.

Dairy in New Zealand

New Zealand is naturally blessed when it comes to making milk.

New Zealand's climate, soil and abundant water create the perfect environment for growing grass and other pasture plants. Cows can access pasture all year round and because we are an island nation far from other countries, New Zealand is free from many pests and animal diseases found elsewhere in the world.

New Zealand produces 3% of all the milk in the world and is the 7th largest milk producer worldwide. New Zealand is the world's largest exporter of dairy products.

Reference:
www.dairynz.co.nz/media/5794072/quickstats-about-dairying-new-zealand-2020-web.pdf

Solutions and mixtures

A mixture is a substance in which 2 or more substances are mixed but not chemically joined together. Mixtures can be easily separated and the substances in the mixture keep their original properties.

A solution is a mixture where one of the substances dissolves in the other. The solid that dissolves is called the solute. The liquid in which the solute dissolves is called the solvent.These components can be easily separated by evaporation and they each contain their original properties.

Milk is both a mixture and a solution.

The solution is a mixture of proteins (such as casein and whey proteins) and sugars (such as lactose) in water. The mixture is the milk fat suspended in the solution.

Student Activities

1. How Are We Related?

TEACHER LED CLASS ACTIVITY

Learning objective (levels 1-4)
Students understand that systems have been devised to classify living things according to their similarities and differences.

YOU WILL NEED:

5 sets of animal sorting cards.

INSTRUCTIONS

1. Divide the class into 5 groups.
2. Distribute one set of animal cards to each group. Each set consists of 20 images of a variety of different animals.
3. Ask each group to come up with suggestions of how these animals can be arranged into categories or groups according to shared qualities or characteristics.
   - How many legs? 4, 2 or none?

   - Where do they live (habitat)? Land or water?
   - Size – small, medium, or large?
   - Skin covering – fur or feathers or scales?
   - Domestic or wild animals?
   - Animals found in New Zealand and those not found in New Zealand.
   - Warm blooded or cold blooded?
   - What they eat – herbivore or carnivore or omnivore?

     Herbivores are animals that rely on plant matter, carnivores rely on meat while omnivores rely on both meat and plant matter.

Science capability:
Gather & Interpret data
Students make observations and look for patterns.

4. Choose several of the suggestions and ask students to group the animals according to the different criteria they have chosen.
5. Ask each group to present their results and discuss their reasoning behind the choices they have made.

Science capability: Use evidence
Students use relevant evidence to support an idea or explanation.

Living things look very different from each other. Scientists study these differences and then follow a process to group (or classify) and identify them.

Grouping living things with others who share similar characteristics makes it easier for scientists to study them.

All the animals represented by the images on the cards belong to one large group (kingdom) called Animalia.

The elephant, whale, cow goat, dog, deer, pig, human, sheep, cat, and giraffe are all part of a smaller group, within the large group Animalia.

- Do they look similar?
- Can you think of anything or see anything they may have in common?
- Do you know what this group is called?

This group is called mammals. Mammals are vertebrates (have a backbone), are warm-blooded, grow hair or fur sometime during their lives and feed their young milk secreted by the female mammary glands.

Note: Most whales, and dolphins, have some hair when they are born and certain species keep hair throughout their life.

Within the group of mammals there is another group of animals called ruminants.

- Do you know what a ruminant animal is?

A ruminant is a mammal that eats and digests plant-based foods using a unique digestive system.

Science capability:
Gather & Interpret data
Students are making comparisons and predictions and looking for patterns.

- Can you sort the group of mammals into ruminants and non-ruminants?

Mammals	
Ruminants	**Non-ruminants**
Cow	Elephant
Goat	Whale
Sheep	Dog
Giraffe	Cat
Deer	Pig
	Human

- Are all mammals, ruminants? No
- Are all ruminants, mammals? Yes

Did you know?

- The global population of wild ruminants number at least 75 million. They are native to all continents except Antarctica and inhabit a wide range of climates (tropics to arctic) and habitats (from open plains to forests).
- The population of domestic ruminants is greater than 3.5 billion, with cattle, sheep, and goats accounting for about 95% of the total population.

2. Pasture Pick and Mix

TEACHER SUPPORT

Learning objective (levels 2-4)
Students understand that. pastures:

- are fields of plants grown for grazing animals.
- are made up of many different plants, not just grass.
- must be of good quality to produce worthwhile quantities of milk from livestock.

YOU WILL NEED:

Each group will need:

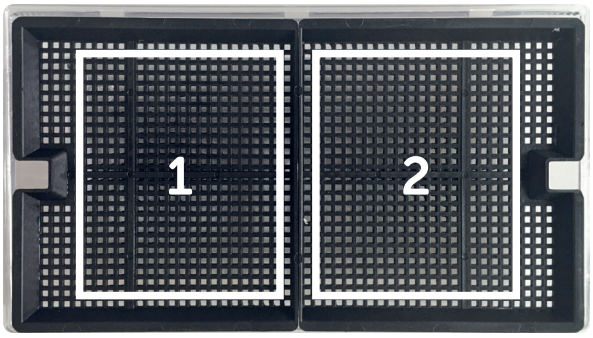
- clear plastic tray
- 2 black growing trays
- tissue paper
- scissors
- teaspoon
- selection of pasture seeds
- spray bottle
- aluminium foil
- Rosie's recipe cards

INSTRUCTIONS

You own a dairy farm and need to plant more pasture for your cows.

1. Place the growing trays into the top of the clear plastic tray.

Each black tray represents one field on your dairy farm.



- What is a pasture?

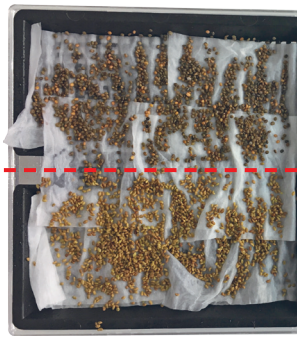
  Pastures are fields growing plants for grazing animals.

Science capability:
Interpret representations:
Communicate science knowledge using a model.

2. Cut the tissue into strips and place in a layer in the bottom of each tray. Use water in the spray bottle to moisten the tissue.

   Pieces of tissue must overlap.

3. Select 2 different types of pasture seeds.
   - Wheatgrass
   - Alfalfa
   - Rocket
   - Amaranth
4. Choose one field. Follow the recipe on the container label and add one pasture seed to half of the field and the other type of seed to the other half.



- What is monoculture?

  It is the agricultural practice of growing a single crop or plant species in a field or farming system at one time.

5. Select one of Rosie's recipes for planting pasture plants. Follow the recipe instructions and add the mixture of seeds to the second field on your farm.

- What is polyculture?

  This is the practice of growing more than one crop species in the same space at the same time.

6. Find a suitable place to leave your pasture to grow and then carefully fill the clear plastic tray with water. Cover the entire tray with a piece of foil.

   Pour the water into the trays using the jug provided. Do not pour the water into the tray over the top of the seeds, use the openings on each side of the black growing trays. Water level must reach the bottom of the black trays.

7. Spray the seeds 2-3 times a day with a fine mist of water. Cover the tray with foil between waterings for the first 3-4 days.

   The foil helps to reduce evaporation between waterings.

8. Check your pasture daily for growth.

Science capability:
Gather & Interpret data
Students make observations.

Once the roots reach the water in the bottom container, spraying and covering with foil are no longer required.

- Does a cow just eat grass?

  Cows do not just eat grass. They eat a mixture of one or more grasses and other plants including legumes like clover and even some weeds. This mixture of plants eaten by grazing animals is called forage.

- Which pasture do you think your cows would prefer to eat?

  A dairy farmer aims to plant a mixture of species that will grow the best and that the cows would like to eat.

You are what you eat, and it is no different for cows.

Cows must have good quality pasture to produce healthy calves and economically worthwhile quantities of milk.

Note:

The seeds used in this activity are microgreens, so they will sprout and grow quickly. Even so, the activity may not be complete before this resource must be returned. Bio-degradable trays have been supplied so the pastures can continue to be grown in the classroom. Pour some water into the bottom of the tray. Carefully lift the plants vertically out of the growing trays by holding onto the leaves and place them root-side down into the water in the bio-degradable trays. Check the water level daily.

Extension Activity

Make your own silage.

Silage is made by cutting pasture plants and then fermenting them to lock in the nutrient content.

Use a pair of scissors to cut a sample of your pasture plants. Place the plants into a zip lock bag. Expel ALL the air from the bag and seal it tightly.

Check the bag every 2-3 days for up to 2 weeks. Do not open the bag – it will be SMELLY.

After 10-12 days

- What is happening to the plants?

- Why would you make silage on a dairy farm? When would you use it?

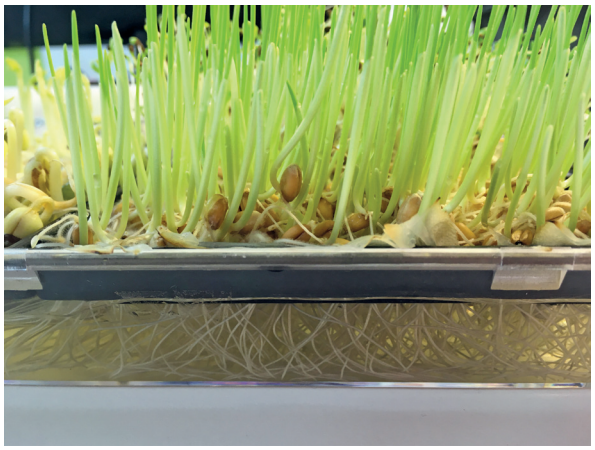
  The goal of making silage is to preserve forage nutrients for feeding at a later date. Natural pasture does not grow well when it is too cold or too dry.

Science capability:
Engaging in Science:
Students engage in discussions and link science issues to everyday life.

- What is dry matter?

  Dry matter is what remains after all of the water has been evaporated out of feed.
  Dry matter is an indicator of the amount of nutrients that are available to the animal in a particular feed. Dairy cows need to consume a certain amount of dry matter per day (measured in kilograms) to maintain health and milk production.

Extension Discussion
Hydroponics is a method of growing plants without soil. Solutions, like water, are used instead. The microgreens used in this activity are grown hydroponically with no extra nutrients added to the water.



Look carefully at the size of the plants and the root structures that have developed. Where did the nutrients – necessary for that growth to occur come from? The seed of course – isn't the natural world amazing!

Science capability:
Gather & Interpret data
Students ask questions and make inferences.

3. Digestion

TEACHER DEMONSTRATION

Even though this activity is in the form of a demonstration, it is lovely and messy, as well as a bit disgusting, and students should be encouraged to participate wherever they can. Handouts have been provided for students to record their learning.

Science capability:
Interpret representations:
and communicate science knowledge using a model.

Part A: Monogastric Digestion

Learning objectives (levels 1-4)
Students understand that:

- all living things need nutrients to survive.
- digestion is the process which allows a body to get the nutrients and energy it needs from the food it eats.
- monogastric animals have a single chambered stomach.

Introduction

The digestive system consists of the parts of the body that work together to turn food and liquids into nutrients that the body needs to survive.

A monogastric digestive system consists of one stomach chamber. Humans and many other animals have a monogastric digestive system.

YOU WILL NEED:

- 'monogastric stomach' containing a plastic bag.
- saliva
- stomach acid
- microbes
- 6 cracker biscuits
- tights (small intestine)
- plastic cup
- polystyrene cup with hole (large intestine)
- tray (body)
- scissors, teaspoon, and tablespoon
- set of 'Monogastric Digestion' posters (1-7)
- Monogastric Digestion handouts

INSTRUCTIONS

This activity models the human monogastric digestive system.

1. Present and discuss 'Monogastric Digestion' poster 1, followed by posters 2 and then 3.
2. Remove the plastic bag from the 'stomach' and add the stomach acid to the bag, plus a teaspoon of microbes.

3. Break the crackers into smaller pieces and then add them, along with the saliva, to the stomach. This demonstrates the swallowing of food and its arrival into the stomach via the oesophagus.
4. Expel the air out of the bag and seal it tightly before placing it back into the stomach.
5. Squeeze and squash the stomach to mix the food, saliva, and stomach acid together (poster 4).
6. Check the contents of the bag and remove it from the stomach when a liquid has been formed.
7. Place the tights in the plastic tray. Put 1 tablespoon of microbes inside the tights.
8. Hold the open end of the tights wide, cut a corner of the plastic bag and carefully empty the 'stomach' contents into the tights (small intestine).
9. Hold the open end of the tights closed and push the stomach contents down, towards the bottom of the tights, squeezing most of the liquid into the tray (body) (poster 5).
10. Cut open the end of the tights and push out any remaining solid material into the polystyrene cup (large intestine). Add 2 tablespoons of microbes.
11. Place the plastic cup inside the polystyrene cup on top of the solid material and push down firmly (poster 6, followed by poster 7).

Science capability:
Gather & Interpret data
Students ask questions, make observations and inferences.

It is important to note that bile produced by the liver and released into the intestine as well as large number of microbes also help with the digestion and absorption of nutrients.

Part B: Ruminant Digestion

Learning objectives (levels 1-4)
Students understand that ruminant animals have:

- a four chambered stomach.
- a unique digestive system that allows them to use energy from plant material better than other herbivores.

Introduction

In ruminants, nature has created a digestive system perfectly suited to the food source. Ruminants convert grasses and forages that are indigestible by mammals into high quality, human-digestible protein in the form of milk and other dairy products.

YOU WILL NEED:

- bag of forage
- 'ruminant stomach'
- saliva
- ruminant microbes
- magnet
- stomach acid
- teaspoon and tablespoon
- latex gloves
- set of 'Ruminant Digestion' posters (1-14)
- Ruminant Digestion handouts

It should be noted that fibrous plant material is difficult to digest (make comparison with the crackers that were digested in the monogastric digestion demonstration.

Science capability:
Gather & Interpret data
Students ask questions, make observations and inferences.

INSTRUCTIONS

This activity models the ruminant digestive system of a cow.

1. Present and discuss 'Ruminant Digestion' poster 1 followed by poster 2.
2. Take the plastic bag labelled 'forage' and add the saliva.
   - What is forage?

     All plants eaten by grazing animals are collectively referred to as forage.
3. Expel the air from the bag and seal tightly. Using your fingers, gently start breaking up the 'plant material'. This demonstrates what happens in the mouth as the teeth and saliva begin the initial crushing and grinding of the plant material.
4. Open the first chamber of the cow's stomach (rumen) and place the bag of forage and saliva inside (poster 3). Seal the chamber and knead the bag for several minutes by pushing on the outside of the stomach. Open and remove the bag from the chamber and examine for 'undigested plant material' (poster 4).
5. Open the bag and add 3 tablespoons of 'rumen microbes' (poster 5).
6. Expel the air from the bag, seal it tightly, place it back into the 'rumen' and knead it for several more minutes.
7. Leaving the rumen sealed, carefully work the bag of forage through the gap at the top right of the chamber, into the second chamber of the stomach (reticulum) (poster 6).
8. Open the reticulum, remove, and open the bag. Take the bar magnet and move it through the contents of the bag to remove any metal objects that may be present (gloves are provided).
9. Remove the air from the bag, seal it tightly, place it back into the reticulum.
10. Seal the reticulum, knead the bag, and then carefully work it through the gap and into the third chamber of the stomach (omasum) (poster 7).
11. After kneading the bag some more, work it through the gap and into the fourth chamber of the stomach – the abomasum (poster 8).
12. Remove the bag from the abomasum and add the stomach acid.
13. Expel air from the bag, seal it tightly, place it back into the abomasum and knead it some more.
14. The digested 'plant material' is now ready to move from the stomach into the small intestine, where most of the nutrients are absorbed, and then into the large intestine (poster 9, followed by poster 10).

It should be noted that lactation is under the control of the endocrine system, not the digestive system. This is included in the 'digestion discussion' as nutrient absorption and distribution is also required for milk production.

15. The processing and collection of milk is discussed in posters 11, 12 and 13.

Make sure that you check out the 'Cool Cow' facts too.

Science capability:
Engaging in Science:
Students engage in discussions and link science issues to everyday life.

Extension Discussion

Are there animals with no stomach?

A stomach seems like a very useful organ for any animal that eats big or complex meals, but over many, many millions of years a number of animals have lost their stomachs.

Examples include the egg-laying mammals (platypus and echidna) and many species of fish.

Animals without stomachs still digest their food, just in a different way.
In some animals there is a shift of function to other areas of the gut.
For example, the throats of some fish have an extra set of teeth that help break down what they swallow.

4. Mixture or Solution?

Part A: Shake It Up

TEACHER SUPPORT

Learning objective (level2-4)
Students understand the difference between a mixture and a solution.

YOU WILL NEED:

Each group will need sand, salt, sugar, water, teaspoon, 3 containers labelled sand, salt, and sugar and a 'Mixture or Solution?' handout.

INSTRUCTIONS

A mixture is formed when 2 or more substances are combined, but each substance keeps its original properties.

1. Fill each container ¾ full of water.
2. Add 1 teaspoon of sand to the container labelled sand and do the same for salt and sugar.

   Try not to get the teaspoon wet.
3. Screw the lids back onto the containers.
4. Give each container a good shake. and then leave it for 2-3 minutes.

   Look carefully at the water in each container.

   - What can you see?

Science capability:
Gather & Interpret data
Students make observations.

   - Are the sand, sugar, and salt still visible?
5. Record your observations on the handout.

A solution is made when a solid, dissolves into a liquid.

- Have any of the 3 mixtures has formed a solution?
- Are all solutions mixtures?

Science capability:
Gather & Interpret data
Students ask questions, make observations and inferences.

Mixture	Observations	Forms a solution, YES, or No?
salt and water	dissolved	yes
sugar and water	dissolved	yes
sand and water	not dissolved	no

Extension discussion

Separating mixtures
There are lots of ways of separating mixtures:

- evaporation and condensation
- magnetism
- filtering – pour a mixture of insoluble solid and a liquid through filter paper.
- sieving – pouring a mixture of different size solids into a sieve.
- decanting – allow a mixture of 2 different liquids to settle into layers, then slowly pour off the top layer.

Can you suggest ways of separating the components out of the 3 mixtures you have made?

Science capability: Use evidence
Students use relevant evidence to support an idea or explanation.

Sand does not dissolve in water. It is insoluble. A fine sieve or filter paper could be used to separate the sand from the water.

Salt and sugar are soluble in water and can be separated by evaporation. Using heat, the water will evaporate (change from a liquid into a gas). Cooling will cause condensation of the gas back into a liquid. Once water has been removed, the salt and sugar will form into crystals.

Note:
Please empty, clean, and dry all containers before packing them back into the kit.

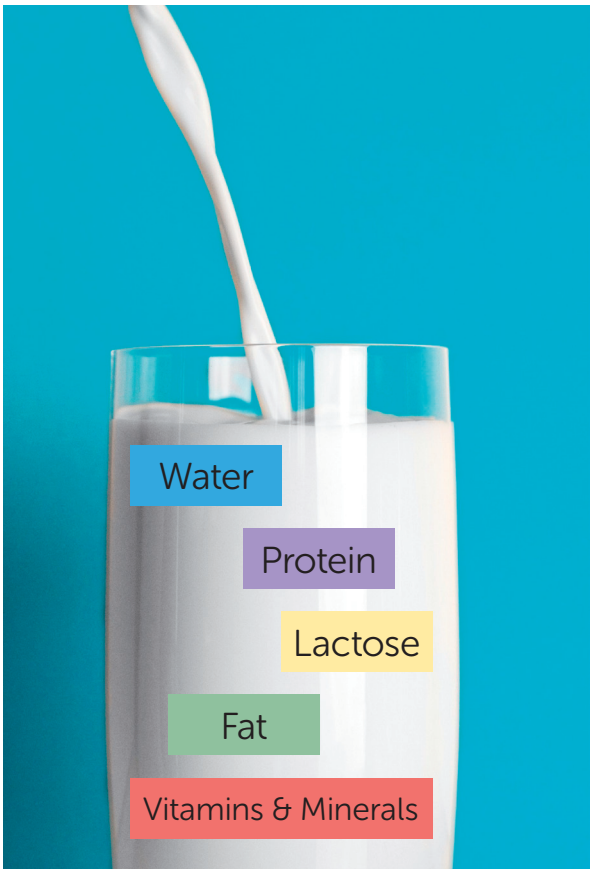
Part B: Milk Shake

Learning objective (levels 2-4)
Students understand that milk is:

- a combination of protein, fat, sugar, vitamins and minerals and water.
- both a mixture and a solution.

YOU WILL NEED:

Each group will need milk powder, water, cooking oil, teaspoon, pipette, beaker, and a container labelled 'milk'.



INSTRUCTIONS

Milk is a combination of fats, protein, sugar, vitamins and minerals and water.

1. Measure 50mL of water and pour it into the container.
2. Add one teaspoon of milk powder.

Milk powder contains protein, sugar and vitamins and minerals.

3. Screw the lid back onto the container and shake well to mix.
    - Has this mixture formed a solution?

      Yes. The solution is a mixture of proteins, sugar, vitamins, and minerals in water.

4. Use the pipette to measure 2mls of cooking oil and add this to the milk solution.

Oil represents the naturally occurring fats in milk.

- What do you notice about the oil?
- Does it stay on top or sink to the bottom of the container?

Science capability:
Gather & Interpret data
Students ask questions, make observations and inferences.

5. Screw the lid back on and shake the container well.
6. Remove the lid and look carefully.
    - What has happened to the oil?

      Shaking the container has broken the oil down into small droplets.

    - Has this mixture formed a solution?

      No. The oil droplets have been suspended throughout the liquid. The smaller the droplets, the more stable they are and the more likely they will stay suspended.

    - What is homogenised milk?

      Homogenisation allows milk manufacturers to combine the fat (cream) in milk, so it does not separate. This ensures that the milk has a smooth even consistency. The process is purely mechanical and involves no additives or chemical treatments. The main purpose of homogenisation is to reduce the size of the fat molecules in milk. Smaller fat molecules stay suspended in the liquid and resist separation. This process also extends the milk's shelf life.

- Do you know the difference between raw milk and pasteurised milk?

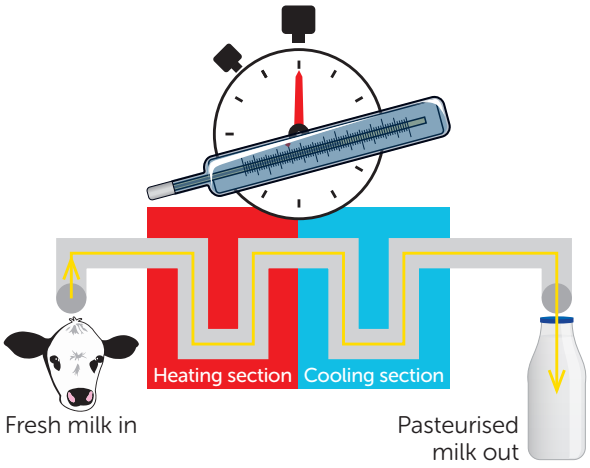
  Pasteurisation is a mild heat treatment of milk to eliminate microbes that contribute to spoilage and disease and to extend shelf life.

  Most milk in New Zealand is pasteurised. It has been heated to 72°C for no less than 15 seconds, then immediately cooled.

  UHT milk has been ultra-heat treated (138°C for 2 seconds) so it has an extra-long shelf life.

  Raw milk is not pasteurised.

Science capability:
Engaging in Science:
Students engage in discussions and link science issues to everyday life.



Extension Activity

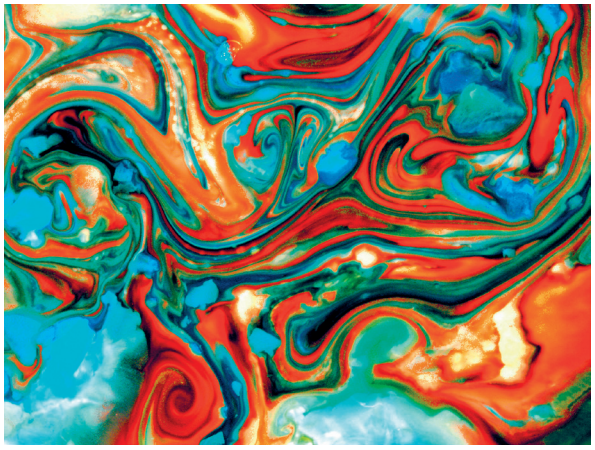
Magic Milk

It is a well-known fact that fat and water do not mix. Therefore, homogenised milk, which contains small, suspended fat molecules is considered to be a mixture.

Pour some milk into a flat, shallow dish and add some drops of different coloured food colouring. Full fat milk works best.

Dip the end of a cotton bud into dishwashing liquid. Carefully touch the end of the cotton bud onto a drop of food colouring. Can you describe what is happening and why?

Soap is made up of molecules that love both water and fat. When you add a drop of soap to the milk, its molecules move quickly to 'catch' the fat molecules. This is the movement that is observed in the coloured milk. Without the addition of food colouring, you would not see this movement.



5. Is all milk created equal?

TEACHER SUPPORT

Learning objective (levels 2-4)
Students understand that:

- mammals are the only group of animals that produce milk for their young.
- the composition of milk varies depending on species.
- milk provides many of the essential nutrients for a balanced diet in an easily digestible form.

YOU WILL NEED:

Science capability:
Engaging in Science:
In this activity students are given the opportunity to be working cooperatively, sharing findings and asking questions.

Divide the class into 5 groups.

Each group will need:

- mother and baby cards
- mammal milk cards
- nutritional profile templates
- nutrient cards – protein, fat, and lactose
- 'Milk Nutrition' poster
- pile of wooden cubes

INSTRUCTIONS

Discuss the statements on the 'Milk Nutrition' poster.

- Why are the 3 macronutrients so important for optimum health?

  Protein is essential for building, maintaining, and repairing the tissues in the body and is an essential component of muscles, bones, hair, and nails. Dietary fats are essential to give bodies energy and to support cell growth. They also protect and insulate organs. Carbohydrates are the main source of energy. They help fuel the brain, kidneys, heart muscles and central nervous system.

- What about micronutrients?

  Vitamins are essential for energy production, immune function and blood clotting and other functions. Minerals play an important role in several processes including growth, bone health and fluid balance.

Different species of mammals produce milk for their babies that is made up of water, protein, fat, carbohydrates and vitamins and minerals.

But do mammalian milks all contain the same quantity of nutrients, vitamins, and minerals?

Science capability: Critique evidence
Students compare and contrast findings.

1. Match each mammal with its nutritional profile template.

The % of water and vitamins and minerals in each type of milk is noted on on the template.

Which 2 mammals produce milk that has a much lower % of water compared to the others?

Whale and seal <45%.

2. Match each mammal with its protein card.

These cards show the % of protein found in the milk produced by each mammal.

3. Use the wooden cubes to build a protein profile for each mammal's milk on its template. Each wooden cube has a value of 1%.

- Which mammal produces milk with the highest % of protein?
- What about the lowest % of protein?

Animal	% protein
Whale	11
Seal	10
Mouse	9
Sheep	5
Water buffalo	4
Elephant	4
Cow	4
Goat	3
Donkey	2
Human	1

4. Repeat to create fat and carbohydrate profiles for each type of mammalian milk.

Animal	% fat
Seal	49
Whale	42
Mouse	13
Water buffalo	9
Sheep	6
Elephant	5
Cow	4
Human	4
Goat	4
Donkey	1

Carbohydrates in milk are mainly in the form of the sugar lactose.

Animal	% lactose (carbohydrate)
Human	7
Donkey	6
Goat	5
Cow	5
Elephant	5
Water buffalo	5
Sheep	5
Mouse	3
Whale	1
Seal	<1

- Why do we mostly drink cow's milk? Why don't we consume milk from other mammals – like camels, goats or even whales?

  It is mostly about economics rather than a superiority of product. Cows have a docile disposition which makes them easy to manage, which is important when it comes to mass production. Cows also have significantly better daily per-animal milk production volume compared to other

potential candidates such as goats and sheep.

The protein and fat content of milk influences its taste and texture, and unpalatable fat and protein levels keep some milks off supermarket shelves. The fat content of cow's milk is similar to human milk, which makes it familiar and more appealing to our palate.

Science capability:
Engaging in Science:
Students engage in discussions and link science issues to everyday life.

- What about plant-based milk alternatives?

  There is a lot of nutritional variation in plant-based products such as soy, almond, oat, rice, and coconut milk and care must be taken when using them as replacements for dairy products in your diet. It is important to look for fortified brands – those with added calcium and vitamins.

Extension activity
Set up and compare complete nutritional profiles (protein, fat, and carbohydrate %) of different mammals.

seal vs human

Extension discussion

How do whales feed their babies underwater?
A female whale must either shoot milk into her baby's mouth through the water or allow the calf to suckle the milk from her nipple.

Whale milk has a high fat content which gives it a thick, toothpaste-like consistency. This high fat percentage allows the whale's milk to travel through the water without breaking up.


Photo credit: Mike Korostelev

6. Supermarket Scavenger Hunt

TEACHER SUPPORT

Learning objective (levels 2-4)
Students explore the number and variety of milk products available for sale on shelves in New Zealand supermarkets.

Introduction:
Dairy isles in New Zealand supermarkets have exploded with milk products over the past few years.

How do these products differ from each other?
Are they all produced by animals or are some plant-based?

YOU WILL NEED:

Each group will need a Supermarket Scavenger Hunt handout.

A stopwatch is also provided for the teacher who will be the designated timekeeper.

This activity can be done in the classroom using the on-line shopping option or by visiting a local supermarket. If choosing the on-line option student groups will need a device to allow access to the internet.

INSTRUCTIONS

1. Choose a supermarket.

countdown

PAKnSAVE

NW NEW WORLD

2. Find as many of the different types of milk listed on the handout as you can in the time you have been given.

   Do not allow too much time – it must be a challenge.

Science capability:
Gather & Interpret data
Students make observations.

   ✓ the box on the handout next to the items you find.

3. If you have time, check out another supermarket.
4. Each box has a number value next to it. Add up the numbers for the milk products that you have found.
   - How many items has your group found?
   - What is your total score?
5. Do some extra research to answer the questions on the handout and earn more points.

Science capability:
Engaging in Science:
Students critique reports of science-related issues.

   - What is the most common type of milk available for purchase in New Zealand supermarkets?

     Cow's milk is the most readily available in New Zealand. A key difference between the different types of cow's milk is the fat content. Full fat, whole and full cream milk must contain at least 3.2% fat. Low fat milk contains between 1.3 and 1.4% fat and skim milk contains 0.15% fat.

- Fortification is the process of adding minerals or vitamins to food products. Enhanced calcium milk has extra calcium added. Can you find the calcium enriched milks listed on the worksheet?

  Calci-trim milk, Calci-trim UHT milk and Calci-Plus Soy milk.

- What is lactose free milk?

  Lactose free milk is available for individuals who are lactose intolerant. People who are lactose intolerant cannot properly digest lactose, the sugar in milk, which makes them feel unwell. Lactose free milk has been pretreated to either remove or breakdown lactose, making it easier to digest.

- How are the plant-based products such as soy, almond, rice, cashew, coconut and hempseed milk made?

  The nuts and seeds are ground and water is added to achieve a milky appearance and consistency.

- What is A2 milk?

  A type of protein, called casein, makes up 80% of all of the protein found in milk. There are 2 types of casein, A1 and A2. Some cows produce just A1 protein in their milk and others just A2. A2 milk comes from cows that only produce the A2 version of the casein protein. Supporters of A2 milk claim that it is easier to digest and absorb than other types of milk.

- Is whole sheep milk, not just milk powder, available for purchase in New Zealand?

  Yes.

- What does Jersey milk mean?

  The Holstein-Friesian (Friesian) is a black and white cow that produces large volumes of milk. Its milk has the highest protein of the 2 main dairy breeds. The Jersey produces less milk than the Frieisans, but it is higher in fat.

  Jersery milk comes from Jersey cows.

  During the 2020 dairy season, almost half of the dairy cows in New Zealand (49%) were Holstein-Friesian/Jersey crossbreeds.* New Zealand farmers are trying to get the best traits from the 2 major breeds used for dairy farming.

  These crossbreed cows can look like a Friesain or Jersey in their colouring, so any colour from jet black through to caramel tan.


Holstein-Friesian (Friesian)


Jersey


Holstein-Friesian/Jersey crossbreeds

Reference:
https://www.statista.com/statistics/1102335/new-zealand-dairy-cow-share-by-breed/

- Dairy products are food produced from or containing the milk of mammals.
  Can you give some examples of dairy products?

  Dairy products include food such as yoghurt, cheese and butter.

Extension Activity
Create some additional 'Supermarket Scavenger Hunt' challenges.

For example, how many types of feta cheese can you find made from the milk of mammals other than cows?

7. Environmental hoofprint

TEACHER-LED CLASS DISCUSSION

Learning objective (level 4)
Students understand that:

- a growing global population needs access to nutritious food.
- food production has an impact on the environment.
- the dairy industry is an important contributor to the global food supply.

Science capability:
Engaging in Science:
Students critique reports of science-related issues.

YOU WILL NEED:

Environmental Hoofprint posters A and B.

Introduction

Sustainability is a significant issue facing the global dairy industry. How can current local, and global, food supply demands be satisfied without compromising the ability of future generations to meet their needs? The New Zealand dairy industry is an important contributor to the world food supply. What is being done to minimise the impact of dairy farming on the environment in this country?

INSTRUCTIONS

1. Divide the class into 10 groups.
2. Distribute a copy of 'Environmental Hoofprint' posters A and B to each group.
3. A question has been posed on each poster as a starting point for the discussion along with several statements that can be used as suggestions for further investigation.
4. Encourage students to do their own research and present their ideas to the rest of the class.

Science capability: Critique evidence
Students are encouraged to think critically and use correlation and causation.

5. Begin with poster A.

Poster A:

Does food production have an impact on the planet?'

Food production is responsible for ¼ of the world's greenhouse gas emissions. Half of the world's habitable land is used for agriculture. Agriculture uses large quantities of freshwater and is responsible for nutrient-rich pollutants in global ocean and freshwater supplies.

- A growing global population means increased demand for high-quality, nutritious food.

  Ensuring everyone in the world has access to a nutritious food in a sustainable way is one of the greatest challenges we currently face.

- Milk and other dairy products play an important role in in the global challenge of feeding a growing population.

  Milk, butter, cheese, yoghurt, ice cream and other dairy products are consumed by billions of people worldwide. Dairy products provide balanced, healthy, and safe nutrition.

- When assessing the environmental impact of food production, nutritional value should also be considered.

  When comparing food products, it is important to not only look at the impact of their production on the environment, but also to quantify their nutritional contribution to a quality diet. How effective is the food in supplying protein, fats, and carbohydrates in an easily digestible form?

  Environmental concerns are one of the main reasons people choose plant-based milk alternatives over cow's milk, but often the environmental footprint of producing these products is overlooked. For example it requires 12L of water to produce just one almond kernel? How many litres of water is needed to create 1L of almond milk?

Poster B

Are New Zealand dairy farmers farming responsibly?

New Zealand dairy farmers are very good at what they do. They are working hard to improve water quality by fencing off waterways and riparian planting, investing in better effluent management systems and retiring areas of their farms that can be reclaimed as wetlands. Farmers are carefully recording nutrient use on their farms so excess fertiliser is not used on pastures and crops. Irrigation consents must be obtained for water usage on farms and up-to-date irrigation equipment that includes moisture monitoring systems are being used.

Many farmers are making changes to their feed management systems. Dairy cows produce methane gas as a by-product of their digestive process and release it into the air by burping. Methane is a greenhouse gas and is a significant contributor to New Zealand's greenhouse gas emissions. The more a cow eats, and the type of plant eaten impacts on the amount of methane gas produced by an animal. Controlling how much and what type of feed, has an effect on the quantity of emissions produced.

- Milk production impacts the environment in various ways.

  Dairy cows and their manure produce greenhouse gas emissions which contribute to climate change. Poor handling of manure and fertilisers can degrade local water sources. Dairy farming on less sustainable land can also lead to loss of wetlands and waterways.. The scale of these impacts depends on the practices of dairy farmers.

- Is milk sustainably produced in New Zealand?

  New research (February 2021) shows New Zealand dairy farmers are leading the world in low-emission dairy milk production, with an on-farm carbon footprint 48% less than the average of 18 countries studied.

  A carbon footprint refers to the whole amount of greenhouse gases produced to, directly and indirectly, support an activity.

- The dairy industry makes a significant contribution to New Zealand's economy.
  - Dairy farming contributed 34% (in 2019-20) of the total value that New Zealand earned from its merchandise exports. This is 2.5 times greater than the meat sector, more than 3 times the wood sector and 10 times the wine sector.
  - The amount of export revenue NZ earnt from dairy farming (year to June 2020) was $NZ19.7 billion.
  - The dairy industry employs 50,000 employees (30,000 on-farm and 20,000 processing and wholesaling)

- Some NZ stats:
    - 4.92 million milking cows
    - 21.1 billion litres of milk processed by dairy companies (2019-20)
    - 3% of all the milk in the world is produced by New Zealand.
    - New Zealand is the world's largest exporter of dairy products.
- Research aimed at reducing New Zealand greenhouse gas emissions is underway.

Lots of groundbreaking research is taking place in New Zealand including:

- breeding low-emitting animals
- planting low-emitting crops and using low-emitting feed additives.
- methane vaccination to reduce methane production.
- methane inhibitors to suppress the methane producing microbes in an animal's gut.
- Alternative manure management treatments to capture or reduce methane from effluent.

References

https://www.dairynz.co.nz/environment/climate-change/dairy-sector-action/nz-dairy-sectors-carbon-footprint/

https://niwa.co.nz/education-and-training/schools/students/climate-change/agriculture

https://www.dairynz.co.nz/media/5794072/quickstats-about-dairying-new-zealand-2020-web.pdf

Other Useful Resources and Websites

Name	Comments	Website
Science Learning Hub (SLH)	Follow this link to a collection that has been created by the SLH, for the House of Science, to support the resources in this kit. Follow this link to find out more about the collection tool and how to use it to sort and classify SLH resources. Find out more about innovative research projects aimed at reducing greenhouse gas emissions associated with dairy farming.	https://www.sciencelearn.org.nz/collections/shared/9358 49a835cc98b8dfe0dfe9b207735c www.sciencelearn.org.nz/resources/2762-creating-collections https://www.sciencelearn.org.nz/resources/3029-dairy-innovations-targeting-climate-change
DairyNZ	DairyNZ's in-school education programme provides teachers with free, curriculum-based on-line learning resources and 'hands-on' classroom kits designed to improve children's understanding of dairy farming.	www.dairynz.co.nz/about-us/education/dairynz-schools/
Rosie's World	Rosie's World is a safe, fun, and educational website designed to help children learn about dairy farming. On the site, children can play, learn, and create with cool games, educational videos, printable activities, hands-on experiments, and kid-friendly recipes.	www.rosiesworld.co.nz
New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC)	Find out more about NZ's approach to reducing greenhouse gas emissions.	www.nzagrc.org.nz
House of Science	Other kits that link to this one: • Climate Change • Water Analysis • Land • Food for Thought • Mighty Microbes	Login to your local House of Science website to see what kits are available.

Sponsor Information

<insert logo>

<insert information paragraph>

<insert sponsor's website>

Funder Information

DairyNZ is the organisation representing all New Zealand dairy farmers, with the purpose of helping them be the best they can be in every aspect of their business.

DairyNZ is funded by dairy farmers and invests their levy into research and helping them be world leading in animal care, protecting and nurturing the environment, providing great workplaces, building sustainable and resilient farming business and producing high quality products.

DairyNZ also has initiatives such as its education programme, to help raise the general understanding of dairy farming and where milk comes from and to promote it as a great career option.

www.dairynz.co.nz

Appendix

Word List

English	Te Reo
carbohydrate	warowaihā
classification	karangatanga
dairy	miraka
digestion	nakunaku
digestive tract	ara nakunaku
economy	ōhanga
energy	pūngao
environment	taiao
fat	ngako
forage	kai kuhukuhu
grass	otaota
mammals	whāngote
milk	miraka
minerals	kohuke
mixture	whakaranu
nutrients	taiora
pasture	pārae
protein	pūmua
ruminants	kararehe kai rua
silage	karapēpē
solution	mehanga
stomach	puku
sustainability	toitūtanga
udder	ū
vitamins	huaora
water	wai

Student Worksheets

Pasture Pick & Mix

STUDENT WORKSHEET

YOU WILL NEED:

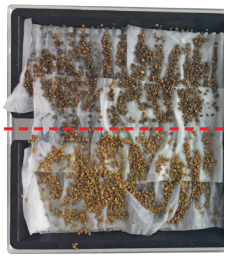
Each group will need:

- clear plastic tray
- 2 black growing trays
- tissue paper
- selection of pasture seeds
- spray bottle
- aluminium foil
- scissors
- teaspoon
- Rosie's Recipe cards

INSTRUCTIONS

You own a dairy farm and need to plant more pasture for your cows.

1. Place the growing trays into the top of the clear plastic tray.
   Each black tray represents one field on your dairy farm.
   - What is a pasture?
2. Cut the tissue into strips and place in a layer in the bottom of each tray. Use water in the spray bottle to moisten the tissue.
3. Select 2 different types of pasture seeds.
4. Choose one field. Follow the recipe on the container label and add one pasture seed to half of the field and the other type of seed to the other half.
   - What is monoculture?
5. Select one of Rosie's recipes for planting pasture plants. Follow the recipe instructions and add the mixture of seeds to the second field on your farm.
   - What is polyculture?
6. Find a suitable place to leave your pasture to grow and then carefully fill the clear plastic tray with water. Cover the entire tray with a piece of foil.
7. Spray the seeds 2-3 times a day with a fine mist of water. Cover the tray with foil between waterings for the first 3-4 days.
8. Check your pasture daily for growth.
   - Does a cow just eat grass?
   - Which pasture do you think your cows would prefer to eat?



You are what you eat, and it is no different for cows.

Mixture or Solution?

STUDENT WORKSHEET

Part A: Shake It Up

YOU WILL NEED:

Each group will need sand, salt, sugar, water, teaspoon, 3 containers labelled sand, salt, and sugar and a 'Mixture or Solution?' handout.

INSTRUCTIONS

A mixture is formed when 2 or more substances are combined, but each substance keeps its original properties.

1. Fill each container ¾ full of water.
2. Add 1 teaspoon of sand to the container labelled sand and do the same for salt and sugar.
   Try not to get the teaspoon wet.
3. Screw the lids back onto the containers.
4. Give each container a good shake and then leave it for 2-3 minutes.
   Look carefully at the water in each container.
   - What can you see?
   - Are the sand, sugar, and salt still visible?

5. Record your observations on the handout.

A solution is made when a solid, dissolves into a liquid.

- Have any of the 3 mixtures has formed a solution?
- Are all solutions mixtures?

Mixture or Solution?

STUDENT WORKSHEET

Part B: Milk Shake

YOU WILL NEED:

Each group will need milk powder, water, cooking oil, teaspoon, pipette, beaker, and a container labelled 'milk'.

INSTRUCTIONS

Milk is a combination of fats, protein, sugar, vitamins and minerals and water.

1. Measure 50mL of water and pour it into the container.
2. Add one teaspoon of milk powder.

Milk powder contains protein, sugar and vitamins and minerals.

3. Screw the lid back onto the container and shake well to mix.
   - Has this mixture formed a solution?
4. Use the pipette to measure 2mls of cooking oil and add this to the milk solution.

Oil represents the naturally occurring fats in milk.

   - What do you notice about the oil?
   - Does it stay on top or sink to the bottom of the container?

5. Screw the lid back on and shake the container well.
6. Remove the lid and look carefully.
   - What has happened to the oil?
   - Has this mixture formed a solution?
   - What is homogenised milk?
   - Do you know the difference between raw and pasteurised milk?

Is All Milk Created Equal?

STUDENT WORKSHEET

YOU WILL NEED:

Each group will need:

- mother and baby cards
- nutritional profile templates
- 'Milk Nutrition' poster
- mammal milk cards
- nutrient cards – protein, fat, and lactose
- pile of wooden cubes

INSTRUCTIONS

Different species of mammals produce milk for their babies that is made up of water, protein, fat, carbohydrates and vitamins and minerals.




But do mammalian milks all contain the same quantity of nutrients, vitamins, and minerals?

1. Match each mammal with its nutritional profile template.
   The % of water and vitamins and minerals in each type of milk is noted on the template.
   - Which 2 mammals produce milk that has a much lower % of water compared to the others?
2. Match each mammal with its protein card.
   - These cards show the % of protein found in the milk produced by each mammal.
3. Use the wooden cubes to build a protein profile for each mammal's milk on its template. Each wooden cube has a value of 1%.
   - Which mammal produces milk with the highest % of protein?
   - What about the lowest % of protein?
4. Repeat to create fat and carbohydrate profiles for each type of mammalian milk.
   - Why do we mostly drink cow's milk? Why don't we consume milk from other mammals – like camels, goats or even whales?
   - What about plant-based milk alternatives?

Supermarket Scavenger Hunt

STUDENT WORKSHEET

INTRODUCTION:

Dairy isles in New Zealand supermarkets have exploded with milk products over the past few years.

How do these products differ from each other? Are they all produced by animals or are some plant-based?

YOU WILL NEED:

Each group will need a Supermarket Scavenger Hunt handout.

INSTRUCTIONS

1. Choose a supermarket.

countdown

PAKnSAVE

NW NEW WORLD

2. Find as many of the different types of milk listed on the handout as you can in the time you have been given.
   ✓ the box on the handout next to the items you find.

3. If you have time, check out another supermarket.

4. Each box has a number value next to it.
   Add up the numbers for the milk products that you have found.
   - How many items has your group found?
   - What is your total score?

5. Do some extra research to answer the questions on the handout and earn more points.