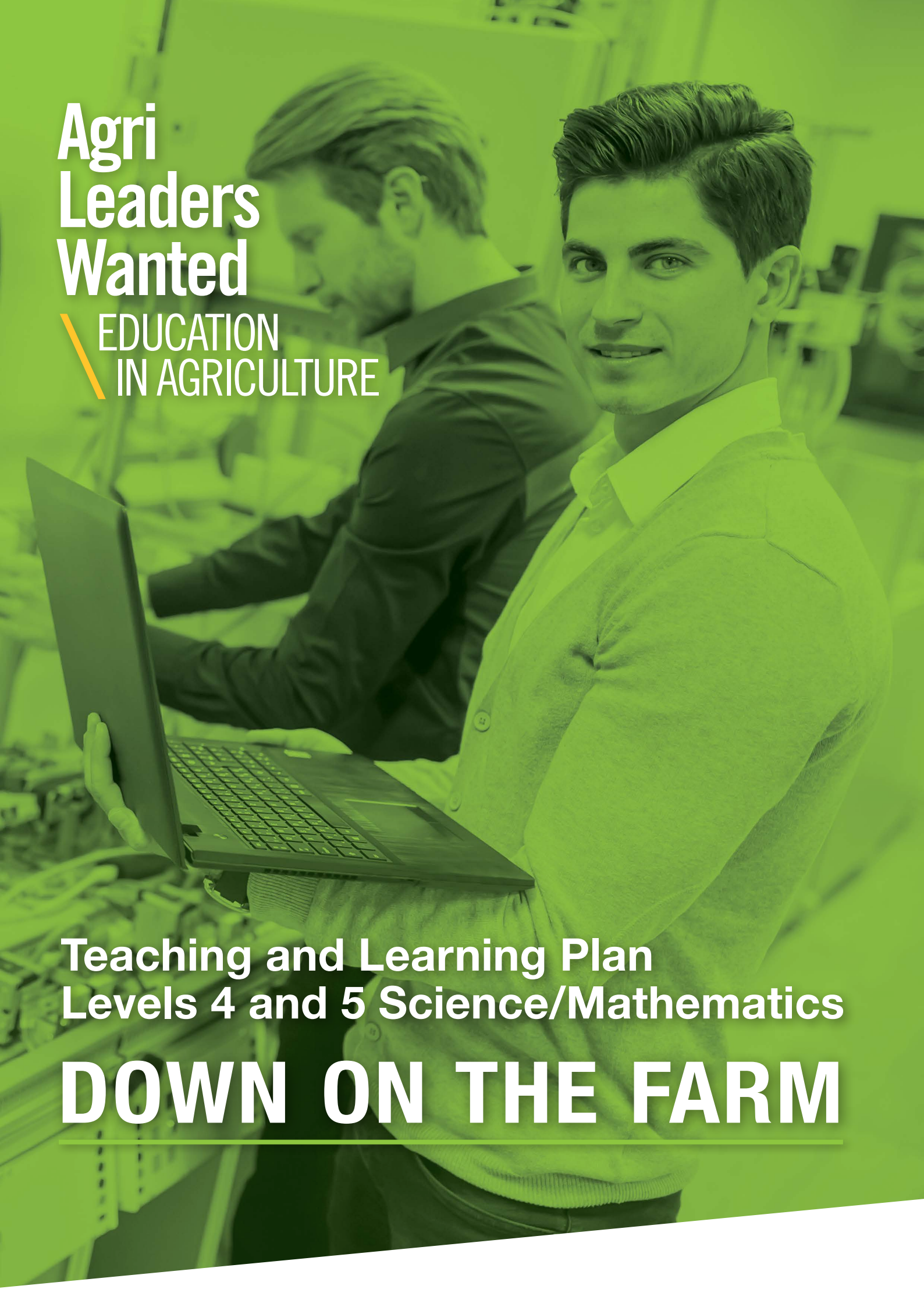


Agri Leaders Wanted

EDUCATION IN AGRICULTURE

Teaching and Learning Plan
Levels 4 and 5 Science/Mathematics

DOWN ON THE FARM

Contents

This resource has been funded by the Red Meat Profit Partnership, in conjunction with NZ Young Farmers and CORE Education.

Context

Sheep and cattle are the most widely farmed animals in New Zealand with 44% of all farms in New Zealand being sheep and beef with a total of 29.5 million sheep and 3.6 million beef cattle (Farm Facts 2016). The world market for lamb and beef is highly competitive and New Zealand farmers need to be smart in order to compete in the global marketplace. New Zealand is fortunate to have advantages such as high rainfall, good quality pasture production, and a climate that allows outdoor farming year round. However New Zealand is geographically isolated from its overseas markets and so transporting our farming products to these markets adds a lot of cost to the final product.

This unit allows junior secondary school students to see how the common life processes of animals and plants on a New Zealand sheep or beef farm are able to be managed by farmers as they aim to improve the number and quality of their animals. The unit also provides a meaningful context for students to develop their scientific and mathematical thinking.

Overview

This is a cross-curricular unit of work where junior secondary students develop skills specifically related to:

- Levels 4 and 5 science
- Level 5 mathematics and statistics.

These units share a common context and a common goal to illustrate the benefits of thinking scientifically and mathematically to improve farming practices.

The context of a New Zealand sheep or beef farm is used to:

- compare the life processes of living things - plants and animals
- understanding how land is measured and mapped and how that can be utilised.

A feature of this resource is that it allows students to learn various skills and concepts in an authentic context through a farm visit. If this is not possible, a farmer could be emailed or skyped to discuss specific aspects of the content being covered. Schools may have contacts with farmers in their local community or can contact a New Zealand Young Farmers (NZYF) field officer for support to arrange a farm visit or organise to be connected with a local farmer. NZYF field officers can be contacted on 0800 6993 4636 or info@youngfarmers.co.nz

It is suggested that ahead of the visit, the farmer is given a list of questions and focus areas that the students wish to investigate about farming practices.

The following content has been developed in three stages:

1. **Before the farm visit** students learn the skills and knowledge they need to be able to investigate the life processes and mathematical concepts required for this topic and how they relate to the agricultural context. Simple experiments, inquiries and simulations that relate to this context can be carried out in class before going.
2. **During the farm visit** students observe and gather information on a range of topics relating to the main life processes in action at the farm. Devices for photos, recordings and video would be useful. Students get an overall idea of how their initial investigation into mapping the farm relates to the reality. They will learn about the purpose and features of various paddocks, and about concepts such as maximum yield, pasture growth and stocking ratios.
3. **After the farm visit** students create a presentation of their investigations to show to each other, their family/whānau, another class or the farmer they visited. Their presentations could also be used to assess the skills and the knowledge acquired during this inquiry. There may be other aspects that could be assessed such as collaborative skills, ability to plan, and ability to communicate ideas and findings.

Teachers can choose to use part or all the information provided in this resource to suit the needs of their students. Students could demonstrate their learning from both curriculum areas in integrated assessment tasks.

Curriculum links

The New Zealand Curriculum identifies five key competencies as capabilities required for living and lifelong learning. All are practised throughout this resource:

- thinking
- using language, symbols, and texts
- managing self
- relating to others
- participating and contributing.

Science

Living world - Life processes (Level 4)

- Students will recognise that there are life processes common to all living things and that these occur in different ways.

Nature of science (Level 4)

- Understanding about science
  - Students will appreciate that science is a way of explaining the world and that science knowledge changes over time.
- Investigating in science
  - Students will build on prior experiences, working together to share and examine their own and others' knowledge.
  - Students will ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations.
- Communicating in science
  - Students will begin to use a range of scientific symbols, conventions, and vocabulary.
- Participating and contributing
  - Students will use their growing science knowledge when considering issues of concern to them.

Mathematics and statistics

Measurement

Students will:

- use appropriate scales, devices, and metric units for length, area and time. (Level 4)
- convert between metric units, using whole numbers and commonly used decimals. (Level 4)
- use side or edge lengths to find the perimeters and areas of rectangles, parallelograms, and triangles. (Level 4)
- interpret and use scales, timetables, and charts. (Level 4)
- select and use appropriate metric units for length, area, volume and capacity, weight (mass) with awareness that measurements are approximate. (Level 5)
- convert between metric units, using decimals. (Level 5)
- deduce and use formulae to find the perimeters and areas of polygons. (Level 5)
- find the perimeters and areas of composite shapes. (Level 5)

Shape

- Students will identify classes of two-dimensional shapes by their geometric properties. (Level 4)

Position and orientation

Students will:

- communicate and interpret locations and directions, using compass directions, distances, and grid references. (Level 4)
- interpret points and lines on coordinate planes, including scales and bearings on maps. (Level 5)

Number strategies and knowledge

Students will:

- find fractions, decimals, and percentages of amounts expressed as whole numbers, simple fractions, and decimals. (Level 4)
- use rates and ratios. (Level 5)

Prior knowledge required by students

There are seven processes that are common to all living things. These seven processes are movement, respiration, sensitivity, growth, reproduction, excretion and nutrition (MRS GREN).

- **Movement** - All living things move. Even plants move. They move very slowly by growing in certain directions. Plants grow towards the light. Even microscopic organisms like bacteria show signs of movement.
- **Respiration** - All organisms need energy so they can do things like move and grow. Respiration releases energy from food so we can do things. All organisms need to respire to get energy.
- **Sensitivity** - Organisms need to be aware of their surroundings. This helps them keep out of danger and away from harm, and it also helps them to find food and shelter. Plants can sense where light is coming from so they can grow towards the light. Microbes can sense where food is in a similar way to the way animals can smell food.
- **Growth** - All living things grow and get bigger. From a tiny seed a tree can grow. Baby animals grow into adults. Even microbes grow, though not very much by human standards.
- **Reproduction** - All organisms need to reproduce to keep the species going so they do not all die out. Humans, like other animals, produce babies. Plants produce seeds, which grow into new plants. Microbes reproduce by simply dividing into two!
- **Excretion** - All organisms make waste. When we respire we make carbon dioxide gas. This is expelled when we breathe. When we urinate we get rid of the waste chemicals and water in our blood. All living things must get rid of the waste they make. This is called excretion.
- **Nutrition** - All living things need food. Animals must consume (eat) other living things to get food. Plants make their own food by photosynthesis. They use simple chemicals and the energy in sunlight to make food like sugar.

ICT skills

- Using Google Maps or Google Earth to locate the farm and take a snapshot (screenshot).
- Use of Geogebra or similar package.

Maths concepts

- Coordinate number plane in relation to maps, grid references and compass directions.
- Concept of area being measured in small squares.
- Conversion of metres to kilometres and vice versa.
- Compass directions and navigation, distance. 360° in a circle.

Terminology

- Maximum yield, pasture growth, stocking ratios, coordinates

Before the visit

1. Introduction

Discuss with the students what they think are some aspects of science and mathematics that they could see on the farm they will be visiting. Make a large list to put up around the room so that they can reflect on this on their return from the visit.

What will they expect to see? This can also be a brainstorm or bus stop activity that is put up around the room for review after their visit. Students can add to this at any time.

What questions could they ask the farmer about the farm, the animals, and what farming is like? These questions can be allocated to different students to investigate during their visit. Record questions to review after the visit and discuss the findings. These could be recorded on paper, post-it notes, shared Google/Word doc or in a Padlet.

2. Living or non-living

The teacher shows a series of images and students sort them, depending on whether they think the image shows a picture of something living, or non-living. This could be run as a true/false game, stand up/sit down game, a 'living/non-living/not sure yet' vote or a pre/post assessment.

Images should include animals and items that they are likely to find on the farm they are going to visit, for example, sheep, cattle, calves, lambs, farmers, fire, tractors, bikes, crops, pasture, hay/silage, seeds, soil.

This then leads into a discussion about what makes each object living or non-living. Ask students to justify their decisions.

Extension activity: Students may choose to add an additional category - once living.

3. MRS GREN – The rules for life

Introduce the seven processes ('rules') that scientists use to determine if something is living or not living -

- Movement
- Respiration
- Sensitivity
- Growth
- Reproduction
- Excretion
- Nutrition

Make a distinction between breathing and respiration. Discuss respiration in plants and how it is different from that of the animals. Where do plants/animals get the oxygen from? Where do they get the sugar?

Students can discuss and investigate how MRS GREN relates to the main animals that they are likely to see during their farm visit - sheep, cattle, humans, dogs. They can use their discussions to design a poster or infographic for one living organism found on their farm and how each aspect of MRS GREN relates to this organism.

Students design a flowchart for plants (for example, clover) and animals (for example, sheep) to show:

- respiration
- nutrition.

Optional activities

- Undertake a dissection of a sheep's lung (respiration).
- Undertake a dissection of a bull's eye (sensitivity).
- Grow seeds to show how they grow towards the light (sensitivity) - arrange an experiment where some seeds have no or limited access to light.

Place pondweed in a very weak baking soda ($NaHCO_3$) solution on a sunny windowsill or in front of a light source to show oxygen being produced (respiration).

4. Where are we going? Mapping skills

Students use Google Earth (or Google Maps) to take a snapshot of the farm they will visit. They then paste this image into the GEOGEBRA app to be manipulated. The students can use Geogebra to:

- resize the image to an appropriate scale on the coordinate number plane
- use the polygon tool to identify all the paddocks on the farm, and then calculate the areas of the paddocks
- identify the coordinates of the main features of the farm - houses, sheds, fences, etc. They can then determine the distances between features and the lengths of the fences.

Student could produce a large wall map in the classroom showing all the main features of the farm. (This could be done digitally using My Maps, Google Drawings, hyperlinks, Thinglink app.)

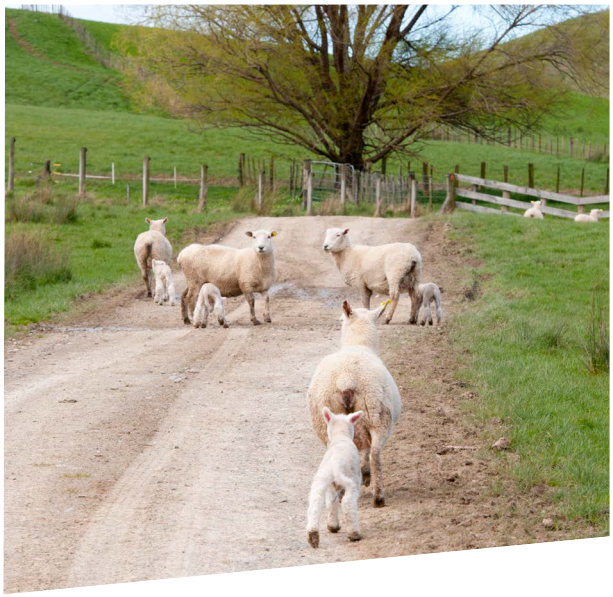
5. Getting to grips with the size of it all

After using Geogebra students can:

- identify the polygons used
- determine directions and bearings between particular farm features
- use a 'by hand' technique to check the area calculations of the polygons in the paddocks
- determine a method of identifying the various paddocks in the field, for example, grid references
- design an orienteering task to get from point A to point B on their map using compass bearings and steps. (They will need to measure the average length of their steps first.)
- investigate and estimate the potential number of livestock that could be accommodated on the farm. How different is it from season to season? Apply knowledge relating to the rate at which the animals eat and how fast the feed grows to the farm area.

6. Check up – What have we learnt?

Each student contributes 1-2 images of objects they believe fit into the 'living/non-living' categories and 1-2 questions relating to what they have learned. The teacher (or the students themselves in groups) design an assessment quiz to check on their learning. This can be done as a paper based quiz, a post box activity, mix and match cards, a Google Quiz in Forms, or a Kahoots Quiz.



During the visit

Equipment required

- Device for recording voice, photos, video
- Tape measure or 1 metre ruler
- Jars/ sealed containers

1. Ako Board

Students chose to follow up on 6-8 of the following tasks during their visit (teacher can adjust the number to suit the class, and can include other tasks as appropriate.)

<table>
<tr><td>Create a video of farm dogs at work to show the different ways they are able to move.</td><td>Carry out an investigation comparing the speed of running in gumboots with running in shoes.</td><td>Write a story titled “A Day in the Life of…” from the point of view from one of the animals on this farm.</td></tr>
<tr><td>Observe an animal eating and link the grass they eat to the sugar required to enable respiration. What is this energy needed for?</td><td>Why use huntaway dogs and/or heading dogs? What are the advantages and disadvantages of both types? What does your farmer have and why?</td><td>If visiting during spring, produce a video or photo series of the different stages of the life cycle of one type of animal on this farm.</td></tr>
<tr><td colspan="2">Interview the farmer about the key growth stages in their flock/herd, for example, gestation period, age when weaned, age started to eat grass, how old when they go for processing; what stock will the farmer keep for next year (and why); how old are the animals before they have offspring; what does the farmer do to increase the growth of the animals; what factors influence the animals’ growth rates.</td><td>Create a series of different food chains that occur on this farm.
Extension activity: Combine the food chains to construct a food web.</td></tr>
<tr><td>Make a video or photographic record of young animals feeding from their mothers. Offer to feed the lambs or calves.</td><td>Design an infographic to show the ratio of males to females of the main types of stock on this farm.</td><td>What are the different plants grown on this farm and what are they used for? Why were these species chosen? What does the farmer do to make sure they grow well?</td></tr>
<tr><td>Collect samples of soil from around the farm, or seeds from the farmer to grow at school.</td><td colspan="2">What is the average lambing rate per ewe? What are the calving rates? Use lambing data to compare the number of ewes that have single lambs or multiples. What is the probability of having a ewe having twins?</td></tr>
<tr><td colspan="3">Estimate the volume of one of the animals on this farm. Imagine that the animal is made from a series of cubes (head, body, legs) to calculate the volume of this composite 3D shape. Choose either an adult or a lamb or calf. Draw the shape of your animal in 3D. Gather the data required - lengths, depths, widths (actual or estimate). How do these relate to your volume? How does this relate to the volume of this animal at a different stage of itslife?
Extension activity: Estimate the volume of all the animals of your chosen type on this farm. Reflect on any errors that this technique could produce.</td></tr>
</table>

2. Mapping skills

Students can:

- get an idea of the scale of the farm and comment on how that relates to the map they produced before their visit. How accurate and useful was the map they produced?
- discuss with the farmer what else needs to be added to their map of the farm
- interview the farmer about the current purposes of some of his paddocks, their stocking ratios, and rate of pasture growth (maximum yield) and add this information to the map
- time how long it takes to travel across parts of the farm and record this on the map
- carry out their orienteering activity. What adjustments were needed?

3. Any other questions?

Students can take the opportunity during the visit to ask their allocated questions generated by the class before the visit. What did they want to find out about the farm and the farmer?

After the visit

All information is collated and students organise a presentation about their visit and what they found out. They choose how they do their presentation - by themselves, in a group, digitally, as a poster, infographic, a PowerPoint, Google Slides, animation or video.

Their presentation must include what they have found out about MRS GREN and use their mapping skills. The correct scientific and mathematical terms must to be used.

This can then be presented to the whole class, to another class, to their family/ whanau, or to the farmer they visited.

Students could reflect on the misconceptions they held prior to their visit, on issues such as the size of the farm; the numbers of livestock; or the role of mathematics in farm management.

Assessment

- Present a photo essay showing life processes occurring in different ways as seen on their farm visit. Show links between these life processes and how they lead to successful farming practice. Photos can be taken during the visit or sourced (and attributed) from on line. Students explain why they chose each picture and what aspects they are illustrating.
- What practices has the farmer undertaken that allow their animals to be bred more successfully on this farm, for example, bottle feeding/mothering up lambs (nutrition/reproduction.growth); fertilising pasture (nutrition); use of high quality rams or bulls (reproduction); type of pasture plants (nutrition); weed control (nutrition).

Extension activities

- Investigate the germination rates of different seeds, or the same type of seed under different conditions, for example, temperature, light, water.
- Measure the growth rate from seed of grass, clover, or other agricultural plants.
- Measure and plot a growth curve of lamb weight from birth to weaning.
- What factors impact on pasture growth rate, and how do farmers encourage optimal growth?
- Does sheep wool grow at the same rate all year round?
- Investigate the growing properties of sheep manure versus cow manure.
- Debate the effects of agricultural methane on NZ and the merits of sheep and beef farming versus its effects on the environment.
- Discuss the waste product of methane and why it is a problem.
- Make a model or poster showing the path that food follows through a sheep or cattle beast. Compare this with human digestion (ruminant vs nonruminant).
- Investigate the starch levels of leaves from plants kept in the dark, compared with the leaves of the same plant kept in the light. Link this to pasture production and how periods of limited sunshine, such as winter, can affect pasture growth.
- Compare the feeding requirements of ewes with single lambs versus that of ewes with twin lambs. Link this to costs if supplementary feed is required.
- Compare different sheep breed data for lambing.
- What effect does different coloured light have on plant growth? Effect of Light Colors on Bean Plant Growth

Supporting resources

Sheep Farming in NZ

- Images of sheep farming
- Life on the farm
- Molesworth Station

Movement:

- Video: Show video of sheep dog herding sheep
- Heading dogs and huntaways at the end
- A *Dogs' Show* with a huntaway at work
- A *Dogs' Show* with two heading dogs
- Plant movement

Respiration:

- Make distinction between respiration and breathing in animals

Sensitivity:

- Use the video clips from the movement section

Reproduction:

- Estimated numbers for lambing this year

Nutrition:

- Constructing a digestive system model
- Experiment to prove light is essential for photosynthesis
- How a ruminat extracts the goodness from the grass it eats
- Feeding requirements of ewes with single lambs compared ewes with twins
- Possible measurement activity

Information on stocking rates and stock density for sheep and beef cattle.