**Design a robotic milking system – unit plan**

**Overview**

Students use information about a new Automated Milking System to design the layout of their own farm. Two-dimensional drawings are processed to make three-dimensional models of the layout.

**Purpose**

To think about how to set up an automatic milking system by integrating knowledge of the farm technology with knowledge of cow behaviour.

At a more advanced level, children could construct a farm model using electronics and link it into Electronics and Control technology.

## Background

### Suggestions for a scenario

Your group has been given a basic plan of a dairy farm. The farmer has recently installed an automatic milking system similar to the one at the [Greenfield project](https://www.sciencelearn.org.nz/resources/2096-investigating-robotic-milking). Your job is to decide on the layout of the farm. Where will you build the races, fences, water troughs and selection unit(s) in relation to the dairy shed? You will need to think about how to get the cows to go to the dairy on their own.

Make a model of your farm layout and show how your cows will move through the milking process.

### Where's the Biotechnology?

A traditional definition of biotechnology is to use living organisms to produce products of use to people. However, biotechnology can also be considered to be the use of biological knowledge to inform technological developments. In the case of automatic milking systems, the interaction between the animal and technology is considered. How can the technology be adjusted to best suit the cow? How can cow behaviour be managed to work within the constraints of the technology? It is important to understand how the cow and the technology can best work together to produce the product, milk. There is also the possibility of using the technology to process the milk while it is being collected.

### Focus of skill and strategy

Although a number of students will be familiar with the dairy farm, others will not. A visit to an ordinary dairy farm will expose the students to the milking process and to the behaviour required of the cows. Students should then explore [robotic milking](https://www.sciencelearn.org.nz/resources/2089-robotic-milking).

A visit from a dog handler could provide a focus for animal behaviour and how animals learn. A plan of the Greenfield farm when it was first set up can be used to introduce discussions on selection units, races, and one-way gate systems. Students can then plan their own farms in groups, producing simple farm models showing cow movement to and from the robotic milking machines. Role modelling during this process could help them sort out their ideas. Students will also develop skills to consider the ethical issues associated with using technology to manage cow behaviour.

### Resources

### Articles for background information: [History of New Zealand dairy farming](https://www.sciencelearn.org.nz/resources/2095-history-of-new-zealand-dairy-farming), [Investigating robotic milking](https://www.sciencelearn.org.nz/resources/2096-investigating-robotic-milking), [Training cows to milk themselves](https://www.sciencelearn.org.nz/resources/2097-training-cows-to-milk-themselves) and [Monitoring cows and milk](https://www.sciencelearn.org.nz/resources/2098-monitoring-cows-and-milk).

Word documents used in the student activities are [Action planner for an automatic milking system](#Actionplanner), [Farm plan for an automatic milking system](#Farmplan) and[Automatic milking system round robin](#robin).

### Health and Safety

Visits to farms should include safety consideration with regard to farm equipment and machines. Clothing and footwear should be appropriate. As docile as cows may seem, they are not pets and have the potential to harm. Children should not approach them.

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| **UNIT PLAN: PLANNING COW MOVEMENT THROUGH AN AUTOMATIC MILKING SYSTEM** |
| **Suggested learning intentions** | Suggested learning experiences*The following learning experiences will provide you with starting points for an exploration of this topic. You may decide to narrow your focus to one component, or include most of the ideas in a unit that incorporates science and/or technology themes.*  | Possible teaching/assessment activities |
| Understanding the milking system. An introduction to cows and the way they behave on a farm as part of the automatic milking system (AMS). | **Introduction*** Discussion on where milk comes from (have a carton of milk available).
* Brainstorm what the children already know about the production process (have pictures available).
* Visit a dairy farm. Focus on the cows’ behaviour. Ask the farmer questions about how they get the cows to the shed. Ask about the temperament and nature of cows, etc.
* Farmers (students’ parents) could visit to tell stories about ‘clever’ cows and other quirks in cow behaviour (e.g. having preferred companions).
* Watch a video of the milking process, focusing on the behaviour of the cow(s).
 | Class brainstormFarm visitInterviewing farmers |
| Understanding the scenario and identifying the information that is needed to solve the problem | **Introduce the scenario and prepare for action**. * Read out scenario. (See background notes on the first page).
* Brainstorm what do need to find out? (What is an AMS? What is the Greenfield project? How is ordinary farming different? What are cows like? How do you train cows?).
* Begin working on an action plan in groups of 3-5. What needs to be done first? Use the [Action planner for an automatic milking system](https://www.sciencelearn.org.nz/resources/2099-design-a-robotic-milking-system-unit-plan). (The second download document on the webpage.)
 | Work as part of a group to develop an action plan |
| Understanding the key components of an automatic milking systemExploring ways in which animal behaviour might be manipulated | **Developing expertise*** Study automatic milking at the Greenfield Project farm introduced in the article [Robotic milking](https://www.sciencelearn.org.nz/resources/2089-robotic-milking).
* Look at the videos on the cow behaviour. How does it differ from the behaviour of cows on the farm that was visited? (Find the videos using the search function and go to the Media results section, i.e. [Search results for robotic milking](https://www.sciencelearn.org.nz/resources/2096-investigating-robotic-milking?more_media=true&search=true&query=robotic+milking).)
* Have a dog handler visit the class with a trained dog. Students see what the dog is able to do. Discuss the dog’s training with the handler. Are all dogs the same to train?
* In small groups use role-play to understand the use of incentives. One person has to read a very boring story. How will the others in the group entice that child to read? They could try different incentives, e.g. spinach, apple, lollies etc. Discuss what worked for that person. How might a cow be encouraged to do something they may not be so keen to do?
* Look at an original farm plan of the Greenfield project. (The farm plan diagram: [Farm plan for an automatic milking system](#Farmplan).)
* Discuss where the cows would have to go and what they would have to be trained to do. Also discuss how they might be trained.
 | Using the Science Learning Hub.Problem solving using role-play.Considering cow movement within an automatic milking system. |
| Developing students’ own ideas for a farm model using a plan, role-play and constructing the model. | **Taking action*** Individually or in groups, children use a basic farm plan showing topography and the position of the milking shed to design and draw a simple farm layout of their own. They should show the races, fences, and at least one selection unit. They also need to consider the terrain and walking distances.
* The group decides on a farm plan and uses role-play to visualise it. They could make paddocks and races with chairs in the classroom and have some of their group as the cows. The others could work out where they wanted the cows to go, what gates they would need, and what the cows would be required to do.
* The group makes a model from the plan. Children will need to decide on the materials they need and add them to the Action Planner. They could include cardboard, plasticine, match sticks, toy cows, etc. The group should consider where the cows need to go and how they will get there (what gates they will go through etc.), [what incentives could be used](https://www.sciencelearn.org.nz/videos/1321-using-incentives-to-control-cow-movement-on-farms), and where they would put them. The incentives could be displayed as well.
 | Design a written plan of the farm and use role play to consider problems that may arise with the proposed farm layoutMake a model of the farmPresent the model to an audience, explaining cow movement Write a summary of what the cows would need to do and how they would be trained |
| Animal welfare must be considered in the development and implementation of an automatic milking system on farms. | **Considering the ethics*** From a cow’s point of view, what are the good things about living on a farm? (Protection, food, vet assistance, wouldn’t exist unless on a farm). What are the bad things? (Lameness from long periods of waiting at the dairy, mastitis, boredom – how could you tell?).
* Using the format of a [Automatic milking system round robin](#robin) make a list of consequences that the farm plan would have for the cows and the people involved.
* In groups, using a **PMI**, look at the consequences and decide on the benefits (**P**lus), harm (**M**inus) and anything **I**nteresting (that might be worth investigating) in them.
* As a class, discuss therights of the cow and of the farmer. Are the rights of the cow affected in your project? (for example the cow’s right to behave in a natural manner). Are the rights of the farmer affected? (for example the right to make their own decisions about how they work their farm).
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**Action Planner**

**Big Idea**

How to set up the farm layout for effective use of the automatic milking system

**What are we going to do?**

**What do we need to be able to do? (skills)**

**Where will we find our information?**

**What materials will we need?**

**What main ideas do we need to think about?**

**Activity: Farm plan for an automatic milking system**

A farmer has installed an automatic milking system. Can you suggest where the three paddocks, a selection unit and the cow pathways should go?

**Automatic milking machine**

 **Hill**

**Pond**

**Activity: Automatic milking system round robin**

This classroom management tool relates to the [Design a robotic milking system – unit plan](https://www.sciencelearn.org.nz/resources/2099-design-a-robotic-milking-system-unit-plan).

**Main Idea**: To generate a great number of ideas in groups of 3-5.

Divide the class into small groups (3-5). Depending on the number of groups, have large sheets of paper, each with a different group that may be affected by the presence of an automatic milking system. These could include:

* What effect would our plan have on the cows?
* What effect would our plan have on the farmer?
* What effect would our plan have on the farmer’s family?
* What effect would our plan have on farm workers?
* What effect would our plan have on the community/me?
* What effect would our plan have on animal rights groups?
* What effect would our plan have on agricultural scientists?

The groups are spread out around the room, each with a different piece of paper.

When the teacher says ‘AMS’ (or some other word that gives the signal to change and write), the students have 2-3 minutes to think of an idea or two (through discussion - hence noisy round robin). A writer for the group records the idea/s on the sheet.

When the teacher calls ‘AMS’ again, the groups move to the next piece of paper (i.e. the paper stays at each station). The students are timed again, and required to generate and write down their ideas. Because ideas cannot be repeated, students cannot write what is already there.

The students move on the teachers instructions around all the papers. The groups may then come together for a class to share and discuss their ideas.

Value could be added by each group taking their final sheet of paper and placing the consequences in order of most important to least important. The teacher can record the top 2-4 of each group’s list on the white board or another list.

A report could be a written document, a poster, an advertisement etc.