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Dairy Farm Data Pack

THIRD AND FOURTH LEVEL

Introduction

Welcome to the RHET Dairy Data Pack. This resource is designed to help you incorporate real-world data from a working dairy farm into your Numeracy and Mathematics teaching. Over the past decade, the number of dairy cows in Scotland has increased, while the number of dairy farms has declined. You can explore more detailed statistics on dairy farming in Scotland by visiting the Scottish Government's Agriculture, Fisheries and Rural Statistics web pages.

Milk is produced on farms across Scotland, but the majority of dairy herds are in the south-west of the country where the warm wet climate yields the lush green grass on which dairy cattle do so well.

A dairy cow must have a calf annually in order to produce milk, in recent years genetics have become important enabling farmers to guarantee female replacements from the best milkers and high quality beef calves from the remaining animals. The most popular breed of dairy cow is Holstein-Friesian, but more and more herds are turning to other breeds to help improve the butterfat and protein content of the milk. Other breeds in Scotland are the Friesian, Swiss Brown, Ayrshire, Shorthorn, Jersey, Guernsey and the Fleckvieh.

There are a series of three videos covering dairy farming that can be used to set the context for dairy learning in the school setting:

A Virtual Tour Of A Dairy Farm In Biggar, Scotland (Part 1)
A Virtual Tour Of A Dairy Farm In Biggar, Scotland (Part 2)
A Virtual Tour Of A Dairy Farm In Biggar, Scotland (Part 3)

There is also additional supporting information to share the story of dairy farming and provide context to the data problems.

Dairy in Scotland facts poster
Find out more about working as a dairy farmer

Thanks to funding from Forth Valley Countryside Initiative for the development of this resource.

What this pack contains

This pack contains information from case studies with classes already embedding our primary 'Moo Maths' resource within numeracy and mathematics as well as planning tools to allow practitioners to identify opportunities for learning and teaching. Lesson plans have been developed to provide some examples to support planning, teaching and learning at Third and Fourth Level Curriculum for Excellence (have a look at the First and Second Level packs to support differentiation within your own setting). Each lesson plan incorporates opportunities for differentiation between First, Second, Third and Fourth Level.

Photographs from the Primary 3 and Primary 5 case studies can be found within the First and Second Level packs. This pack focuses on the learning experiences with a second-year class from Bannockburn High School, Stirling. The pack was compiled in collaboration between Donna Bullivant (Numeracy Lead, Equity Team, Stirling Council and Chartered Teacher) and Reshma Esmail (Maths Teacher, Bannockburn High School, Stirling).

Contents

Objectives 5

Learning for Sustainability links 5

Third and Fourth Level E&Os 8

Examples of data from dairy farmer 13

Tractor costs on a dairy farm lesson plan 14

Learner worksheet Tractor costs on a dairy farm 15

Slurry costs on a dairy farm lesson plan 16

Learner worksheet Slurry costs on a dairy farm 17

Forage harvester costs on a dairy farm lesson plan 20

Learner worksheet Forage harvester costs on a dairy farm 21

Yearly operational costs on a dairy farm lesson plan 23

Learner worksheet Yearly operational costs on a dairy farm 24

Income from a dairy farm lesson plan 27

Learner worksheet Income from a dairy farm 28

Answers 31

Objectives

Enhance Engagement: Utilise real-world scenarios and data, to make numeracy and mathematics interesting, relatable and practical.

Practical Application: Show and demonstrate to learners how maths is used in everyday life and the world of work.

Data Literacy: Introduce basic data collection, analysis and interpretation skills.

Interdisciplinary Learning: Make connections between mathematics and other curricular areas within Curriculum for Excellence.

Learning for Sustainability

Goal 4 Quality education: Increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

Goal 12 Responsible consumption and production: Achieve the sustainable management and efficient use of natural resources.

Data from a dairy farm

This pack contains examples of a myriad of ways data from a dairy farm can be maximised to create a 'Dairy Data learning context', exploring a range of numeracy and mathematic Experiences and Outcomes within Curriculum for Excellence. Some of the data received from the farmer for First and Second Level includes weight of food consumption, volume of milk produced, and number of steps taken by the cow each day. At Third and Fourth Level, additional data regarding the operational costs of a dairy farm can be used to plan for teaching and learning.

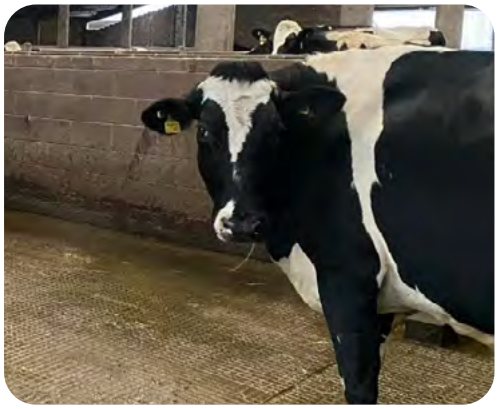
Using data from farmer Lynne Reid (Plean Farm, Stirling), you can find some examples of learning experiences developed by Maths Teacher, Reshma Esmail (Bannockburn High School) and Numeracy Lead, Equity Team, Donna Bullivant.

Initially, learners from Second Year at Bannockburn High School visited Boquhan Farm to find out about dairy farming and the operational costs involved in the running of the farm.

The planned activities could be incorporated into Third and Fourth Level to support learning and teaching of numeracy and mathematics as well as other inter-disciplinary areas. Opportunities for data analysis could be explored using a range of software and approaches by exploring Third and Fourth Level experiences and outcomes.

Within the examples shared here, problems and questions were designed to come from either 'the adopted cow' or from 'the farmer' to encourage learners to support the cow and farmer with real life problem solving scenarios.

Buttercup
(Primary 3 adopted cow)



Oreo
(Primary 5 adopted cow)

Farm visits are invaluable in providing learners with real life insight into the life of a working farm.

Guided tours of the milking parlour offer a firsthand look at where milk begins its journey.

Data collected from dairy cows can then be analysed at the appropriate level and challenge for learners.

Excursion to local farm (S2 Learners, Bannockburn High School)

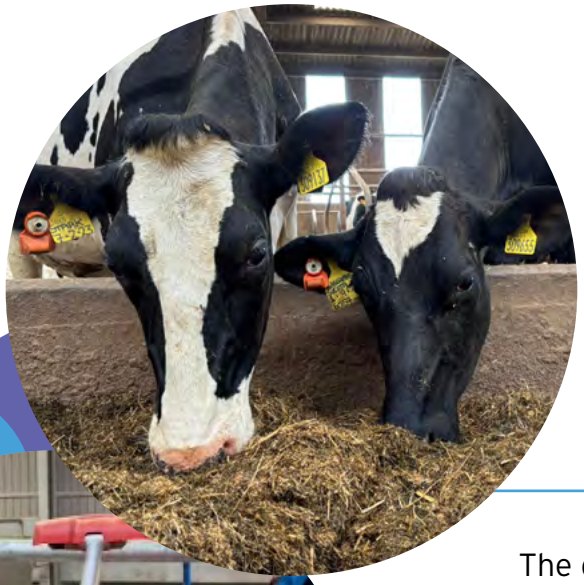
During farm visits, learners can find out how data is collected from individual cows and the herd.

The **pedometer** shown here contains data which can be shared with practitioners to use as part of problem solving scenarios.

Pedometer from dairy cow

Visits also provide the opportunity to find out more about data collection. For example, robotic milkers record the volume of milk produced from each udder teat.

Milk collection tank and real time milking volumes.



The dairy cows are fed silage and to keep it within reach of the cows to eat, a robot is programmed to move up and down the shed and sweep it towards the feeding cows.

Robotic sweeper and feeding dairy cows

Third and Fourth Level E&Os

Curriculum for Excellence Experiences and Outcomes	Suggested activities
The dairy farm data learning context will provide learners with opportunities to explore the following themes from Third and Fourth Level Numeracy and Mathematics: **Mathematics – its impact on the world, past, present and future** I have worked with others to research a famous mathematician and the work they are known for, or investigated a mathematical topic, and have prepared and delivered a short presentation. **MTH 3-12a**	
Estimating and Rounding:	
I can round a number using an appropriate degree of accuracy, having taken into account the context of the problem. **MNU 3-01a** Having investigated the practical impact of inaccuracy and error, I can use my knowledge of tolerance when choosing the required degree of accuracy to make real-life calculations. **MNU 4-01a**	**Estimating and Rounding with Volume:** Using data from the farm, devise examples of problems to explore estimating and knowledge of rounding decimal fractions to three decimal places. For example: • Rounds decimal fractions to three decimal places. Learners can round answers to a specified significant figure based on using figures from the farmer. Learners can demonstrate that the context of the question needs to be considered when rounding by taking into consideration what the farmer wants to find out.
Number and Number Processes:	
I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my processes and solutions. **MNU 3-03a** I can continue to recall number facts quickly and use them accurately when making calculations. **MNU 3-03b** I can use my understanding of numbers less than zero to solve simple problems in context. **MNU 3-04a** Having recognised similarities between new problems and problems I have solved before, I can carry out the necessary calculations to solve problems set in unfamiliar contexts. **MNU 4-03a** I have investigated how introducing brackets to an expression can change the emphasis and can demonstrate my understanding by using the correct order of operations when carrying out calculations. **MTH 4-03b**	**Multiplication and addition** Learners can recall quickly multiplication and division facts to the 10th multiplication table – apply this when solving problems from the farmer. Learners can • Solve addition and subtraction problems working with whole numbers and decimal fractions to three decimal places. • Solve addition and subtraction problems working with integers. • Solve multiplication and division problems working with whole numbers and decimal fractions to three decimal places. • Solve multiplication and division problems working with integers. Opportunities for learners to apply learning in a range of situations connected to data information from the farmer. Learners can work out addition, subtraction, multiplication and division problems with whole numbers and decimal fractions to three decimal places. Use data over a period of time to explore addition, subtraction, multiplication and division e.g. how much milk is produced over a week, month...

Powers and Roots	
Within real-life contexts, I can use scientific notation to express large or small numbers in a more efficient way and can understand and work with numbers written in this form. **MNU 4-06b**	Using data from the farmer, learners can use their knowledge of mathematical notation to express numbers in scientific notation.
Money:	
When considering how to spend my money, I can source, compare and contrast different contracts and services, discuss their advantages and disadvantages, and explain which offer best value to me. **MNU 3-09a** I can budget effectively, making use of technology and other methods, to manage money and plan for future expenses. **MNU 3-09b** I can discuss and illustrate the facts I need to consider when determining what I can afford, in order to manage credit and debt and lead a responsible lifestyle. **MNU 4-09a** I can source information on earnings and deductions and use it when making calculations to determine net income. **MNU 4-09b** I can research, compare and contrast a range of personal finance products and, after making calculations, explain my preferred choices. **MNU 4-09c**	Learners can use data from the farmer to explore Money Experiences and Outcomes: • demonstrate understanding of best value in relation to contracts and services when comparing products. Use digital technologies as appropriate, showing development of financial capabilities. Farmers can provide information about the amount of money they receive from the dairy for each litre of milk produced. This allows learners to investigate different prices for a litre of milk from different retailers to compare the price with what the farmer gets paid. These activities also link with the terms profit and loss, learners can work out how much profit is made by the retailers and initiate discussions about who else makes a profit? Other options include the amount farmers have to budget for animal feed over the winter compared to summer months when cows are out in the field. Learners can calculate the total cost for feeding individual cow as well as the herd of cows. Links can be made here with technologies by creating spreadsheets and adding formulas for appropriate columns. Learners can apply understanding of credit and debit in relation to earnings and deductions in the running of the farm. Learners can calculate net income by selecting appropriate information from the data provided by the farmer. Learners can communicate the impact of financial decisions by considering the data provided by the farmer.

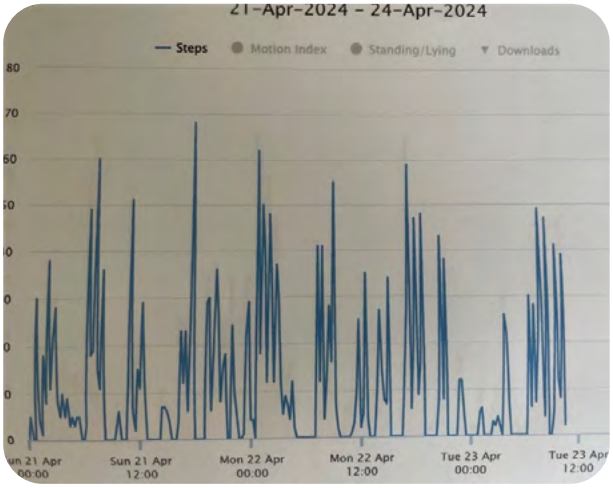
Time:	
Using simple time periods, I can work out how long a journey will take, the speed travelled at or distance covered, using my knowledge of the link between time, speed and distance. **MNU 3-10a**	Extend beyond Second Level to investigate time periods linked to estimating the time and distance for journey of the milk from farm to the dairy. Time durations across hours and days can be calculated by exploring how long it takes for the milk to reach shops.
Fractions, Decimal Fractions and Percentages:	
I can solve problems by carrying out calculations with a wide range of fractions, decimal fractions and percentages, using my answers to make comparisons and informed choices for real-life situations. **MNU 3-07a** By applying my knowledge of equivalent fractions and common multiples, I can add and subtract commonly used fractions. **MTH 3-07b** Having used practical, pictorial and written methods to develop my understanding, I can convert between whole or mixed numbers and fractions. **MTH 3-07c** I can show how quantities that are related can be increased or decreased proportionally and apply this to solve problems in everyday contexts. **MTH 3-08a** I can choose the most appropriate form of fractions, decimal fractions and percentages to use when making calculations mentally, in written form or using technology, then use my solutions to make comparisons, decisions and choices. **MNU 4-07a** I can solve problems involving fractions and mixed numbers in context, using addition, subtraction or multiplication. **MNU 4-07b** Using proportion, I can calculate the change in one quantity caused by a change in a related quantity and solve real-life problems. **MNU 4-08a**	**Fractions, Decimals and Percentages:** During onsite and virtual farm visits, farmers can share information about the composition of animal feed. Using this information, plan for activities to investigate the amount of each ingredient as a fraction, decimal and percentage. **Example of cow diet composition:** Concentrates 17% Hay 2% Draff 10% Silage 59% Whole crop silage 12% Use the data from the animal feed composition to convert between whole or mixed numbers and fractions. Learners will use knowledge of fractions, decimal fractions and percentages to carry out calculations with and without a calculator. Learners will choose the most efficient form of fractions, decimal fractions or percentages when making calculations involving data from the farmer. Learners will use calculations to support comparisons, decisions and choices when considering data from the farmer.

Measurement:	
I can solve practical problems by applying my knowledge of measure, choosing the appropriate units and degree of accuracy for the task and using a formula to calculate area or volume when required. **MNU 3-11a** I have worked with others to research a famous mathematician and the work they are known for, or investigated a mathematical topic, and have prepared and delivered a short presentation. **MNU 3-12a** I can apply my knowledge and understanding of measure to everyday problems and tasks and appreciate the practical importance of accuracy when making calculations. **MNU 4-11a** Through investigating reallife problems involving the surface area of simple 3D shapes, I can explore ways to make the most efficient use of materials and carry out the necessary calculations to solve related problems. **MNU 4-11b** I have discussed the importance of mathematics in the real world, investigated the mathematical skills required for different career paths and delivered, with others, a presentation on how mathematics can be applied in the workplace. **MNU 4-12a**	Learners will choose appropriate units for length, area and volume when solving practical problems (formulated around the data from farmer). Learners will convert between standard units to three decimal places and apply this when solving calculations of length, capacity, volume and area when solving problems with data from the farm. Learners will research and communicate using appropriate mathematical vocabulary and notation, the work of a famous mathematician or a mathematical topic and explains the relevance and impact they have on society – linking with learning from the visit to the farm. **Estimation and Measurement** Solve problems using loose materials. Using information from government guidelines for legislation for disease prevention and control, learners can create real life 'pens' for calves of specific age in weeks. Extend beyond First and Second level to explore compound 2D shapes to build pens of appropriate size. Guidelines as of March 2024: **Minimum individual pen size should be:** • 1.5m long x 0.75m wide up to 4 weeks • 1.8m long x 1.0m wide up to 8 weeks. • Calves over 8 weeks old should not be individually pe nned. • Calves penned individually must have direct visual and tactile contact with other calves through pen walls. **Minimum space requirements for group reared calves are:** • 1.5m^2 per calf up to 150kg (about 4 months old)) • 2.0m^2 per calf up to 200kg (about 6 months old) • Red Tractor recommends a minimum of 6.5 square metre total space per dairy cow, and AHDB recommends 10.5 square metres per cow. Demonstrates understanding of the impact of truncation and premature rounding. Uses formulae and calculates the surface area of cylinders, cuboids and triangular prisms. Calculates the volume of triangular prisms and cylinders using formulae. Contributes to discussions and presentations on the role of mathematics in everyday life and in the workplace. Investigates the mathematical skills required for a range of careers, including those in STEM subjects.

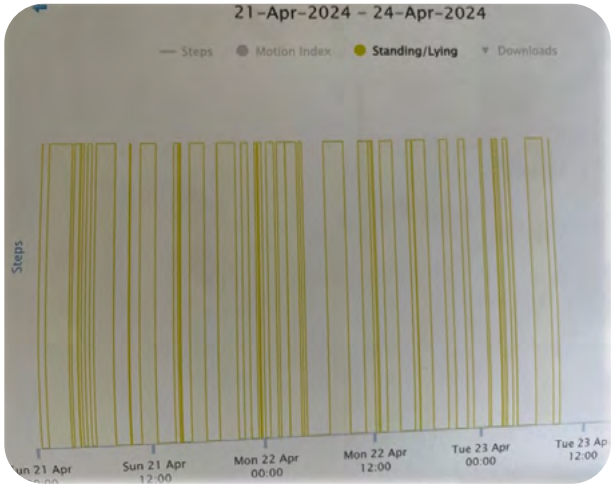
Properties of 2D shapes and 3D objects	
Having investigated the relationships between the radius, diameter, circumference and area of a circle, I can apply my knowledge to solve related problems. **MTH 4-16b**	Uses the formula $C = \pi D$ or $C = 2\pi r$ to calculate the circumference of a circle Uses the formula $A = \pi r^2$ to calculate the area of a circle.
Data Analysis	
I can work collaboratively, making appropriate use of technology, to source information presented in a range of ways, interpret what it conveys and discuss whether I believe the information to be robust, vague or misleading. **MNU 3-20a** I can display data in a clear way using a suitable scale, by choosing appropriately from an extended range of tables, charts, diagrams and graphs, making effective use of technology. **MTH 3-21a** I can evaluate and interpret raw and graphical data using a variety of methods, comment on relationships I observe within the data and communicate my findings to others. **MNU 4-20a** In order to compare numerical information in real-life contexts, I can find the mean, median, mode and range of sets of numbers, decide which type of average is most appropriate to use and discuss how using an alternative type of average could be misleading. **MNU 4-20**	Organises and displays data appropriately in a variety of forms, for example, compound bar and line graphs and pie charts, making effective use of technology as appropriate. **Data Handling** Opportunities for practitioners to use the data from farmers to explore these Experiences and Outcomes. As shown in photos below, it is possible to use the food and milk production data in a variety of ways. Challenge learners at Third Level by extending the range of tables, charts, diagrams, graphs and technologies at appropriate level to meet learner needs e.g. compound bar and line graphs and pie charts, making effective use of technology as appropriate. Learners will be able to compare data month by month to analyse trends. With farmer support, more complex data can be analysed to challenge learners (see examples of graph data from farmer). Interprets raw and graphical data. Calculates the mean, median, mode. Uses different types of charts to display discrete, continuous and grouped data appropriately.

Examples of Data from Dairy Farmer

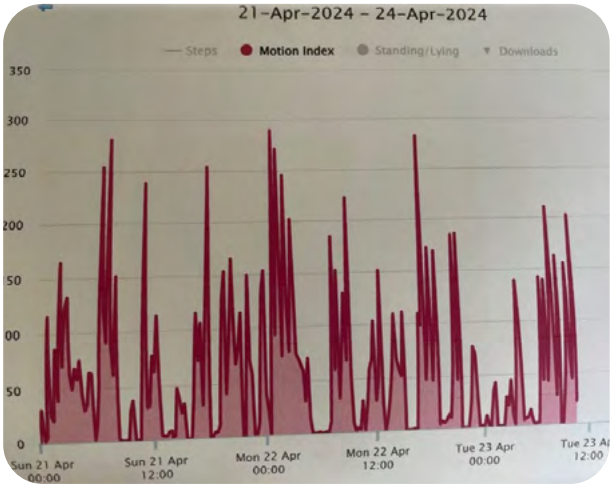
Raw data from dairy farm



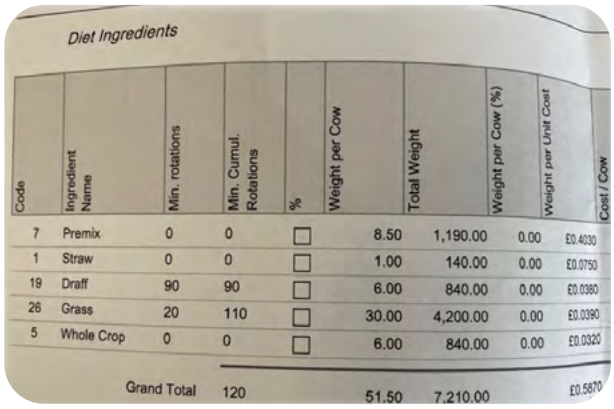
Example of raw data from farmer:
Steps taken over days and time



Example of raw data from farmer:
Standing/Lying taken over days and time



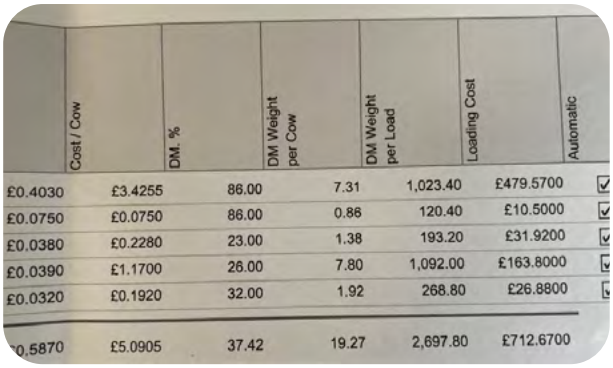
Example of raw data from farmer:
Motion Index taken over days and time



Diet Ingredients

Code	Ingredient Name	Min. rotations	Min. Cumul. Rotations	%	Weight per Cow	Total Weight	Weight per Cow (%)	Weight per Unit Cost	Cost / Cow
7	Premix	0	0	☐	8.50	1,190.00	0.00		£0.4030
1	Straw	0	0	☐	1.00	140.00	0.00		£0.0750
19	Draff	90	90	☐	6.00	840.00	0.00		£0.0380
26	Grass	20	110	☐	30.00	4,200.00	0.00		£0.0390
5	Whole Crop	0	0	☐	6.00	840.00	0.00		£0.0320
	Grand Total	120			51.50	7,210.00			£0.5870

Example of raw data from farmer:
e.g. weight of food per cow



Cost / Cow	DM. %	DM Weight per Cow	DM Weight per Load	Loading Cost	Automatic
£0.4030	£3.4255	86.00	7.31	1,023.40	£479.5700
£0.0750	£0.0750	86.00	0.86	120.40	£10.5000
£0.0380	£0.2280	23.00	1.38	193.20	£31.9200
£0.0390	£1.1700	26.00	7.80	1,092.00	£163.8000
£0.0320	£0.1920	32.00	1.92	268.80	£26.8800
0.5870	£5.0905	37.42	19.27	2,697.80	£712.6700

Example of raw data from farmer:
e.g. farm costings

Tractor Costs on a Dairy Farm Lesson plan

Learning Intention:	These activities aim to introduce learners to the running costs involved in managing a farm. Learners will investigate the costs involved in operating a tractor on the farm. Learners will learn about the need for this type of machinery on the farm.
Curriculum for Excellence area:	I can use a variety of methods to solve number problems in familiar contexts, clearly communicating my processes and solutions. **MNU 3-03a** I can continue to recall number facts quickly and use them accurately when making calculations. **MNU 3-03b** I can use my understanding of numbers less than zero to solve simple problems in context. **MNU 3-04a** When considering how to spend my money, I can source, compare and contrast different contracts and services, discuss their advantages and disadvantages, and explain which offer best value to me. **MNU 3-09a** I can budget effectively, making use of technology and other methods, to manage money and plan for future expenses. **MNU 3-09b** Having recognised similarities between new problems and problems I have solved before, I can carry out the necessary calculations to solve problems set in unfamiliar contexts. **MNU 4-03a** I have investigated how introducing brackets to an expression can change the emphasis and can demonstrate my understanding by using the correct order of operations when carrying out calculations. **MTH 4-03b** I can discuss and illustrate the facts I need to consider when determining what I can afford, in order to manage credit and debt and lead a responsible lifestyle. **MNU 4-09a** I can source information on earnings and deductions and use it when making calculations to determine net income **MNU 4-09b** I can research, compare and contrast a range of personal finance products and, after making calculations, explain my preferred choices. **MNU 4-09c**
Resources:	• Figures from farmer relating to operational costs of a tractor on the farm for a given month (differentiate accordingly depending on Level). • Selection of concrete materials. • Optional use of technologies for calculations.
Learning outline:	• Link back to prior learning from either the visit to the farm or the virtual farm experience. Ask learners what they can remember about operational costs of machinery. • Assess learners' knowledge of number processes by asking learners to use concrete materials, pictorial representations and/or abstract ways to calculate problems. Encourage learners to use a range of strategies to solve the problem.

LEARNER WORKSHEET

Tractor Costs on a Dairy Farm

Problem:
Feeding the dairy cattle on Plean Farm requires using a 100 Horse Power Tractor.
This costs £100,000 to buy outright, but can be financed over 5 years at £1,752.78 per month.

How much will this cost the farm over the 5 year period?
(Show your working)

At the end of 5 years, the tractor is worth 30% of its original value.
How much is the tractor now worth? (Show your working)

How much do you pay for the tractor in 1 year? (Show your working)

Slurry Costs on a Dairy Farm Lesson plan

Learning Intention:	These activities aim to introduce learners to the running costs involved in managing a farm. Learners will investigate the costs involved in operating a slurry tanker on the farm. Learners will learn about the need for this type of machinery on the farm.
Curriculum for Excellence area:	I can solve problems by carrying out calculations with a wide range of fractions, decimal fractions and percentages, using my answers to make comparisons and informed choices for real-life situations. **MNU 3-07a** When considering how to spend my money, I can source, compare and contrast different contracts and services, discuss their advantages and disadvantages, and explain which offer best value to me. **MNU 3-09a** I can budget effectively, making use of technology and other methods, to manage money and plan for future expenses. **MNU 3-09b** I can solve practical problems by applying my knowledge of measure, choosing the appropriate units and degree of accuracy for the task and using a formula to calculate area or volume when required. **MNU 3-11a** I can choose the most appropriate form of fractions, decimal fractions and percentages to use when making calculations mentally, in written form or using technology, then use my solutions to make comparisons, decisions and choices. **MNU 4-07a** I can discuss and illustrate the facts I need to consider when determining what I can afford, in order to manage credit and debt and lead a responsible lifestyle. **MNU 4-09a** I can source information on earnings and deductions and use it when making calculations to determine net income. **MNU 4-09b** I can research, compare and contrast a range of personal finance products and, after making calculations, explain my preferred choices. **MNU 4-09c** I can apply my knowledge and understanding of measure to everyday problems and tasks and appreciate the practical importance of accuracy when making calculations. **MNU 4-11a**
Resources:	• Figures from farmer relating to operational costs of a slurry tanker on the farm for a given month (differentiate accordingly depending on Level). • Selection of concrete materials. • Calculator.
Learning outline:	• Link back to prior learning from either the visit to the farm or the virtual farm visit. Ask learners what they can remember about operational costs of machinery. • Ask learners about the role the slurry tanker has on the farm to make links with real-life learning. • Assess learners' prior knowledge of measurement, volume, by exploring vocabulary such as gallons, litres and millilitres. • Assess learners' knowledge of number processes by asking learners to use concrete materials, pictorial representations and/or abstract ways to calculate problems. • Encourage learners to use a range of strategies to solve the problem.

LEARNER WORKSHEET

Slurry Costs on a Dairy Farm

Slurry is the liquid faeces produced by dairy cows. It differs from manure, which consists of faeces mixed with straw bedding.

Slurry can be used as a fertiliser to promote grass growth and is typically applied to fields either by spraying it with a slurry tanker or by injecting it directly into the soil using specialized equipment. Because dairy farms produce large quantities of slurry and spreading is limited to certain times of the year, it is usually stored in large on-farm tanks.

Part 1: The Slurry Tanker volume

The farm requires a 2000 gallon slurry tanker.
1 gallon = 4.54609 litres

Question 1: Round this to 3 decimal places

Question 2: How many litres will a 2000 gallon slurry tanker hold? How many ml is this?

Question 3: Round your answer in litres to 2 significant figures.

Question 4: Write your rounded answer in scientific notation.

LEARNER WORKSHEET

Slurry Costs on a Dairy Farm

Part 2: The Slurry Tanker cost

The slurry tanker has a cost price of £30,000.
It costs £575 per month to pay for it.

Question 1: How long will it take the farm to pay this off?

Part 3: The slurry store

The original slurry store has a diameter of 60 metres.
It is 20 metres tall.

Question 1: What is the surface area of this store?

Question 2: What is the volume of this store in centimetre cubes?

Question 3: Write your answer in scientific notation.

Slurry Costs on a Dairy Farm

Question 4: What is the volume of this store in litres?

Part 4: New slurry store

The farm has also built a new slurry store.

The new store has a diameter of 62 metres and a height of 25 metres.

Question 1: What is the difference in volume and surface area of this new store compared to the original store?

Forage Harvester Costs on a Dairy Farm Lesson plan

Learning Intention:	These activities aim to introduce learners to the running costs involved in managing a farm. Learners will investigate the costs involved in running a forage harvester for making silage. Learners will learn about the need for this type of machinery on the farm.
Curriculum for Excellence area:	I can solve problems by carrying out calculations with a wide range of fractions, decimal fractions and percentages, using my answers to make comparisons and informed choices for real-life situations. **MNU 3-07a** When considering how to spend my money, I can source, compare and contrast different contracts and services, discuss their advantages and disadvantages, and explain which offer best value to me. **MNU 3-09a** I can budget effectively, making use of technology and other methods, to manage money and plan for future expenses. **MNU 3-09b** I can solve practical problems by applying my knowledge of measure, choosing the appropriate units and degree of accuracy for the task and using a formula to calculate area or volume when required. **MNU 3-11a** I can discuss and illustrate the facts I need to consider when determining what I can afford, in order to manage credit and debt and lead a responsible lifestyle. **MNU 4-09a** I can source information on earnings and deductions and use it when making calculations to determine net income. **MNU 4-09b** I can research, compare and contrast a range of personal finance products and, after making calculations, explain my preferred choices. **MNU 4-09c** I can apply my knowledge and understanding of measure to everyday problems and tasks and appreciate the practical importance of accuracy when making calculations. **MNU 4-11a**
Resources:	• Figures from farmer relating to operational costs of a forager (differentiate accordingly depending on Level). • Information about the need for a forage harvester on a farm (silage). • Selection of concrete materials • Calculator
Learning outline:	• Link back to prior learning from either the visit to the farm or the virtual farm visit. Ask learners what they can remember about operational costs of machinery. • Ask learners about the role the forage harvester has on the farm to make links with real-life learning. • Assess learners' prior knowledge of measurement, volume, by exploring vocabulary such as gallons, litres and millilitres. • Assess learners' knowledge of number processes by asking learners to use concrete materials, pictorial representations and/or abstract ways to calculate problems. • Encourage learners to use a range of strategies to solve the problem.

LEARNER WORKSHEET

Forage Harvester Costs on a Dairy Farm

One of the main foods dairy cows eat is silage, which is essentially fermented, or "pickled," grass. The grass is cut during the summer and then either wrapped in plastic or placed in a silage clamp and covered with plastic sheeting. This airtight covering allows the grass to ferment, preserving it for use throughout the year.

A forage harvester is used to cut the grass and chop it into small pieces, making it easier for cows to digest. Forage harvesters can also be used to cut other crops, such as maize, which can similarly be fermented into silage for dairy cows.

If a farmer had to buy a forager for making silage they cost between £250,000 and £600,000.

Problem: The cheapest one costs £5,000 per month.
How many months would you need to pay for until you covered the cost price of this?

Another option is to pay a contractor to carry this out.
The costs for contractors are in the table below.

	£/h	£/acre
Forage harvesting – **whole crop**, three trailers and clamping	208.33	84.11
Silage – complete service (mow, rake, forage harvest, cart and clamp; three trailers)	191.25	77.40

On the farm
160 acres are cut for grass silage – three times a year
80 acres are cut for whole crop silage – once a year
Problem: How much would it cost per year for the contractor to make all the silage?

Another contractor is used for slurry spreading. The cost for this is £50 per hour.
It takes the contractor 20 hours to carry out this task.

Problem: How much does this cost the farm?

LEARNER WORKSHEET

Finance Deals on a Dairy Farm

There is a range of different machinery used on a dairy farm. Take a look at the different items and see if you can calculate the cost to the farm over 5 years.

Item:	Price:	Finance Deal:	Cost to farm over 5 years?	Cost of finance deal
Feed Wagon	£42,000	£805 per month for 5 years		
Telescopic Handler	£70,000	£1342 per month for 5 years		
Kverneland 10 rotor tedder	£22,000	£421 per month for 5 years		
Kverneland 2 ton fertilser spreader	£9,100	£175 per month for 5 years		
NC dung spreader	£27,000	£581 per month for 5 years		
John Deere 10 ft mounted mower	£19,800	£380 per month for 5 years		
Kverneland bedder	£16,500	£317 per month for 5 years		
TOTAL MONTHLY COST			Total cost of finance deal	
Plus monthly cost of 100 horse power tractor		£1,752.78	Total cost of finance deal per month:	

Yearly operational Costs on a Dairy Farm Lesson plan

Learning Intention:	These activities aim to introduce learners to the running costs involved in managing a farm. Learners will investigate the costs involved sowing and combining costs on the farm. Learners will learn about the need for this type of machinery on the farm.
Curriculum for Excellence area:	I can solve problems by carrying out calculations with a wide range of fractions, decimal fractions and percentages, using my answers to make comparisons and informed choices for real-life situations. **MNU 3-07a** When considering how to spend my money, I can source, compare and contrast different contracts and services, discuss their advantages and disadvantages, and explain which offer best value to me. **MNU 3-09a** I can budget effectively, making use of technology and other methods, to manage money and plan for future expenses. **MNU 3-09b** I can solve practical problems by applying my knowledge of measure, choosing the appropriate units and degree of accuracy for the task and using a formula to calculate area or volume when required. **MNU 3-11a** I can discuss and illustrate the facts I need to consider when determining what I can afford, in order to manage credit and debt and lead a responsible lifestyle. **MNU 4-09a** I can source information on earnings and deductions and use it when making calculations to determine net income. **MNU 4-09b** I can research, compare and contrast a range of personal finance products and, after making calculations, explain my preferred choices. **MNU 4-09c** I can apply my knowledge and understanding of measure to everyday problems and tasks and appreciate the practical importance of accuracy when making calculations. **MNU 4-11a**
Resources:	• Figures from farmer relating to operational costs of a combine harvester (differentiate accordingly depending on Level). • Data regarding type of crops grown on the farm. • Selection of concrete materials. • Calculator and optional access to technologies.
Learning outline:	• Link back to prior learning from either the visit to the farm or the virtual farm visit. Ask learners what they can remember about operational costs of machinery. • Ask learners about the role the combine harvester has on the farm to make links with real-life learning. • Assess learners' prior knowledge of measurement, volume, by exploring vocabulary such as gallons, litres and millilitres. • Assess learners' knowledge of number processes by asking learners to use concrete materials, pictorial representations and/or abstract ways to calculate problems. • Encourage learners to use a range of strategies to solve the problem.

LEARNER WORKSHEET

Yearly operational Costs on a Dairy Farm

Part 1

To grow the cereal portion of a dairy cow's diet, farmers must plant seeds and harvest the crops. This process requires specialized and often expensive machinery. Instead of purchasing this equipment themselves, many dairy farmers hire contractors—professionals who already have the necessary tools and expertise to carry out the work on their behalf.

Sowing and combining costs are contracted out at a cost of £5,094.00 per year.
Question 1: How much is this per month?

The cost of fertiliser is £34814.64 per year.
Question 2: How much is this per month?

LEARNER WORKSHEET

Yearly operational Costs on a Dairy Farm

Part 2

Using your figures from part 1 and the information below what is the total amount spent EACH month to run the farm.

Other monthly costs include:

Item:	**Cost per month:**
The average cost of paying for spares, servicing and vehicle maintenance:	£2,611.82 per month
150 horse power tractor £100,000	£1,917.00 per month
A mower £15-£20,000	£300.00 per month.
Straw for feeding and bedding is approximately	£2,000.00 per month.
Calf feed is approximately	£1,855.00 per month.
Cattle feed is approximately	£11,444.93 per month

Monthly costs	
Slurry tanker	
150 horse power tractor	
Mower	
Sowing & combining contractor	
Fertiliser	
Vehicle maintenance	
Straw	
Calf feed	
Cattle feed	
TOTAL MONTHLY COST:	

LEARNER WORKSHEET

Yearly operational Costs on a Dairy Farm

Use the concrete, pictorial and abstract areas to demonstrate working out in a range of ways

One problem in 4 ways!

Use the area below to demonstrate 4 different ways to solve the problem:

Concrete			
Pictoral			
Abstract			

Income from a Dairy Farm Lesson plan

Learning Intention:	I am learning to calculate the profit a dairy farm makes after taking into consideration expenditure. I am learning to use the terms **profit** and **loss** in buying and selling products.
Curriculum for Excellence area:	I can solve problems by carrying out calculations with a wide range of fractions, decimal fractions and percentages, using my answers to make comparisons and informed choices for real-life situations. **MNU 3-07a** I can budget effectively, making use of technology and other methods, to manage money and plan for future expenses. **MNU 3-09b** I can source information on earnings and deductions and use it when making calculations to determine net income. **MNU 4-09b**
Resources:	• Figures from farmer relating to milk income • Calculator and optional access to technologies
Learning outline:	• Link back to prior learning from either the visit to the farm or the virtual farm visit. Ask learners what they can remember about operational costs of machinery. • Ask learners to think about the cost of milk in the shops they visit. How does this compare to the price farmers receive? • Use the figures provided to calculate mean, median and modal figures • Graph the changing milk prices

LEARNER WORKSHEET

Dairy Farm income

Dairy farmers in Scotland sell their milk to processors (for example Arla and Müller) who then process and sell the milk and milk products. The price the farmer receives per litre is determined by various factors, including:

1. The contract they have with their milk buyer, which outline the price they will be paid, the volume of milk they will supply, and other terms like milk quality standards.
2. The composition of the milk and the fat and protein content of the milk can influence the price.
3. Market demand as milk prices are influenced by global supply and demand, as well as other market forces.

Month	Price per litre
October 2023	36p
November 2023	35p
December 2023	35p
January 2024	35p
February 2024	35p
March 2024	35p
April 2024	36p
May 2024	36p
June 2024	36p
July 2024	37p
August 2024	37p
September 2024	38p

Part 1

The prices that the farm receives for every litre of milk varies monthly. Here are the prices of milk per litre of milk for the past 12 months.
Using the figures above, calculate the mean, median and mode of the price of milk per litre.

Mean	
Median	
Mode	

Dairy Farm income

Part 2

INCOME

Display the changing milk prices on a suitable graph of your choice.
Use squared paper to draw the graph accurately.

LEARNER WORKSHEET

Dairy Farm income

Part 3
Calculating farm income

The farm's average monthly milk production is 123,833.333 litres

Question 1. Round this figure to the 3 significant figures.

Question 2. Write your rounded answer in scientific notation.

Question 3. Using the median price for milk, how much will the farm earn per month?

Question 4.
Now work out the monthly net profit or loss for the farm by doing the following calculation:
Total monthly income – Total monthly costs = monthly net profit.

Answers

TRACTOR COSTS ON A DAIRY FARM

Problem:
Feeding the dairy cattle on Plean Farm requires using 100 Horse Power Tractor. This costs £100 000 but can be financed over 5 years at £1380 per month.

How much will this cost the farm over the 5 year period?

£1,752.78 x 12 x 5 = £105,166.80

At the end of 5 years, the tractor is worth 30% of its original value. How much is the tractor now worth?

30% of 100,000 = £30 000

How much do you pay for the tractor in 1 year?

£1,752.78 x 12 = £21,033.36

SLURRY COSTS ON A DAIRY FARM

Part 1. Question 1. Round this to 3 decimal places

4.546

Part 1. Question 2. How many litres will a 2,000 gallon slurry tanker hold? How many ml is this?

4 · 546 x 2 x 1000 = 9,092 litres [non calculator]
9,092 x 1,000 = 9,092,000 ml

Part 1. Question 3. Round your answer in litres to 2 significant figures.

9,100 litres

Part 1. Question 4. Write your answer in scientific notation

$9{\cdot}1x10^3$

Part 2. Question 1. How long will it take the farm to pay this off?

30,000 ÷ 575 = 52.17 months = 53 months = 4 yrs and 5 months

Part 3. Question 1. What is the surface area of this store?

Surface area = π x diameter x height = 3·14 x 60 x 20 = 3,768 m2
[can be done without a calculator]

Part 3. Question 2. What is the volume of this store in centimetre cubes?

Diameter = 60m = 60 x 100 = 6,000cm so radius = 3,000cm
Height = 20m = 20 x 100 = 2000cm
Volume = π x radius2 x height = $3{\cdot}14 \times 3{,}000^2 \times 2{,}000 = 56{,}520{,}000{,}000cm^3$

Part 3. Question 3. Write your answer in scientific notation.

$5{\cdot}652 \times 10^{10}$

Part 3. Question 4. What is the volume of this store in litres?

$56{,}520{,}000{,}000cm^3 = 56{,}520{,}000{,}000ml \div 1{,}000 = 56{,}520{,}000$ litres

Part 4. Question 1. What is the difference in volume and surface area of this new store compared to the original store?

Surface area = π x diameter x height = $3{\cdot}14 \times 62 \times 25 = 4{,}867\ m^2$
New surface area = $4{,}867 - 3768 = 1{,}099m^2$ bigger

Diameter = 62m = 62 x 100 = 6,200cm so radius = 3,100cm
Height = 25m = 25 x 100 = 2500cm
Volume = π x radius^2 x height = $3{\cdot}14 \times 3{,}100^2 \times 2{,}500 = 75{,}438{,}500{,}000\ cm^3$
New volume = $75{,}438{,}500{,}000 - 56{,}520{,}000{,}000 = 18{,}918{,}500{,}000\ cm^3$ bigger
(=18,918,500 more litres stored)

FORAGE HARVESTER COSTS ON A DAIRY FARM

Problem: The cheapest one costs £5000 per month.
How many months would you need to pay for until you covered the cost price of this?

$250{,}000 \div 5{,}000 = 50$ months = 4 years and 2 months

Problem: How much would it cost per year for the contractor to make all the silage?

Grass silage 160 x 77.40 = £12,384 x 3 cuts per year = £37,152
Whole crop silage 80 x 84.11 = £6728.80
Total for all silage making £43,880.80

Problem: How much does this cost the farm?

50 x 20 = £1,000

FINANCE DEALS ON A DAIRY FARM

Item:	Price:	Finance Deal:	Cost to farm over 5 years?	Cost of finance deal
Feed Wagon	£42,000	£805 per month for 5 years	**805 x 12 x 5 = £48300**	**£6,300**
Telescopic Handler	£70,000	£1,342 per month for 5 years	**1342 x 12 x 5 = £80,520**	**£10,502**
Kverneland 10 rotor tedder	£22,000	£421 per month for 5 years	**421 x 12 x 5 = £25,260**	**£3,260**
Kverneland 2 ton fertilizer	£9,100	£175 per month for 5 years	**175 x 12 x 5 = £10,500**	**£1,400**
NC dung spreader	£27,000	£581 per month for 5 years	**581 x 12 x 5 = £34,860**	**£7,860**
John Deere 10 ft mounted mower	£19,800	£380 per month for 5 years	**380 x 12 x 5 = £22,800**	**£3,000**
Kverneland bedder	£16,500	£317 per month for 5 years	**317 x 12 x 5 = £19,020**	**£2,520**
TOTAL MONTHLY COST		**£4,021**	Total cost of finance deal	**£34,842**
Plus monthly cost of 100 horse power tractor		£1,752.78	Total cost of finance deal per month:	**34,842 ÷ 60 =£580.70**
		£5,773.78		

SOWING AND COMBINING COSTS ON A DAIRY FARM

Question 1: How much is this per month?

5,094 ÷ 12 = £424.50

Question 2: How much is this per month?

34,814.64 ÷ 12 = £2,901.22

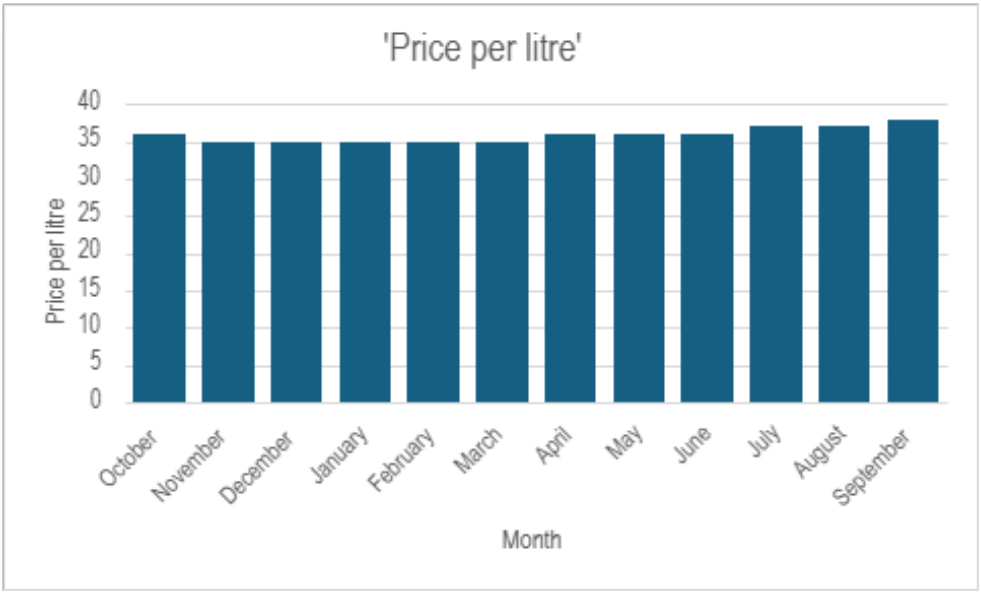
Monthly costs	
Slurry tanker	£575
150 Horse Power Tractor	£1,917.00
Forage harvester	£5,000
Sowing & Combining Contractor	£424.50
Fertiliser	£2,901.22
Vehicle maintenance	£2,611.82
Straw	£2,000.00
Calf feed	£1,855.00
Cattle feed	£11,444.93
TOTAL MONTHLY COST:	**£28,729.47**

INCOME FROM A DAIRY FARM

Part 1.

Mean	35.9p
Median	36p
Mode	35p

Part 2.



Part3. Question 1. Round this figure to the 3 significant figures.

124,000 litres

Part3. Question 2. Write your rounded answer in scientific notation.

$1{\cdot}24 \times 10^5$

Part3. Question 3. Using the median price for milk, how much will the farm earn per month?

124,000 x 0.36 = £44,640

Part3. Question 4. Now work out the monthly net profit or loss for the farm by doing the following calculation: Total monthly income – Total monthly costs

44,640 - 28,729.47= £15,910.53 profit