Links and discrepancies between maths and science

One of the findings in Ofsted's Finding the optimum: the science subject report (February 2023) was that,

> "very few leaders had planned their science curriculum to take account of what pupils learned in mathematics".

The report recommended that schools should,

> "Ensure that the science curriculum is planned to take account of what pupils learn, particularly in mathematics."

This document is designed to help schools identify the links and discrepancies between the maths skills required by the science curriculum in each year-group and those included in the maths curriculum in the National Curriculum in England. It should provide a useful basis for science subject leaders to discuss and resolve any issues that emerge in the sequencing of the two curricula in their school.

The document is also designed to help individual teachers identify where the content in the science topics for their year-group depend on maths skills that their pupils are learning in the same year. This will enable them to check whether they need to teach the maths skill as part of science, if their pupils will not be learning the skill in maths until later in the year. It will also help teachers identify where there are discrepancies between the maths and science curricula, i.e. where the maths skills required in science are taught in a later year-group in the maths curriculum. In these circumstances, teachers will need to teach or scaffold the maths skills as part of science.

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Introduction

Learning maths can seem quite abstract to some pupils if the skills they learn are not put to practical use. How often do we hear pupils say things like, "Why do I need to measure the length of a line on a piece of paper?" or "Why do I need to be able to draw a bar chart?" Science provides an excellent opportunity to put maths skills to practical use and illustrate to pupils how measuring, recording and presenting data are relevant and useful skills.

Skills learnt in maths should be applied and practised in science but, as Ofsted indicates in their Subject report series: science (April 2021), there are issues to consider.

"It is also important that teachers do not assume that pupils can easily transfer their learning from mathematics to the science classroom. Pupils will need to be taught how to use mathematics in science."

It is important that teachers remind pupils of the skills they have developed in maths lessons before they use them in a science activity and also ensure that they perform these skills to the same level of competence within science activities as they do within maths. It is not always obvious to pupils that they are using the same skill in science and they sometimes have a tendency to carry out the skill in a less sophisticated way during a science activity than when they were taught the skill in maths.

Links and discrepancies

To help teachers identify the skills their pupils have developed in maths that they will use in science in each year-group, the Links and discrepancies tables in this document identify the statements from the maths curriculum from previous years that relate to skills that pupils will be using in science, as well as the statements from the current year. This will enable teachers to remind pupils of the maths skills that they will be using and ensure that they perform those skills at the same level of competence that was expected in maths.

The Links and discrepancies tables for each year-group also include any discrepancies between the maths skills pupils will use in science and those they have learnt or will be learning in maths during the year. For example, there are no statistics statements in the maths curriculum for Year 1, but pupils need to use simple tables and tally charts in science. Where there are these discrepancies, the document includes guidance on the maths skills that pupils need to be taught in science.

Finally, the Links and discrepancies tables also include an 'Other considerations' section that highlights any other issues that teachers need to be aware of when asking pupils to apply maths skills in science.

Using maths skills in science

To support teachers identify where maths skills can be used in science, the Using maths skills in science tables in this document identify examples of science activities in the topics in each year-group and the maths skills that they involve, so teachers can teach their pupils how to use the relevant maths skills in the science activity.

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Links and discrepancies

Year 1

Prior learning
Maths that needs to be secure before use in science
Measurement Pupils should have learnt to compare length, weight and capacity.
Links
New maths content required for science (see 'Using maths skills in science' table below)

Measurement
Pupils will be taught to:
• compare, measure and begin to record the following:
  ○ lengths and heights
  ○ mass/weight
  ○ capacity and volume
  ○ time (hours, minutes, seconds)
• sequence events in chronological order using language [for example, before and after, next, first, today, yesterday, tomorrow, morning, afternoon and evening]
• recognise and use language relating to dates, including days of the week, weeks, months and years
• tell the time to the hour and half past the hour and draw the hands on a clock face to show these times.

Discrepancies
Maths required for science that has yet to be covered in maths
Statistics In science, pupils need to be able to complete simple tables and tally charts to record data gathered. However, in maths, there are no statistics statements in Year 1, as interpreting and constructing simple pictograms, tally charts, block diagrams and simple tables are not covered in maths until Year 2. Consequently, these skills will need to be taught explicitly in science lessons prior to being used. <u>Simple tables</u> Where a simple table is required, pupils should be provided with a T-table template with headings. Pupils will need to be shown how to put the data into the table, ensuring that it is lined up in both columns.

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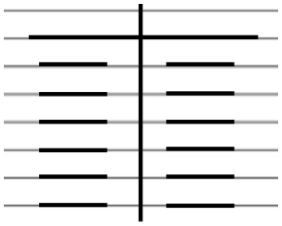

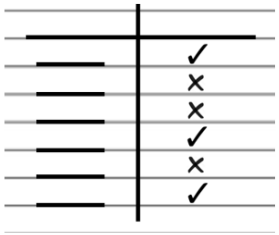

Tally charts

Where a tally chart would be required, an alternative is to give pupils a template table to which they add ticks to record their data (see illustration below) and then count the ticks to calculate the total.

	✓								1
	✓	✓	✓						3

Venn diagrams

In science, pupils need to be able to use simple Venn diagrams. However, this skill does not feature in the primary maths curriculum. Consequently, this skill will need to be taught explicitly in science lessons prior to being used. Pupils can be taught how to choose a criterion, use this to label a hoop and then put objects inside or outside the hoop depending on whether they meet the criterion or not.

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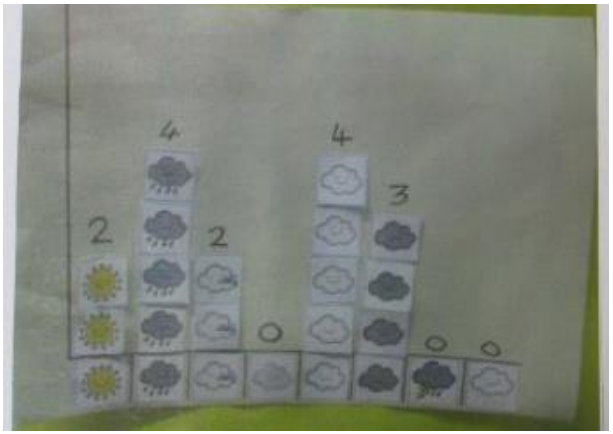
Other considerations
In science, in the 'Seasonal changes' topic, pupils will gather weather data that it may be useful to present as a pictogram. This is not covered in maths until Year 2 and therefore pupils should not be asked to do this. Teachers should support pupils to present this data by adding it to a class pictogram.



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Year 2

Prior learning
Maths that needs to be secure before use in science
Measurement Pupils should have learnt to compare, measure and begin to record the following: • lengths and heights • mass/weight • capacity and volume • time (hours, minutes, seconds). **Statistics** Pupils may have some experience of simple pictograms, tally charts, block diagrams and simple tables, but there are no statistics statements in the National Curriculum in Year 1.
Links
New maths content required for science (see 'Using maths skills in science' table below)
Measurement Pupils will be taught to: • choose and use appropriate standard units to estimate and measure length/height in any direction (m/cm); mass (kg/g); temperature (°C); capacity (litres/ml) to the nearest appropriate unit, using rulers, scales, thermometers and measuring vessels • compare and order lengths, mass, volume/capacity and record the results using >, < and =. **Statistics** Pupils will be taught to interpret and construct simple pictograms, tally charts, block diagrams and simple tables.

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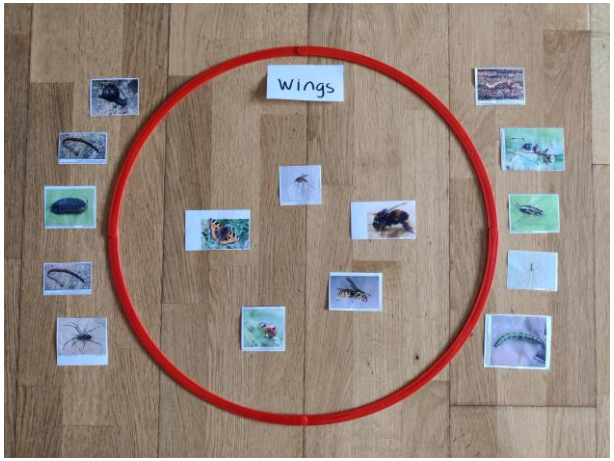
Discrepancies

Maths required for science that has yet to be covered in maths

In science, pupils need to be able to use simple Venn diagrams. However, this skill does not feature in the primary maths curriculum. Consequently, this skill will need to be taught explicitly in science lessons prior to being used. Pupils can be taught how to choose a criterion, use this to label a hoop and then put objects inside or outside the hoop depending on whether they meet the criterion or not.



Other considerations

Measurement
When measuring in science, pupils are sometimes asked to:

- use mixed units
- convert between units
- use decimal points.

These skills are not covered in maths until Years 3 and 4 and therefore pupils should not be asked to do them.

Statistics
When presenting or interpreting data, pupils are sometimes asked to interpret and construct bar charts. This is not covered in maths until Year 3, so block graphs should be used instead.

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Year 3

Prior learning
Maths that needs to be secure before use in science
Measurement Pupils should have learnt to choose and use appropriate standard units to estimate and measure length/height in any direction (m/cm); mass (kg/g); temperature (°C); capacity (litres/ml) to the nearest appropriate unit, using rulers, scales, thermometers and measuring vessels. **Statistics** Pupils should have learnt to interpret and construct simple pictograms, tally charts, block diagrams and simple tables.
Links
New maths content required for science (see 'Using maths skills in science' table below)
Measurement Pupils will be taught to: • measure, compare, add and subtract: lengths (m/cm/mm); mass (kg/g); volume/capacity (l/ml) • compare durations of events [for example to calculate the time taken by particular events or tasks]. **Statistics** Pupils will be taught to interpret and present data using bar charts, pictograms and tables.
Discrepancies
Maths required for science that has yet to be covered in maths
Statistics In science, pupils need to be able to use Venn diagrams and/or Carroll diagrams. However, these skills do not feature in the primary maths curriculum. Consequently, these skills will need to be taught explicitly in science lessons prior to being used. Once pupils can identify two or more criteria for sorting, they can be encouraged to use these to create intersecting Venn diagrams, recognising the four areas, and also Carroll diagrams (see illustrations below).

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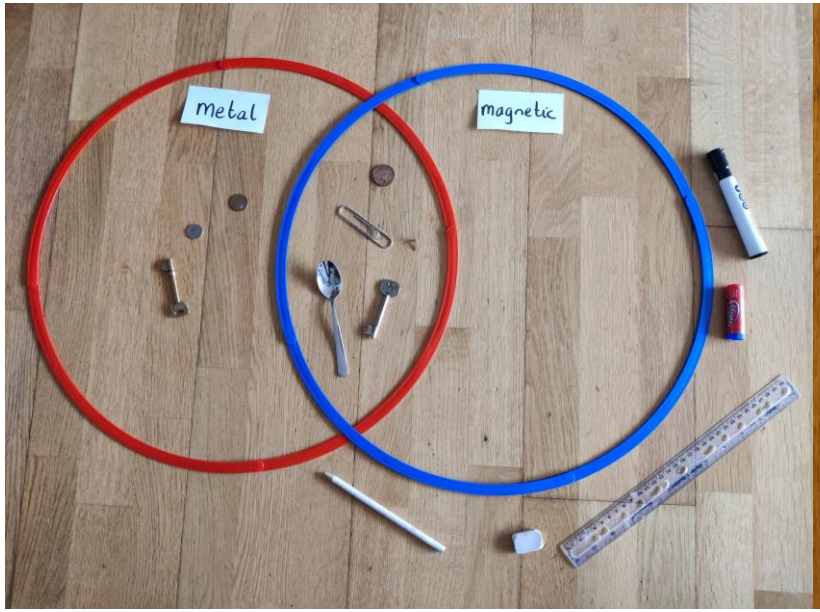

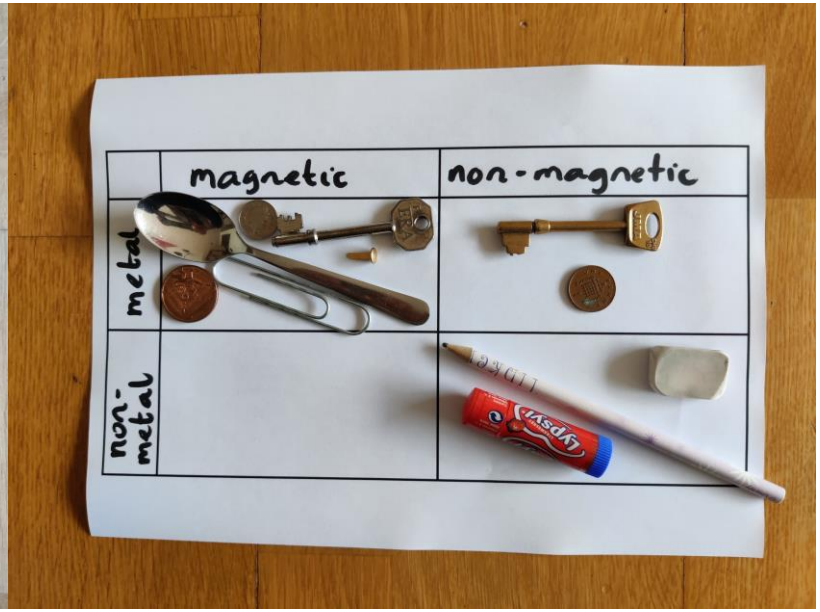

Other considerations

Measurement
In the non-statutory notes and guidance for maths, it states that, during Year 3, pupils may be taught to:

- use mixed units
- convert between units.

Once pupils are secure in using mixed units and converting between units, these skills can be used in science.

Statistics
Pupils are sometimes asked to interpret or construct time graphs or line graphs in science. These skills are not covered in maths until Years 4 and 5 and therefore pupils should not be asked to do this.

Number
In the non-statutory notes and guidance for maths, it states that, during Year 3, pupils may be taught to connect tenths to decimal measures. Once pupils are secure in using decimal measures, they can be used in science.

Pupils are unlikely to be able to round numbers, as this skill is not covered in maths until Year 4. This can cause problems for pupils if they are asked to use stopwatches that measure tenths and hundredths of seconds in science.

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Year 4

Prior learning
Maths that needs to be secure before use in science
Measurement Pupils should have learnt to measure, compare, add and subtract: lengths (m/cm/mm); mass (kg/g); volume/capacity (l/ml). **Statistics** Pupils should have learnt to interpret and present data using pictograms, tally charts, block diagrams, tables and bar charts.
Links
New maths content required for science (see 'Using maths skills in science' table below)
Measurement Pupils will be taught to find the area of rectilinear shapes by counting squares. **Statistics** Pupils will be taught to interpret and present discrete and continuous data using appropriate graphical methods, including bar charts and time graphs. **Number** Pupils will be taught to count backwards through zero to include negative numbers.
Discrepancies
Maths required for science that has yet to be covered in maths
Statistics In science, pupils need to be able to use Venn diagrams and/or Carroll diagrams. However, these skills do not feature in the primary maths curriculum. Consequently, these skills will need to be taught explicitly in science lessons prior to being used. Once pupils can identify two or more criteria for sorting, they can be encouraged to use these to create intersecting Venn diagrams, recognising the four areas, and also Carroll diagrams (see illustrations below).

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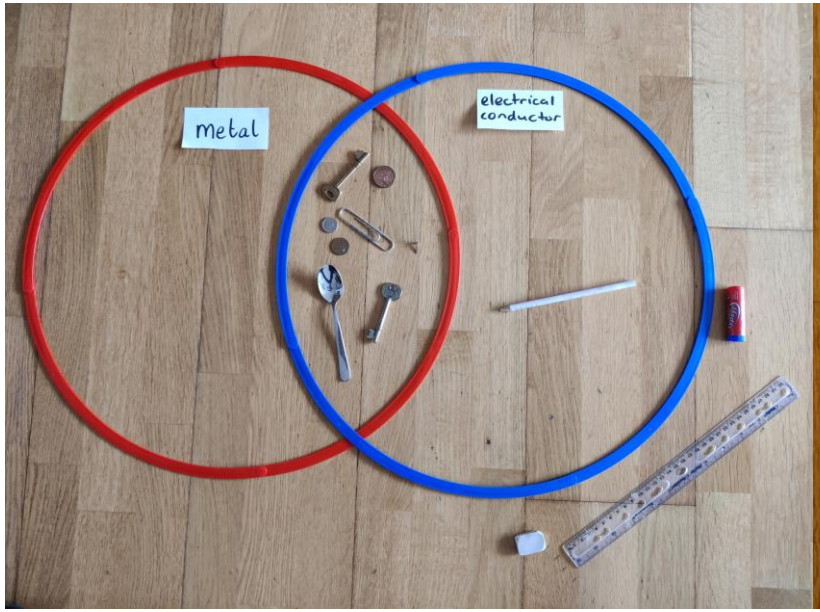

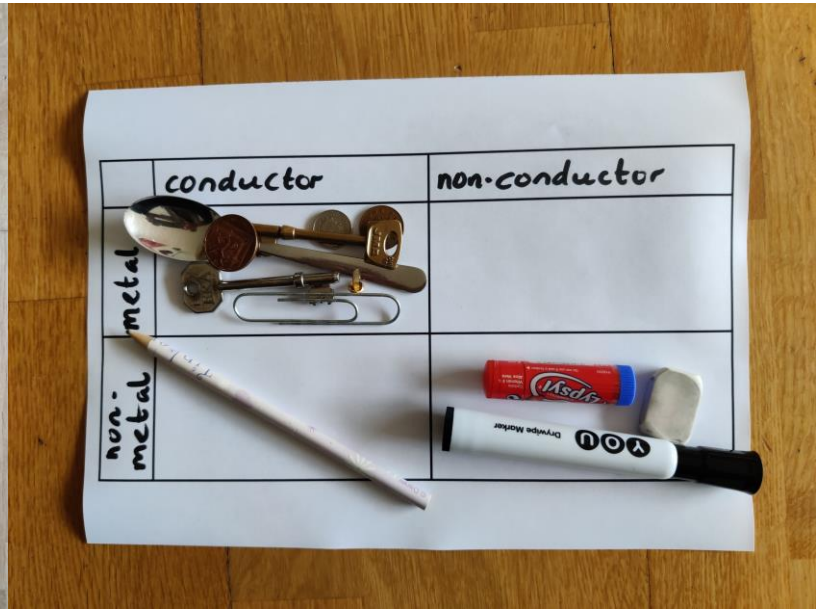

Other considerations

Statistics
In science, pupils will sometimes need to gather data that is most appropriately presented as a line graph. Line graphs are not covered in maths until Year 5 or Year 6 and therefore pupils should not be asked to construct a line graph from their data. This kind of data can be gathered using a spreadsheet and the graphing tool should be used to generate the line graph.

Number
In science, pupils are expected to research the temperature at which materials change state, as part of the 'States of matter' topic. They may find it difficult to interpret this data where it involves negative numbers.

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Year 5

Prior learning

Maths that needs to be secure before use in science

Measurement
Pupils should have learnt to measure, compare, add and subtract: lengths (m/cm/mm); mass (kg/g); volume/capacity (l/ml).

Statistics
Pupils should have learnt to interpret and present discrete and continuous data using appropriate graphical methods, including bar charts and time graphs.

Links

New maths content required for science (see 'Using maths skills in science' table below)

Measurement
Pupils will be taught to calculate and compare the area of rectangles (including squares), and including using standard units, square centimetres (cm^2).

Statistics
Pupils will be taught to:

- solve comparison, sum and difference problems using information presented in a line graph
- complete, read and interpret information in tables, including timetables.

Number
Pupils will be taught to:

- round decimals with two decimal places to the nearest whole number and to one decimal place
- read, write, order and compare numbers with up to three decimal places
- read, write, order and compare numbers to at least 1 000 000 and determine the value of each digit.

Discrepancies

Maths required for science that has yet to be covered in maths

Statistics
In science, pupils will sometimes need to gather data that is most appropriately presented as a line graph. Constructing line graphs is not covered in maths until Year 6. However, pupils will have learnt to construct time graphs in maths in Year 4. These skills can be used to present data gathered in science that is most appropriately presented as a line graph, provided the pupils are given a template line graph to use with the axes labelled.

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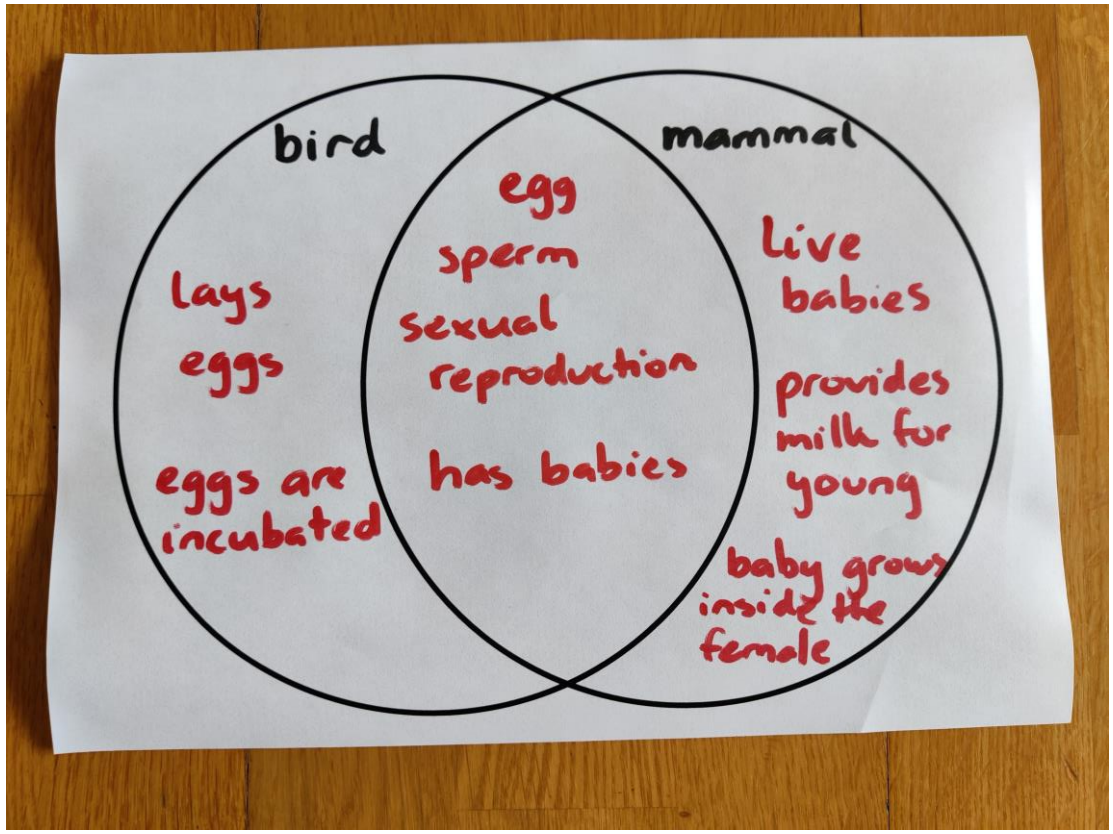
In science, pupils will sometimes need to gather data that is most appropriately presented as a scatter graph. Constructing scatter graphs is not covered in maths until Key Stage 3 and therefore pupils should not be asked to construct a scatter graph from their data. This kind of data can be gathered using a spreadsheet and the graphing tool should be used to generate the scatter graph.

In science, pupils need to be able to use Venn diagrams and Carroll diagrams. However, these skills do not feature in the primary maths curriculum. Consequently, these skills will need to be taught explicitly in science lessons prior to being used. Once pupils can identify two or more criteria for sorting, they can be encouraged to use these to create intersecting Venn diagrams, recognising the four areas, and also Carroll diagrams.



In science, when carrying out comparative or fair tests, pupils need to take repeat readings, when appropriate. Calculating the mean average is not covered in maths until Year 6 and therefore pupils should not be asked to do this. Rather than calculating a mean average, it is more appropriate to ask pupils to look closely at the data, identify readings that do not fit with the others and cross these out. Then, they can look at the range of the remaining readings and use them to identify the 'most likely' answer. In other words, estimating the expected answer, based on the full range of data. This will help them to estimate before calculating the mean average in Year 6.

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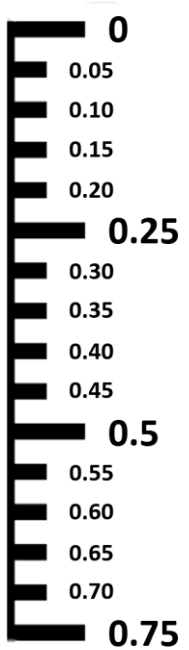
Other considerations

Measurement
In science, in the 'Forces' topic, pupils need to use Newton meters and can find the scales on some very difficult to interpret. To support pupils to read the scales, provide a number line with the equivalent increments and graduations marked on it (see illustration) and be prepared to read the scales for them, if necessary.

Number
In science, in the 'Earth and space' topic, pupils may struggle to interpret data about the distance planets are from the Sun if the distances are presented using mixed units (e.g. million km, billion km). If all the data is presented in km, despite the size of the numbers, pupils will be able to compare them using their understanding of place value.

Ratio and proportion
In science, in the 'Forces' topic when looking at the relationship between the size of gears/number of teeth and the number of turns/speed of turn, sometimes pupils are asked to use ratios to describe their findings. Ratios are not covered in maths until Year 6 and therefore pupils should not be asked to do this. They will only be able to identify general patterns not specific numerical patterns.



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Year 6

Prior learning

Maths that needs to be secure before use in science

Measurement
Pupils should have learnt to measure, compare, add and subtract: lengths (m/cm/mm); mass (kg/g); volume/capacity (l/ml).

Statistics
Pupils should have learnt to:

- interpret and present discrete and continuous data using appropriate graphical methods, including bar charts and time graphs
- solve comparison, sum and difference problems using information presented in a line graph
- complete, read and interpret information in tables, including timetables.

Links

New maths content required for science (see 'Using maths skills in science' table below)

Statistics
Pupils will be taught to:

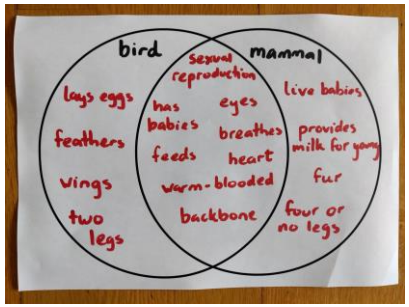
- interpret and construct pie charts and line graphs and use these to solve problems
- calculate and interpret the mean as an average.

Discrepancies

Maths required for science that has yet to be covered in maths

In science, pupils will sometimes need to gather data that is most appropriately presented as a scatter graph. Constructing scatter graphs is not covered in maths until Key Stage 3 and therefore pupils should not be asked to construct a scatter graph from their data. This kind of data can be gathered using a spreadsheet and the graphing tool should be used to generate the scatter graph.

In science, pupils need to be able to use Venn diagrams and Carroll diagrams. However, these skills do not feature in the primary maths curriculum. Consequently, these skills will need to be taught explicitly in science lessons prior to being used. Once pupils can identify two or more criteria for sorting, they can be encouraged to use these to create intersecting Venn diagrams, recognising the four areas, and also Carroll diagrams.



Other considerations

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Using maths skills in science

Year 1

Plants	Animals, including humans	Everyday materials	Seasonal changes

Link to maths curriculum	Science topic	Science activity
Measurement		
Compare lengths and heights, using the vocabulary, long/short, longer/shorter, tall/short, double/half, specified in the maths curriculum		Comparing the height of plants
		Comparing parts of the human body (e.g. hand span)
		Comparing how much different materials stretch
Compare mass/weight, using the vocabulary heavy/light, heavier than, lighter than, specified in the maths curriculum		Comparing objects
		Comparing the mass of bulbs
Compare time, using the vocabulary earlier and later, specified in the maths curriculum		Comparing how early or late it gets dark during different seasons
Measure lengths and heights, using non-standard discrete units, (for example, counting multilink cubes) and then manageable common standard units		Measuring the length of leaves
		Measuring parts of the human body (e.g. hand length, foot length, leg length)
Measure capacity, using the vocabulary full/empty, more than, less than, half, half full, quarter, specified in the maths curriculum		Measuring the rain caught in a rain gauge every day/week

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Sequence events in chronological order, using language before and after, next and first		Describing the changing plants in a flower bed through the year
Recognise and use language relating to the months of the year		• Drawing on knowledge about the order of the months in the year to name the months in each season • Recording weather measurements during a month
Tell the time to the hour and half past the hour and draw the hands on a clock face to show these times		Telling the time it gets light or dark at different times during the year

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Year 2

Living things and their habitats	Plants	Animals, including humans	Uses of everyday materials

Link to maths curriculum	Science topic	Science activity
Measurement		
Compare and order lengths	Animals, including humans	Comparing the average height of humans at different ages
Compare and order mass	Animals, including humans	Comparing the weight of a baby at different ages
Choose and use appropriate standard units to estimate and measure length/height in any direction (m/cm); to the nearest appropriate unit, using rulers	Plants	• Measuring the height of plants grown from bulbs and seeds over a period of time • Measuring the space between seeds and bulbs required when planting
	Uses of everyday materials	Measuring how much different materials stretch
Choose and use appropriate standard units to estimate and measure mass (kg/g) to the nearest appropriate unit, using scales	Plants	• Measuring the weight of a range of bulbs when exploring if heavier bulbs grow into bigger plants • Measuring the weight of a potato and the weight of the crop of potatoes it produces
Choose and use appropriate standard units to estimate and measure temperature (°C) to the nearest appropriate unit, using thermometers	Plants	Measuring and comparing the temperature in the shade, full sun and in a greenhouse
Choose and use appropriate standard units to estimate and measure (litres/ml) to the nearest appropriate unit, using measuring vessels	Plants	Talking about the amount of water given to plants to keep them healthy (e.g. one watering can, one and a half watering cans)
	Uses of everyday materials	Measuring out a specific volume of water when testing materials for absorbency
Statistics		
Interpret and construct simple pictograms	Living things and their habitats	Presenting the number of different minibeasts found in a micro-habitat (repeated over the year)

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Interpret and construct tally charts		Recording the number of different minibeasts found in a micro-habitat (repeated over the year)
Interpret and construct block diagrams		Presenting the number of different minibeasts found in a micro-habitat (repeated over the year)
Interpret and construct simple tables		Recording the classification of objects as living, dead and never been alive
		Recording the observations or measurements of a plant over time
		Recording observations made when carrying out different types of exercise
		Recording data from classification and comparative tests, such as waterproofness, absorbency, flexibility, transparency

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Year 3

Plants	Animals, including humans	Rocks	Light	Forces and magnets

Link to maths curriculum	Science topic	Science activity
Measurement		
Measure, compare, add and subtract: lengths (m/cm/mm)		• Measuring body parts and linking this to the length of bones • Taking measurements to gather data to answer questions such as 'Can people with longer legs jump higher?'
		• Measuring the size of shadows
		• Measuring the distance a ball or car moves on different surfaces • Measuring the distance over which different magnets attract a paperclip • Measuring the distance a paperclip is attracted by a magnet on different surfaces
Measure, compare, add and subtract: mass (kg/g)		Measuring and comparing the mass of rocks before and after soaking in water
Measure, compare, add and subtract: volume/capacity (l/ml)		Measuring out the correct amount of water to give plants when investigating how the amount of water affects how plants grow
		Measuring and comparing the amount of water different types of soil can hold
Compare durations of events [for example to calculate the time taken by particular events or tasks]		Measuring how long it takes for water to flow through different types of soil
		Measuring the amount of time a spinning top spins on different surfaces

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Statistics		
Interpret and present data using bar charts		Presenting the amount of nutrients in different foods
		• Presenting data gathered when exploring the amount of water different types of soil can hold • Presenting data gathered when exploring how long it takes for water to flow through different types of soil
		• Presenting data gathered using a light meter about the amount of light reflected from different materials and using this to make predictions for new values
		• Presenting data gathered when exploring the amount of time a spinning-top spins on different surfaces and using this to make predictions for new values • Presenting data gathered when exploring the distance a ball or car moves on different surfaces and using this to make predictions for new values • Presenting data gathered when exploring the distance over which different magnets attract a paperclip • Presenting data gathered when exploring the distance a paperclip is attracted by a magnet on different surfaces and using this to make predictions for new values

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Year 4

Living things and their habitats	Animals, including humans	States of matter	Sound	Electricity

Link to maths curriculum	Science topic	Science activity
Measurement		
Find the area of rectilinear shapes by counting squares		Finding the surface area of containers when exploring the rate of evaporation and using this to make predictions for new values
Statistics		
Interpret and present discrete and continuous data using bar charts		Presenting data gathered when exploring the melting point of different solids
		Presenting data gathered when exploring the maximum volume of musical instruments and using this to make predictions for new values
Interpret and present continuous data using time graphs		Presenting data gathered when exploring the circumference of an ice block over a period of time and using this to make predictions for new values
		Interpreting data gathered using a datalogger of the volume of sound in a classroom over 24 hours
Number		
Count backwards through zero to include negative numbers		Researching the temperatures that different materials change state (e.g. freezing points of materials that are solid at room temperatures)

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Year 5

Living things and their habitats	Animals, including humans	Properties and changes of materials	Earth and space	Forces

Link to maths curriculum	Science topic	Science activity
Measurement		
Calculate and compare the area of rectangles (including squares), and including using standard units, square centimetres (cm^2)		Finding the area of rectangular canopies when exploring the time it takes parachutes to fall to the ground
Statistics		
Solve comparison, sum and difference problems using information presented in a line graph		Interpreting data showing how the temperature of water cools when in containers wrapped in different materials
		Interpreting data showing how the area of a parachute canopy affects the time it takes to fall
		Interpreting data showing weight or length of babies at different ages (time graph but involves the same skills)
Complete, read and interpret information in tables, including timetables		Constructing tables to record a range of data about the life cycles of animals from the same vertebrate group
		Extending a table to record repeat readings when exploring air resistance and water resistance
		Extending a table to compare the temperature of water cooling when in containers wrapped in different materials
Number		
Round decimals with two decimal places to the nearest whole number and to one decimal place		Rounding the numbers on a stopwatch that measures in tenths and hundredths of a second to the nearest second when exploring water resistance and air resistance
		Rounding the numbers on a stopwatch that measures in tenths and hundredths of a second to the nearest second when dissolving

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Read, write, order and compare numbers with up to three decimal places		Comparing the measurements taken using Newton meters when exploring the amount of friction
Read, write, order and compare numbers to at least 1 000 000 and determine the value of each digit		Comparing the diameter of the Earth, Sun and Moon

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Year 6

Living things and their habitats	Animals, including humans	Evolution and inheritance	Light	Electricity

Link to maths curriculum	Science topic	Science activity
Statistics		
Interpret and construct pie charts and line graphs		Presenting data gathered when exploring how pulse rate changes during and after exercise
		Presenting data gathered when exploring how the size of a shadow can be varied to make predictions
Calculate and interpret the mean as an average		Measuring average resting pulse rate

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