Assessing the Cross-Curricular Skills

Expansion of the Levels of Progression in Using Mathematics across the Curriculum: Key Stage 3 (Levels 1–7)

(Non-statutory guidance)

Contents

Purpose of this Document

The following guidance is intended to support teachers when:

- planning and designing assessment opportunities;
- observing pupil performance; and
- making summative judgements.

The guidance gives more detailed support to explain aspects of performance at each level within each requirement for Using Mathematics. It also includes examples of how pupils can use aspects of the 'Knowledge and Understanding' at each level to demonstrate their Using Mathematics skills.
These examples are only illustrations and are not designed to be a prescriptive or exhaustive list.

The guidance does not specify performance at each level in the requirements 'develop financial capability' and 'use ICT to solve problems and/or present their work'.

Progression in financial capability is demonstrated within the 'Knowledge and Understanding'. It can be found mainly within the 'Number and Algebra' strand.

As pupils progress through the levels, the contexts within which they demonstrate their financial capability should increase in complexity and require a higher level of independence and problem-solving ability.

Opportunities exist for pupils to integrate and demonstrate their Using ICT skills within mathematical situations.

Expansion of the Levels of Progression – Level 1

Requirements for Using Mathematics Across the curriculum, at a level appropriate to their ability, pupils should be enabled to:	Level 1 In structured activities, in familiar and accessible contexts, pupils can:
• **choose the appropriate materials, equipment and mathematics to use in a particular situation;**	• **talk about and use the materials and equipment provided to carry out an activity;** Pupils can, with teacher direction, use mathematical materials and equipment provided, for example: – *make their own repeated pattern using sets of shapes or beads;* – *sort real objects for one criterion, for example colour, shape or size; and* – *use balance scales to find which object is heavier.*
• **use mathematical knowledge and concepts accurately;**	• **use some mathematical notation;** Pupils can: – *match numerals to sets up to 10, including 0 to the empty set; and* – *record their work using numerals or words to 10.*
• **work systematically and check their work;**	• **show some organisation in their practical work;** Pupils can organise practical work, for example: – *arrange objects into organised groupings; and* – *match objects to find which group has more/fewer.*
• **use mathematics to solve problems and make decisions;**	• **talk about ways to solve simple everyday problems;** In response to questions, pupils can talk about how an activity might be approached, for example: – *suggest that they use a balance scale to compare the weights of two objects;* – *talk about different ways they could sort a group of objects, for example by colour, size and texture; and* – *suggest how to find out if there is enough cutlery for four people.*
• **develop methods and strategies, including mental mathematics;**	• **use counting strategies when carrying out activities;** Pupils can use teacher prompts in practical and mental mathematics activities, for example: – *to count on/count back from different starting points, for example count forwards/backwards from 7;* – *to order numbers within 10, for example know that 6 comes between 5 and 7; and* – *add and subtract within 10, for example count on when adding 5 and 4*
• **explore ideas, make and test predictions and think creatively;**	• **look for and talk about patterns;** Through discussion with the teacher, pupils are aware of and can talk about patterns; pupils are prompted to say what comes next and why, for example: – *talk about patterns in their environment, for example bricks, leaves and floor tiles;* – *copy/continue/create a pattern, for example put out a blue cube, red cube, blue cube and continue the pattern; and* – *explore patterns in number, for example set out objects in twos.*
• **identify and collect information;**	• **talk about and collect information required;** Pupils can collect identified information. They can interpret the information in response to prompts, for example: – *work as a class to collect information, for example colour of hair, favourite food; and* – *answer questions about information, for example "Do more children take school dinners than packed lunch?"*
• **read, interpret, organise and present information in mathematical formats;**	• **represent their work using pictures and objects;** Pupils can represent identified information in practical activities. They represent their work in 3-D form (blocks, objects) or 2-D form (using stickers or drawings), for example: – *use drawings or pictures to represent and sequence events and special times; and* – *make a variety of sets for a given number using a range of materials, for example make sets of 8 using large/small objects and know they are equal sets.*
• **use mathematical understanding and language to ask and answer questions, talk about and discuss ideas and explain ways of working;**	• **use appropriate mathematical language to respond to questions about their work;** Pupils can use everyday language, relevant to the mathematical activity, to respond to questions and talk about their work, for example: – *"How have you sorted your shapes?" "I put this shape here because it looks the same as the others but it is bigger."; and* – *in practical situations, talk about what they are doing or have done using language such as 'bigger than', 'altogether', 'more', 'forwards' and 'empty'.*

Using Mathematics – Level 1

	Level 1
using their **Knowledge and Understanding** of:	In structured activities, in familiar and accessible contexts, pupils can:
Number and Algebra	**Pupils can:** • **use, estimate, add and subtract numbers up to at least 10;** *for example state if they think a set contains more than 5 or fewer than 5, add and subtract numbers practically and use appropriate language to record the results;* • **understand conservation of number;** *for example know that a set contains the same number without having to recount, even if the objects have been rearranged; recognise that zero represents the empty set;* • **create and describe repeating patterns using objects, numbers or pictures;** *for example red bead, blue bead, yellow bead, red bead, blue bead, ...; 1, 2, 3, 1, 2, ... and red square, blue triangle, red square, ...;* • **recognise and use coins;** *for example engage in role play, showing recognition of coins and an understanding of the concept of exchanging goods for money.*
Shape, Space and Measures	**Pupils can:** • **use everyday language associated with length, 'weight', capacity and area to describe, compare and order three objects;** *for example is the longest, weighs the same as, holds less than;* • **sequence familiar events;** *for example wake up, wash and dress, eat breakfast;* • **know the days of the week and their sequence;** *for example know that Sunday comes after Saturday and before Monday;* • **recognise 'special' times on the clock;** *for example recognise break time and lunch time on the clock;* • **sort 2-D and 3-D shapes and make and describe 2-D and 3-D constructions;** *for example sort for one criterion, such as red and not red, and give reasons for sorting; and talk about the shapes used to make a picture of a clown that has a triangle for the hat, circle for the face and rectangle for the body;* • **use language and follow instructions, in practical situations, for position and movement;** *for example under, over, inside, outside, beside, backwards, forwards and whole turn.*
Handling Data	**Pupils can:** • **sort and classify real objects for one criterion and re-sort for a different criterion, using Venn, Carroll and Tree diagrams;** *for example sort a collection of farm animals by type and then re-sort by colour, and sort animals with two legs/not two legs;* • **collect information and record using real objects or drawings;** *for example use a photograph or drawing to self-register, and use cubes to record the number of people with blue/brown eyes.*

Expansion of the Levels of Progression – Level 2

Requirements for Using Mathematics Across the curriculum, at a level appropriate to their ability, pupils should be enabled to:	Level 2 In structured activities, in familiar and accessible contexts, pupils can:
• **choose the appropriate materials, equipment and mathematics to use in a particular situation;**	• **talk about how to approach an activity;** Pupils can discuss possible approaches to solve a problem and can begin to respond to questions from the teacher, for example: – *"What information do we need to collect?", "How will we record it?" and* – *"What equipment should we use?", "Is there anything else we could use?"*
	• **select and use the materials, equipment and mathematics required;** Pupils can talk about the information and/or possible approaches that are needed to complete the activity. Given a range of teacher-identified materials/equipment/strategies, they can select which ones to use in a given activity, for example: – *choose counters or number line for a counting activity;* – *select materials for a weighing activity, for example balance scales, marbles and cubes; and* – *choose their own methods to find which set has more objects.*
• **use mathematical knowledge and concepts accurately;**	• **use appropriate mathematical notation;** Pupils can record practical work using symbols such as +, –, =, and →.
• **work systematically and check their work;**	• **organise their practical work and check what they have done;** Pupils can organise and check their work in collaboration with their teacher and peers, for example: – *organise the equipment for the activity;* – *check by repeating the process; and* – *check that all information has been included and does not appear more than once.*
• **use mathematics to solve problems and make decisions;** • **develop methods and strategies, including mental mathematics;**	• **use mental strategies to carry out calculations when solving problems/carrying out activities;** Pupils can choose and use the appropriate number operations and mental strategies to solve problems in a wide variety of contexts, for example: – *count on to give change within £1; and* – *use mental calculation strategies to add and subtract within 20, such as counting on, doubling and adjusting (6 + 7 = 6 + 6 + 1).*
• **explore ideas, make and test predictions and think creatively;**	• **recognise patterns and relationships and make predictions;** Pupils can: – *identify and explore patterns in the 100 square, for example patterns of fives and tens;* – *make predictions, such as 10 more than 27, and check using the 100 square; and* – *explore number sequences, including odd/even.*
• **identify and collect information;**	• **discuss the information required and how it can be collected;** Pupils can collect information relevant to a topic, for example: – *how they get to school and what pets they have;* They can compare and talk about data that represents objects/people, for example: – *in drawings, pictures, block graphs, simple pictograms and simple tables/databases.*
• **read, interpret, organise and present information in mathematical formats;**	• **present the information appropriately and talk about their findings;** Pupils can discuss and decide how they are going to record and present information collected from practical/mental activities, for example: – *use a diagram to represent half or quarter of a pizza;* – *record addition and subtraction horizontally;* – *record weights of objects measured in non-standard units;* – *record information in labelled Venn, Carroll and Tree diagrams; and* – *label items in a shop to show and discuss their price (1p, 10p, £1 etc).*
• **use mathematical understanding and language to ask and answer questions, talk about and discuss ideas and explain ways of working;**	• **use appropriate mathematical language to talk about their work and respond to questions;** Pupils can use mathematical terms to, for example: – *talk about 'weight', length, time and capacity, using 'longest', 'shortest', 'heaviest', 'lightest', 'hold more/less', 'sooner/later', etc;* – *talk about 2-D and 3-D shapes, for example the number of sides/corners; and* – *talk about the days of the week, months and seasons, including sequencing the seasons and months of the year.* Pupils can respond to questions, for example: *"How can we find out about…?", "What can you tell me about 25?", "What should we use to measure/record…?"*

	Level 2
using their **Knowledge and Understanding** of:	In structured activities, in familiar and accessible contexts, pupils can:
Number and Algebra	**Pupils can:** • **read, write and order whole numbers up to at least 100;** *for example identify missing numbers in a sequence;* • **understand that the place of the digit indicates its value;** *for example understand that 57 is 5 tens and 7 units and 75 is 7 tens and 5 units;* • **use quick recall of number facts up to 10;** • **add and subtract within 20 mentally and in written form;** *for example add 5, 1, and 10 mentally by rearranging the numbers, and subtract 7 from 19 using paper and pencil;* • **use addition and subtraction patterns within 20 to explore the relationship between addition and subtraction;** *for example understand that since 6 + 5 = 11, then 11 – 6 = 5;* • **understand that addition is commutative and subtraction is not;** *for example understand that 5 + 3 is the same as 3 + 5 but 5 - 3 is not the same as 3 – 5;* • **add and subtract within 100;** *for example using the 100 square or other structured apparatus, add or subtract two 2-digit numbers without bridging the 10;* • **understand the use of a symbol to stand for an unknown number;** *for example use apparatus to work out 14 = 6 + □* and *2, 4, 6, Δ, 10;* • **understand and use halves and quarters;** *for example using regular shapes and sets of objects;* • **understand relationships between all coins up to £1 and use this knowledge to carry out shopping activities;** *for example during role play activities, compile a shopping list to keep within a specified budget up to £1 and talk about their choices, and find ways in which to spend a specific amount of money up to £1*
Shape, Space and Measures	**Pupils can:** • **identify and use non-standard units to measure length, 'weight', capacity and area;** *for example pencils for length, cubes for 'weight', cups full for capacity and postcards for area;* • **understand the need for standard units and know the most commonly used units in length, 'weight', capacity and time;** *for example understand that not all pencils are the same length, and know metres and centimetres, litres and millilitres, kilograms and grams, and hours and minutes;* • **name and order days of the week, months of the year and seasons;** *for example know the month that comes after March and the day of the week between Tuesday and Thursday;* • **read simple digital and analogue clock displays;** *for example recognise o'clock, half past and quarter past;* • **recognise and name common 2-D and 3-D shapes;** *for example square, circle, triangle, rectangle, cube, cuboid, cylinder and sphere;* • **sort 2-D and 3-D shapes, giving reasons for sorting;** *for example shapes with 3 sides/more than 3 sides and shapes with 4 corners/more than 4 corners;* • **use language and follow instructions, in practical situations, for turning movements;** *for example half turn and quarter turn, and left and right.*
Handling Data	**Pupils can:** • **sort and classify objects for two criteria using Venn, Carroll and Tree diagrams;** *for example sort birds with long beaks/not long beaks and webbed feet/not webbed feet, and sort odd numbers/not odd numbers and numbers greater than 10/less than 10;* • **collect information and record results using simple tables, block graphs, simple pictograms and diagrams;** *for example complete horizontal or vertical block graphs and use Venn, Carroll, or Tree diagrams;* • **discuss and interpret information;** *for example from a simple table, block graph, pictogram or database.*

Expansion of the Levels of Progression – Level 3

Requirements for Using Mathematics Across the curriculum, at a level appropriate to their ability, pupils should be enabled to:	**Level 3** In structured activities, in familiar and accessible contexts, pupils can:
• **choose the appropriate materials, equipment and mathematics to use in a particular situation;**	• **suggest different ways an activity might be approached;** In response to questions, such as "Why are we doing this?", "What do we need for this?", "What are the different ways we could do this?" pupils can for example: – *obtain information from books, through observation, using the internet as an individual/class/group, for example about road accidents/recycling;* – *use a writing frame to begin to plan how to solve the problem;* – *ask questions to solve problems and clarify information;* – *use structured apparatus and smaller numbers; and* – *suggest ways to record/present their findings, such as bar chart, pictogram, tally chart, table and list.*
	• **select and use the appropriate materials, equipment and mathematics required;** Given a range of teacher-identified materials/equipment/strategies, pupils can, for example: – *when measuring choose the most appropriate instrument by understanding its special characteristics (for example ruler, metre stick, trundle wheel, measuring tape, stopwatch, thermometer, measuring jug and measuring scales);* – *choose the correct operation to solve a problem, for example addition, subtraction and multiplication;* – *choose and use accurately the most appropriate method of calculating (practical, mental, pencil and paper and calculator); and* – *use measuring instruments with reasonable accuracy.*
• **use mathematical knowledge and concepts accurately;**	• **use a range of appropriate mathematical notation;** Pupils can record their own work using, for example: – *symbols such as x (multiply);* – *units such as p, £, cm, m, g, kg; and* – *fraction notation such as* $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{4}$.
• **work systematically and check their work;**	• **organise their work and know how to check its accuracy;** Pupils can for example: – *use simple guidelines and procedures, for example a writing frame to structure their work; and* – *set out their work clearly and show their working out.* Through discussion with the teacher and peers, pupils can use strategies to check their work, for example: – *repeat the process;* – *use addition and subtraction as inverse operations for simple calculations;* – *work backwards; and* – *check that information hasn't been omitted or repeated.*
• **use mathematics to solve problems and make decisions;**	• **use mathematics to solve simple two-stage problems;** Pupils can solve problems where a final answer requires the use of an earlier answer, for example: – *use addition, subtraction and multiplication in shopping activities, and calculate the change required after buying a number of items; and* – *find the number of buses required for a particular number of pupils going on a school trip.*
• **develop methods and strategies, including mental mathematics;**	• **use a range of mental calculation strategies;** Pupils can use a range of strategies when solving simple problems, for example: – *count on/back in ones, twos, fives and tens to/from 100;* – *use their knowledge of number facts to 20 and multiplication facts (2, 3, 4, 5 & 10);* – *round and adjust to make the calculation easier, for example when adding 19 + 7, round 19 up to 20, work out 20 + 7, then adjust by taking away 1; and* – *rearrange numbers to make calculations easier, for example when adding, group numbers together that add up to 10, so 14 + 9 + 6 can be seen as 10 + 4 + 6 + 9, which is 10 + 10 + 9, which is 29*

	Level 3 In structured activities, in familiar and accessible contexts, pupils can:
• **explore ideas, make and test predictions and think creatively;**	• **identify and explain patterns and relationships and make predictions;** Pupils can identify and explain patterns and make predictions, for example: – *identify and describe number patterns within the 100 square, for example patterns formed by multiplication tables;* – *explore relationships between addition and subtraction as well as addition and multiplication (such as multiplication as repeated addition);* – *read and interpret calendar patterns, for example if Monday is the 4th, give the dates of all the other Mondays in the month; and* – *make predictions and give reasons, for example predict that most cars passing the school will be silver because most parents' cars are silver.*
• **identify and collect information;**	• **identify, collect and record the information required;** Pupils can, for example: – *find specific information from a range of databases, such as ICT databases, tables and lists; and* – *collect and record by completing given data collection sheets and tally charts/frequency tables.*
• **read, interpret, organise and present information in mathematical formats;**	• **present their findings clearly using a range of appropriate mathematical formats;** Pupils can make suggestions as to how findings might be presented and present them in an appropriate way, for example: – *use a writing frame, make a list and complete a bar chart, table or pictogram;* – *label findings using correct units, for example cm, g, l, kg, hr and min; and* – *enter findings in simple databases/tables.*
	• **explain their findings;** Pupils can explain what they have found out orally and/or in written form, for example: – *answer questions about the information/data recorded in tables, graphs and charts; and* – *draw simple conclusions from tables, graphs and charts, for example too many people eat crisps and not enough eat vegetables.*
• **use mathematical understanding and language to ask and answer questions, talk about and discuss ideas and explain ways of working;**	• **use appropriate mathematical language to discuss and describe their way of working and respond to questions;** With the teacher and peers, pupils can use appropriate language to discuss and describe their way of working, for example: – *how they carried out an activity/solved a problem;* – *why they chose the method used;* – *what they found out;* – *why they chose a particular way to present their findings; and* – *how their findings differ from those of others.* Pupils can respond to questions, for example: – *"How are you going to present your findings?", "What information did you collect, and why?", "How did you check that your work was accurate?"*

Expansion of the Levels of Progression – Level 3

using their **Knowledge and Understanding** of:	**Level 3** In structured activities, in familiar and accessible contexts, pupils can:
Number and Algebra	**Pupils can:** • **understand, use, add and subtract whole numbers up to at least 1000;** *for example use pencil and paper methods to calculate 167 + 230 + 87;* • **understand and use the concept of place value in whole numbers;** *such as the place of the digit indicates its value, zero is a place holder and the digits on the left are of greatest value;* • **use quick recall of number facts up to 20;** • **add and subtract mentally two 2-digit numbers within 100;** *for example without bridging the 10 and using partitioning such as 66 + 23 = 60 + 20 + 6 + 3 = 89;* • **approximate to the nearest 10 or 100;** *for example when estimating the answer to the calculation 58 + 203, they add 60 and 200 to give an estimate of 260;* • **identify and describe simple number patterns within the 100 square;** *for example those linked with multiplication facts;* • **know 2, 3, 4, 5 and 10 multiplication facts;** • **understand that multiplication is commutative;** *for example understand that 3 lots of 4 and 4 lots of 3 are the same;* • **explore and use division in practical situations;** *for example share 26 sweets equally among 5 people and understand that 1 remains, and find how many sets of four there are in 12;* • **understand and use simple fractions in context;** *for example if a bag of sweets has 3 blue and 1 red, then $\frac{3}{4}$ are blue and $\frac{1}{4}$ is red;* • **use number skills in the context of money up to £10;** *for example calculate change from £10 after buying an item at £1.50 and another at £3.00*
Shape, Space and Measures	**Pupils can:** • **choose and use appropriate standard units to estimate, measure and record length, capacity, volume, 'weight', time and temperature;** *for example estimate in metres, using benchmarks such as the height of the door as 2 metres, estimate 'weight' in kilograms and estimate the duration of practical activities (1 min, 2 mins, etc);* • **read simple measuring instruments with an appropriate degree of accuracy;** *for example measure the length of a table to the nearest cm and the volume of liquid to the nearest 100 ml;* • **find the area of shapes by counting whole and half squares;** *for example when finding the area of a shape, count two half squares as one whole square and add to the number of whole squares;* • **read and interpret a calendar;** *for example identify all the Thursdays in the month of January;* • **read digital and analogue clock displays;** *for example read time on the analogue clock in five minute intervals past and to the hour and relate these to digital displays;* • **recognise, name and describe common 2-D and 3-D shapes;** *for example talk about the number of sides, faces, edges and corners of different shapes and recognise and describe shapes including hexagon, pentagon, semi-circle, cone, pyramid and prism;* • **recognise one line of symmetry in common 2-D shapes;** *for example fold a shape to find a line of symmetry;* • **recognise tessellations through practical activities;** *for example tile using shapes such as squares, triangles or parallelograms;* • **recognise right angles in the environment and understand angle as a measure of turn;** *for example use a right angle tester to identify right angles and talk about angles that are bigger than/smaller than a right angle, and use language such as left/right and clockwise/anti-clockwise to describe turns;* • **use grid references in practical situations;** *for example identify a square using two points of reference 'the treasure is in B2'.*

	Level 3
	In structured activities, in familiar and accessible contexts, pupils can:
Handling Data	**Pupils can:** • **collect and record relevant data for a given activity;** *for example complete a given observation sheet or tally chart;* • **draw and label pictograms and bar charts;** *for example complete and label pictograms where the symbol represents more than one object and complete and label bar charts (with axes given);* • **read and interpret information from tables, pictograms, diagrams, lists, bar charts, simple pie charts and databases;** *for example identify the most/least popular food from a simple pie chart and read frequencies from a bar chart.*

Expansion of the Levels of Progression – Level 4

Requirements for Using Mathematics Across the curriculum, at a level appropriate to their ability, pupils should be enabled to:	Level 4 In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:
• **choose the appropriate materials, equipment and mathematics to use in a particular situation;**	• **decide how an activity might be approached and compare their approaches with others;** Through discussion with the teacher/peers, pupils can suggest and compare ways an activity might be approached by, for example: – *simplifying the activity;* – *looking for a pattern; and* – *drawing a diagram;* and can decide on which they consider is the most appropriate.
	• **identify and use appropriately the materials, equipment and mathematics required;** Through discussion with the teacher/peers, pupils can decide on the materials and equipment required to solve the problem/carry out the activity, for example: – *choose the appropriate equipment, method and unit of measurement to measure the perimeter of the playground; and* – *decide how they will collect and present the information.*
• **use mathematical knowledge and concepts accurately;**	• **use a range of appropriate mathematical techniques and notation;** Pupils can carry out their work using appropriate methods, for example: – *use division to find out the number of buses required for a school trip;* – *graphically represent data from a table;* – *record to two decimal places; and* – *label coordinates, use ÷ and % symbols and include units such as cm^2 and m^2.*
• **work systematically and check their work;**	• **organise their own work and work systematically;** Pupils can, through discussion with their peers: – *organise the equipment required;* – *outline the steps to be taken orally or by using bullet points or a writing frame; and* – *work in a logical manner, for example to find all possible combinations.*
	• **review their work and check for accuracy;** Pupils can use estimation to find the approximate solution to a problem. They can review the identified steps taken as they work. They can use their estimation to decide if their answers are reasonable. They can check the accuracy of their work by, for example: – *repeating the calculation;* – *using the relationship between addition and subtraction to identify different methods of calculation; and* – *using a calculator.*
• **use mathematics to solve problems and make decisions;**	• **use a range of problem-solving strategies;** Pupils can choose and use practical, mental, paper and pencil and calculator methods as appropriate. They can discuss and compare ideas and methods with others. They can use a range of problem-solving strategies, persevering when difficulties are encountered by, for example: – *making an organised list;* – *drawing a picture/diagram;* – *finding patterns; and* – *simplifying by using smaller numbers.*
• **develop methods and strategies, including mental mathematics;**	• **use a range of efficient mental calculation strategies;** Pupils can use a range of strategies to estimate answers and find exact solutions, for example: – *rounding numbers to estimate an answer, for example 118 + 463 = 120 + 460 = 580; and* – *adding two 2-digit numbers mentally, bridging the ten, for example 29 + 56 = 30 + 55 = 85 and 36 + 45 = 36 + 40 + 5 = 76 + 4 + 1 = 81*

Using Mathematics – Level 4

	Level 4 In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:
• **explore ideas, make and test predictions and think creatively;**	• **investigate patterns and relationships, using their findings to make predictions;** Pupils can investigate patterns and relationships while carrying out activities. They can describe and explain patterns/relationships, using simple rules expressed in words where possible, for example: – *identify a simple pattern and use this information to predict future answers, such as the number of metre square tiles needed to cover areas (2 × 2, 2 × 3, 2 × 4, ..., 2 × 15);* – *find the rule for a simple number sequence, for example 2, 5, 8, 11, ..., and find the next two terms; and* – *find the area of squares and rectangles by drawing on cm squared paper, leading to the rule length times breadth.*
	• **investigate general statements to see if they are true;** Pupils can discuss a general statement with the teacher/peers and can check whether particular cases match it, for example: – *any even number can be written as the sum of two odd numbers;* – *some numbers can only be divided by themselves and 1; and* – *hot liquid cools more quickly in a plastic cup than a polystyrene cup.*
• **identify and collect information;**	• **find, organise and interpret relevant information;** Pupils can use given resources to find, organise and manipulate a wider range of information, for example: – *interrogate a database in response to a range of questions;* – *use an observation sheet to record data using given class intervals;* – *use a Decision Tree diagram to organise information; and* – *read and interpret information from a range of graphical/pictorial representations.*
• **read, interpret, organise and present information in mathematical formats;**	• **present information clearly;** Pupils can decide on an appropriate method of presentation and present their findings using a range of graphs, tables, diagrams, prose, numbers and symbols (including the use of ICT). They can present their work clearly, for example: – *setting out calculations and showing their working out step-by-step;* – *using appropriate scale/units;* – *drawing shapes/diagrams accurately;* – *labelling diagrams; and* – *using appropriate mathematical language.*
	• **compare methods of presentation;** Pupils can give reasons for their choice of presentation. They can compare their method of presentation with others and discuss which presentation shows the information most clearly, for example: – *compare results given in a table or in a bar chart; and* – *compare results given in a pie chart and a bar chart.*
• **use mathematical understanding and language to ask and answer questions, talk about and discuss ideas and explain ways of working;**	• **use appropriate mathematical language to discuss their work and explain their thinking;** Pupils can discuss their work with others. They can explain their approaches/choices and can compare their thinking with others, for example: – *how to approach a problem/which strategy to use;* – *what equipment is needed;* – *how to present findings;* – *how they checked their work;* – *why they chose to present the results/information in a particular way; and* – *what they found out, drawing relevant conclusions.*

Expansion of the Levels of Progression – Level 4

	Level 4
using their **Knowledge and Understanding** of:	In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:
Number and Algebra	**Pupils can:** • **read, write and order whole numbers within 10 000;** • **use knowledge of place value to multiply and divide whole numbers by 10 and 100;** *for example 30 x 100; 4200 ÷ 10;* • **understand place value to two decimal places;** *for example understand that for the number 0.56, 5 represents five tenths and 6 is six hundredths;* • **approximate within 10 000 to the nearest 10, 100 and 1000;** *for example round 6473 to either 6470, 6500 or 6000 depending on expectations;* • **estimate answers to calculations and approximate by rounding;** *for example estimate the answer to 21 × 19 using 20 × 20, or 327 + 879 using 300 + 900;* • **add, subtract, multiply and divide whole numbers using a range of mental, written and calculator methods;** *for example add and subtract mentally any two 2-digit numbers within 100 (without any apparatus), show working out for multiplying two whole numbers up to 100 and use a calculator to divide a whole number within 10 000 by another whole number within 10 000;* • **add and subtract numbers with up to two decimal places;** *for example add 5.4 m and 1.76 m;* • **use the relationship between addition and subtraction to check calculations;** *for example understand that to find how much money is left from £100 after spending £50 and then £30, it can be worked out by subtracting £50 from £100 and then subtracting a further £30 and checking this by adding £50 and £30 and subtracting the total from £100;* • **know multiplication facts up to 10 × 10 and derive associated division facts;** *for example understand that as 6 × 7 = 42, then 42 ÷ 7 = 6;* • **understand and use multiples and factors;** *for example work out how many different equal teams can be made from a class of 30 pupils;* • **use fractions to describe quantities;** *for example if $\frac{5}{8}$ of a class are girls, what fraction of the class are boys;* • **perform simple calculations involving unitary fractions;** *for example understand that $\frac{1}{5}$ of 20 is 4 ; $\frac{1}{9}$ of 45 is 5 ; $\frac{1}{3} + \frac{1}{3} = \frac{2}{3}$;* • **understand equivalence of fractions;** *for example from pictures/diagrams understand that $\frac{1}{3} = \frac{2}{6} = \frac{4}{12}$;* • **understand and use simple percentages;** *for example understand that 25% of a pizza is the same as a quarter;* • **interpret and apply simple rules expressed in words;** *for example use a function machine where the rule is 'double the previous number and add 1' to generate a sequence;* • **interpret a calculator display when solving money problems;** *for example understand that 5.4 represents £5.40;* • **make choices about spending and value for money;** *for example decide whether it is better value to buy 3 cans of cola or a litre bottle, and consider other factors that need to be taken into consideration when deciding on best value;* • **know different ways in which payments for goods can be made;** *for example understand that goods and services can be paid for with cash, cheques, store cards, credit and debit cards and understand that payments for goods and services can be made electronically, such as, through the internet and by setting up a direct debit or standing order with banks and building societies.*

Level 4

In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:

Shape, Space and Measures	**Pupils can:** • **estimate and measure length, 'weight'/mass and time and temperature, working to an appropriate degree of accuracy;** *for example estimate the width of a room to the nearest metre; measure and record the length of an envelope in millimetres; and measure the temperature of water to the nearest degree Celsius;* • **understand the relationship between metric units;** *for example understand that 1 m 25 cm is the same length as 125 cm;* • **add and subtract common measures;** *for example subtract 1.76 m from 3.3 m;* • **estimate area and volume of shapes by counting squares/cubes;** *for example estimate area by counting more than half a square as a whole square and count rows and columns of cubes that fill/almost fill a container to estimate its volume;* • **work out perimeters of simple shapes;** *for example add the given lengths of a rectangle, square, triangle; and use squared paper to count the distance around a simple shape;* • **understand and use digital and analogue clock displays, using am, pm and 24-hour notation;** *for example 16:20 is the same as 4:20 pm;* • **explore the properties of common 2-D and 3-D shapes;** *for example count edges, faces and vertices of cubes, cuboids, pyramids; and identify regular and irregular shapes by finding shapes that have equal internal angles;* • **explore the relationship between 2-D and 3-D shapes;** *for example open 3-D shapes to find which 2-D shapes they consist of, and recognise nets of common 3-D shapes;* • **recognise and draw lines of symmetry in a variety of 2-D shapes;** *for example draw lines of symmetry on squares, rectangles, equilateral triangles and hexagons;* • **know the eight points of the compass;** *which are North (N), North East (NE), East (E), South East (SE), South (S), South West (SW), West (W), North West (NW);* • **understand and use the language of line, angle and location;** *for example perpendicular, horizontal, vertical; acute, obtuse, reflex angles; and south west of the lighthouse;* • **use coordinates in the first quadrant;** *for example plot and label coordinates such as (3, 4) and (6, 0).*
Handling Data	**Pupils can:** • **collect, group, record and present data with given class intervals;** *for example use the class intervals 1 – 5, 6 – 10, 11 – 15, etc, to record ages of patients waiting in A&E;* • **present and interpret data using a range of graphs, tables, diagrams, spreadsheets and databases;** *for example use bar charts with given class intervals and pictograms where the key contains more than one symbol;* • **understand and use the language of probability;** *for example might, certain, likely, unlikely, could happen, impossible, definitely, definitely not, and fair.*

Expansion of the Levels of Progression – Level 5

Requirements for Using Mathematics Across the curriculum, at a level appropriate to their ability, pupils should be enabled to:	Level 5 In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:
• **choose the appropriate materials, equipment and mathematics to use in a particular situation;**	• **plan and decide how an activity might be approached;** Pupils can identify how they will approach an activity ensuring that any approach is relevant and efficient, for example: – *state what they need to do in order to solve a problem;* – *explain what they intend to do, how they will do it and why; and* – *relate their approach, from start to finish, to the activity.*
	• **identify and use efficiently the materials, equipment, mathematics and strategies required;** In discussion with peers, pupils can select and effectively use, materials and equipment required for their work, for example measuring instruments and graph paper. They can identify appropriate methods/strategies to use, for example: – *breaking activities into smaller steps;* – *working backwards; and* – *using trial and improvement methods.*
• **use mathematical knowledge and concepts accurately;**	• **use a range of appropriate mathematical techniques and notation;** Pupils can: – *express a rule for generating sequences in symbolic form;* – *express a remainder as a fraction, decimal or whole number, as appropriate;* – *convert one metric unit to another, for example calculate the area of a rectangle (2 m x 80 cm) and give the answer in either m^2 or cm^2; and* – *draw a plan of the classroom to scale or calculate the actual measurements from a scale drawing.*
• **work systematically and check their work;**	• **plan and work systematically and efficiently;** Pupils can, following group/class discussion, plan and work systematically by deciding, for example: – *what information they need and how to obtain it;* – *which variables to control;* – *where to begin and how to proceed; and* – *how to present their findings.* They can work efficiently by using the most effective methods for the activity, following identified steps and carrying out calculations/measurements accurately.
	• **review their work, considering if their findings are reasonable and making changes where appropriate;** Pupils can check their work, for example: – *the steps taken;* – *that information is appropriate/sufficient for purpose;* – *that information has been presented in an organised/appropriate way; and* – *if the outcomes are reasonable or are as expected.* They can use a variety of ways to check their results by, for example: – *checking their outcomes against estimations;* – *using multiplication and division as inverse operations; and* – *taking account of the range in which the answer should lie.*
• **use mathematics to solve problems and make decisions;** • **develop methods and strategies, including mental mathematics;**	• **use a range of problem-solving strategies, suggesting and trying out different approaches when difficulties arise;** Pupils can use a range of strategies, drawing on different areas of mathematics and making connections as appropriate, for example: – *review and refine the steps to be taken;* – *try a different strategy to solve the problem/carry out the activity; and* – *identify if any additional information is required.*

Using Mathematics – Level 5

	Level 5
	In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:
• **explore ideas, make and test predictions and think creatively;**	• **make and test predictions;** Pupils can look for patterns and make predictions, for example: – *predict the number of $\frac{1}{2}$ m² tiles needed to cover any size of square by finding and using the pattern; and* – *test their prediction using another square.*
	• **make general statements based on findings and test using new examples;** Pupils can make general statements based on their findings, for example: – *square numbers always have an odd number of factors; and* – *every even number from 8 to 100 can be made by adding together two different prime numbers.*
	• **summarise their findings;** Pupils summarise their findings orally or in written form, for example: – *from a pie chart, rank order the popularity of holiday destinations;* – *from a table, identify the years with the greatest/least rainfall;* – *generate a formula in words or symbolic form; and* – *draw conclusions based on their findings.*
• **identify and collect information;**	• **identify, obtain, process and interpret information appropriate and sufficient for the activity;** Pupils can decide the information required for a particular activity and how to obtain it, for example: – *identify sources for information, such as the internet, books, public records and the census;* – *design and use a data collection sheet to collect information;* – *insert data into a database or spreadsheet and interrogate;* – *decide on appropriate intervals and group the data; and* – *record each measurement three times and calculate the mean.* They can decide if the information gathered is appropriate and sufficient, for example: – *whether enough data has been collected to provide accurate results/valid conclusions; and* – *interpret the information and decide what is relevant.*
• **read, interpret, organise and present information in mathematical formats;**	• **present information accurately and appropriately including the use of mathematical language, symbols and diagrams;** Pupils can decide how to present information/findings, for example using symbols, tables, diagrams, graphs and prose. They can give reasons for their chosen method of presentation and compare them with others. They can record and present information accurately, for example: – *present calculations, showing working out and checking strategies;* – *choose and use appropriate scales, labels and titles; and* – *use graph paper/squared paper to draw line graphs.*
• **use mathematical understanding and language to ask and answer questions, talk about and discuss ideas and explain ways of working;**	• **use appropriate mathematical language to express and communicate ideas accurately;** Pupils can express ideas precisely, orally or in written form, for example: – *use mathematical language to create formulae, for example 'the volume of a cuboid is length times breadth times height';* – *use the language of shape to describe properties of triangles and quadrilaterals, for example angles of a triangle add up to 180°; and* – *use the language of probability to make comparisons, for example more/less likely, 'evens', fifty-fifty, improbable and possible.*

Expansion of the Levels of Progression – Level 5

using their **Knowledge and Understanding** of:	**Level 5** In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:
Number and Algebra	**Pupils can:** • **read, write and order whole numbers of any size;** • **use knowledge of place value to multiply and divide numbers by 10, 100 and 1000;** *for example 0.325 x 1000; 6 ÷100;* • **understand place value to three decimal places;** *for example understand that for the number 0.562, 2 represents two thousandths;* • **round decimals to the nearest whole number;** *for example round 28.37 to 28 or 4216.5 to 4217;* • **multiply and divide numbers with up to two decimal places by a whole number;** *for example work out 16.75 x 14; 1.65 m ÷ 5;* • **check calculations by applying inverse operations;** *for example calculate the total cost of dinners for four weeks and check by dividing the answer by 4;* • **understand and use negative numbers in practical contexts;** *for example know that when the temperature rises from -6° C to -1° C, it has risen by 5° C and understand height above and below sea level;* • **understand and use square, cube and prime numbers;** *for example work out the volume of a cube if its length is 4 cm and recognise that a class of 17 pupils cannot be divided into equal groups;* • **understand the relationship between common fractions, decimals and percentages;** *for example know that 40% = $\frac{2}{5}$ = 0.4;* • **calculate fractions and percentages of quantities, including money;** *for example find $\frac{3}{4}$ of £22.88; 30% of 180; $\frac{1}{3}$ of 10;* • **use understanding of equivalence to add and subtract fractions;** *for example understand that $\frac{1}{4} + \frac{3}{8} = \frac{2}{8} + \frac{3}{8} = \frac{5}{8}$;* • **devise and use rules for generating sequences in words and/or symbolic form;** *for example find the next term in a sequence given the rule "4 × n - 1";* • **express and use formulae in words and/or symbolic form;** *for example find the volume of a cuboid using the formula V = l × b × h;* • **make informed choices about personal budgeting and spending;** *for example plan a week of leisure activities for a family of four with a budget of £500, taking into consideration their collective and varied interests and requirements.*
Shape, Space and Measures	**Pupils can:** • **convert from one metric unit to another;** *for example convert 1245 ml to 1.245 l; 14 mm to 1.4 cm; 1260 g to 1.26 kg;* • **use the four operations to solve problems related to measures;** *for example find how many 120 ml glasses can be filled from a 1 litre bottle of cola;* • **calculate areas of squares, rectangles and right-angled triangles and volumes of cubes and cuboids;** *for example find a way to calculate the area of a right-angled triangle;* • **calculate perimeters of a range of shapes;** *for example regular and irregular shapes with some missing, but attainable measurements;* • **understand and use scale in the context of simple maps and drawings;** *for example calculate the actual distance between two places on a map and draw a plan of the classroom to scale;* • **read and interpret timetables;** *for example plan a journey using public transport;* • **describe the properties of regular and irregular 2-D shapes in terms of sides, angles, symmetry and tessellations;** *for example use properties to classify different types of triangles;* • **reflect 2-D shapes in a line;** *for example use squared paper to reflect shapes and check using a mirror;* • **describe the properties of 3-D shapes in terms of faces, edges and vertices;** *for example describe the properties of a triangular prism;* • **draw nets of 3-D shapes;** *for example use cm squared paper to draw how a 3-D shape will look when opened out flat;* • **estimate, measure, draw and label angles up to 360 degrees;** *for example use a 360° angle measurer to compare angles, and estimate the size of an angle as between 90° and 135°.*

	Level 5
	In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:
Handling Data	**Pupils can:** • **collect, organise, record and represent data;** *for example decide on appropriate class intervals to organise data and represent the data graphically;* • **design and use a data collection sheet;** *for example ask appropriate questions to obtain and record information;* • **construct, label and interpret a range of graphs, tables, diagrams, spreadsheets and databases;** *for example understand when it is appropriate to use a line graph and understand that intermediate values may or may not have a meaning; draw and interpret a dual bar chart; complete and interpret given pie charts with divisions marked;* • **understand, calculate and use mean and range;** *for example find the mean and range of the heights of 20 girls;* • **place events in order of likelihood;** *for example use language such as impossible, unlikely, even chance, likely and certain to order everyday events.*

Expansion of the Levels of Progression – Level 6

Requirements for using Mathematics Across the curriculum, at a level appropriate to their ability, pupils should be enabled to:	Level 6 Through discussion, solving routine and non-routine problems with increasing independence in a wide range of familiar and unfamiliar contexts and situations, pupils can:
• **choose the appropriate materials, equipment and mathematics to use in a particular situation;**	• **plan for an activity by identifying and sequencing component steps;** Given an open-ended activity and/or an activity that involves several stages, pupils can identify the sub-activities/steps required and the order in which they can be completed, for example: – *break the activity down into more manageable steps and identify how these steps are connected; and* – *plan how to bring the simplified steps together to solve the problem/complete the activity.*
	• **consider and identify a range of materials/equipment, mathematical techniques and problem-solving strategies required to meet the purpose of activities;** Pupils can identify the aim of an activity and can discuss a range of materials and strategies from their knowledge/previous experience. They can choose what they consider is most appropriate/efficient for the activity, for example: – *choose the most appropriate materials and equipment needed for a given activity;* – *relate mathematical concepts to a problem, such as denoting terms to unknown values or drawing a shape to scale to find an unknown length; and* – *compare different options and decide on the best one, relevant to the activity.*
• **use mathematical knowledge and concepts accurately;**	• **use a range of appropriate mathematical techniques and notation;** Pupils can successfully choose mathematical techniques that are clearly appropriate for the activity at hand. They use clear and accurate notations and can provide appropriate reasoning behind their chosen techniques, for example: – *prove their results are correct by using formula and graphs to obtain the same answer;* – *solve unknown values of length by sketching shapes and applying algebra; and* – *use notation such as* $a : b$, $x > y$, $m \leq n$, $2(a + b)$, $\sqrt{x}$
• **work systematically and check their work;**	• **work systematically and efficiently to a given degree of accuracy;** Pupils can plan their work by taking into account different steps/strategies when solving a problem while maintaining accuracy and recognising their work is suitably simplified throughout the activity, for example: – *consider different aspects of a problem and how they may be related to each other;* – *appreciate that when combining different units for area that they all must be converted to one common unit;* – *simplify values based on suitable rounding to help make problem-solving more manageable; and* – *draw a table to identify all the possible outcomes from a practical activity.*
	• **review their work, using appropriate checking procedures and evaluating their effectiveness at each stage;** Throughout the activity, pupils can use prediction, estimation and checking procedures to monitor the reasonableness/accuracy of their work. They can monitor the effectiveness of their chosen materials/methods by, for example asking the following: – *Is the answer reasonable?* – *Is this method appropriate?* – *Is this the most efficient method?* – *Can I improve my method?*
• **use mathematics to solve problems and make decisions;** • **develop methods and strategies, including mental mathematics;**	• **adapt their approach as needed;** As a result of ongoing review, pupils can use alternative approaches, for example: – *adapt/amend work already undertaken in light of new information;* – *collect and use more/different information;* – *try an alternative or more efficient method; and* – *question their own results and conclusions by attempting to find examples where their solution doesn't work.*
• **explore ideas, make and test predictions and think creatively;**	• **make and test predictions, make general statements and draw conclusions;** Pupils can make general statements and give a supporting argument based on evidence. They can support their general statements using further examples and present conclusions, for example: – *rewrite a pattern as an expression and then test their expression using known values; and* – *test a hypothesis and comment on their results in relation to the hypothesis.*

Using Mathematics – Level 6

	Level 6
	Through discussion, solving routine and non-routine problems with increasing independence in a wide range of familiar and unfamiliar contexts and situations, pupils can:
• **identify and collect information;**	• **obtain, process and interpret information from a range of sources;** Pupils can understand data/information presented in a range of formats, using both primary and secondary sources. They can use the most appropriate method to gather information, for example: – *design and use a questionnaire;* – *conduct a survey/experiment;* – *combine information from a range of sources to solve problems, for example when booking a holiday; and* – *make comparisons between two sets of data/information, for example to find the correlation.*
• **read, interpret, organise and present information in mathematical formats;**	• **use a range of suitable ways to present findings, following accepted conventions;** Pupils can choose the most appropriate form of presentation for the audience/purpose and give valid reasons for their choice. They follow accepted conventions, for example: – *construct and label axes using appropriate scales;* – *represent discrete or continuous data in frequency diagrams; and* – *use appropriate algebraic form.*
• **use mathematical understanding and language to ask and answer questions, talk about and discuss ideas and explain ways of working;**	• **use appropriate mathematical language/notation to communicate and explain their work for a wider audience;** Pupils can communicate their ideas mathematically, progressing from the use of mathematical vocabulary to the use of algebra. They can discuss, analyse and interpret their findings, for example: – *explain what a graph/diagram indicates in relation to the problem at hand;* – *discuss misleading representations or errors in calculations; and* – *communicate the mathematics of a solution using appropriate language.* They can begin to use algebra to generalise patterns/relationships, for example: – *find the n^{th} term of a linear sequence; and* – *write simple formulae.*

Expansion of the Levels of Progression – Level 6

using their **Knowledge and Understanding** of:	**Level 6** Through discussion, solving routine and non-routine problems with increasing independence in a wide range of familiar and unfamiliar contexts and situations, pupils can:
Number and Algebra	**Pupils can:** • **carry out calculations with whole numbers of any size;** *such as including positive and negative numbers;* • **add, subtract, multiply and divide decimals;** *for example calculate 7.34 + 2.96; 12.6 – 5.8; 1.8 x 2.35; 23.2 ÷ 0.2;* • **round to a given number of decimal places;** *for example round 821.643 to 2 decimal places, and round 0.07093 to 3 decimal places;* • **understand and use order of precedence in numerical calculations, including the use of brackets;** *for example calculate 3^2 + 5(9 – 2) using BIDMAS;* • **understand and calculate square roots;** *for example use trial and improvement or a calculator to find the length of the side of a square which has an area of 32 cm^2;* • **understand, use and calculate ratio and proportion;** *for example solve the problem "Red and yellow paint are mixed in the ratio of 2 : 5 to produce orange paint. How much red and yellow paint is needed to make 1.4 litres of orange paint?"* • **add and subtract fractions, including mixed numbers;** *for example calculate $4\frac{1}{4} + 7$ by finding the common denominator;* • **use equivalences between fractions, decimals and percentages to solve problems;** *for example solve "If 40% of a cereal bar is carbohydrate, how many degrees would represent carbohydrate on a pie chart?";* • **calculate percentage increase and decrease in relevant contexts;** *for example "A cake is reduced from £4.50 to £3.00 in a sale. What is the percentage reduction?"* • **use appropriate formulae;** *for example $A = \frac{1}{2}(a + b)h$; $v = u + at$; $C = \frac{5}{9}(F - 32)$; $A = \pi r^2$;* • **use conventional notation in algebra;** *for example appropriately use terms like c^2, $\sqrt{d}$, 6n and xy, and use symbols such as $\sqrt{}$, >, <, ( );* • **use and interpret graphs from real situations;** *for example use straight line graphs to convert sterling to euro, miles to kilometres, etc., and use and interpret a 'distance - time' graph;* • **apply mathematical concepts to a range of financial situations;** *for example "Karl deposits £2500 into a savings account earning an Annual Percentage Rate (APR) of 2.4%. How much money will he have after one year?"*
Shape, Space and Measures	**Pupils can:** • **use, convert and calculate measures involving metric and, where appropriate, imperial units;** *for example convert kilometres to miles, convert pounds to kilograms, and find the cost of 10 pints of milk when 10 litres costs £15;* • **calculate perimeters and areas of composite shapes involving squares, rectangles and triangles;** *for example partition an irregular 2-D shape to calculate the perimeter and/or area;* • **calculate surface area and composite volumes of cubes and cuboids;** *for example draw the net of a 3-D shape and calculate the area of each 2-D face, and partition an unfamiliar 3-D shape into cuboids to calculate the total volume;* • **calculate the circumference and area of circles;** *such as when given the radius or diameter;* • **work out dimensions using scale;** *for example use a ratio to calculate real life or scaled dimensions, such as a ratio of 1 : 25 000 to work out the length in km of a lake measuring 5 cm on a map;* • **understand and use compound measures;** *for example Speed = Distance ÷ Time, and Density = Mass ÷ Volume;* • **recognise 2-D representations of 3-D shapes;** *for example recognise nets, plans, and front and side elevations of 3-D objects;* • **use coordinates in all four quadrants;** *such as use and plot x and y coordinates that have positive and/or negative values; for example plot the points (-3, 6), (-3, -6), (9, -6), (9, 6) to construct a square.*

Level 6

Through discussion, solving routine and non-routine problems with increasing independence in a wide range of familiar and unfamiliar contexts and situations, pupils can:

Handling Data	**Pupils can:** • **collect and record discrete and continuous data using a variety of methods;** *for example record quantitative data separately, record discrete data in groups using discrete class intervals, and record continuous data in groups using continuous class intervals, such as, $1 \leqslant n < 5$, $5 \leqslant n < 10$, $10 \leqslant n < 15$, etc;* • **construct and interpret a variety of diagrams and graphs for discrete and continuous data;** *for example produce pie charts, stem and leaf diagrams, and scatter diagrams;* • **work out and use the median and mode;** *for example know that the median is the value in the middle of a numerically ordered set of data, while the mode is the most frequently occurring value;* • **work out the mean, median and mode of a frequency distribution;** *for example use a frequency table to calculate the mean for a set of discrete data by using the appropriate method;* • **use one of the measures of average to compare two sets of data;** *for example work out either the mean, mode or median for two sets of data and discuss the average used in relation to the data;* • **understand and use the probability scale from 0 to 1 to express likelihood or comparability;** *for example express the probability of getting a tail when a coin is tossed or the probability of selecting a red ball from a bag containing 3 red balls and 5 blue balls.*

Expansion of the Levels of Progression – Level 7

Requirements for Using Mathematics Across the curriculum, at a level appropriate to their ability, pupils should be enabled to:	Level 7 Through discussion, solving routine and non-routine problems with increasing independence in a wide range of familiar and unfamiliar contexts and situations, pupils can:
• **choose the appropriate materials, equipment and mathematics to use in a particular situation;**	• **plan an activity, explaining their reasons for their chosen structure and approach;** Pupils can plan and outline their approach to an open-ended activity effectively, giving concise reasons for their choice of strategies at each stage, for example: – *decide on the best way of approaching an activity;* – *clearly explain their approach using concise language and relevant examples; and* – *show a clear understanding of relationships and connections.*
	• **consider and identify, with some justification, the materials/equipment, mathematical techniques and problem-solving strategies required;** Pupils can discuss the suitability of a range of materials and strategies, choosing the one that is most appropriate/efficient and justifying this choice, for example: – *fully and clearly relate mathematical concepts to a problem; and* – *explain with reasoning why their method is the most appropriate.*
• **use mathematical knowledge and concepts accurately;**	• **use a range of appropriate mathematical techniques and notation;** Pupils can choose the most appropriate mathematical techniques and justify their reasoning as to why they chose those techniques. They can also use the most appropriate notations with no errors, for example: – *manipulate algebraic expressions, equations and formulae to investigate different variables;* – *use three figure bearings when working out the distance and direction one object is from another; and* – *solve two unknowns using the most appropriate method.*
• **work systematically and check their work;**	• **critically review to what extent they succeeded in carrying out activities, checking if the level of accuracy and their findings are appropriate and making an assessment of any limitations.** Pupils can: – *interpret and evaluate their findings, focusing on their completeness and appropriateness;* – *consider the importance and possible limitations of any conclusions/assumptions made; and* – *discuss and evaluate the effectiveness of the strategies used.*
• **use mathematics to solve problems and make decisions;** • **develop methods and strategies, including mental mathematics;**	• **consider alternative approaches and adapt them as required;** Pupils can use and analyse alternative approaches, giving reasons, for example: – *suggest ways in which the activity could be further explored; and* – *use the handling data cycle to further investigate a hypothesis.*
• **explore ideas, make and test predictions and think creatively;**	• **make and test predictions and attempt to justify their generalisations;** Pupils can use mathematical concepts to explain and justify their generalisations and conclusions. They can explain the difference between a mathematical model and experimental evidence, for example: – *understand that in probability, the relative frequency of getting 'heads' when a coin is tossed becomes closer to its theoretical probability of 0.5 as you increase the number of trials; and* – *fully interpret information provided in a variety of forms (for example algebra, graphs, tables) and cross-reference each to reach a reasonable conclusion.*
• **identify and collect information;**	• **consider, identify, obtain and analyse data/information from more than one source;** Pupils can consider data/information from a range of sources and evaluate its appropriateness, relevance and reliability. They can use a range of (statistical) methods to process, analyse and make comparisons, for example: – *compare the estimated mean and range for two sets of grouped data; and* – *analyse a range of information from different sources to make informed decisions involving money.*
• **read, interpret, organise and present information in mathematical formats;**	• **select and use the most appropriate methods to present findings, following accepted conventions;** Having pursued their own line of enquiry, pupils can choose the most effective/ appropriate method to present their findings to a wider audience. They can evaluate their findings and justify their choice of presentation.

Using Mathematics – Level 7

	Level 7
	Through discussion, solving routine and non-routine problems with increasing independence in a wide range of familiar and unfamiliar contexts and situations, pupils can:
• **use mathematical understanding and language to ask and answer questions, talk about and discuss ideas and explain ways of working;**	• **use appropriate mathematical language/notation to explain and justify their findings or solutions;** Pupils can communicate their ideas and findings mathematically in a consistent and accurate way through the use of vocabulary, symbols, algebra and graphical representations (as appropriate) to justify their conclusions.

Expansion of the Levels of Progression – Level 7

using their **Knowledge and Understanding** of:	**Level 7** Through discussion, solving routine and non-routine problems with increasing independence in a wide range of familiar and unfamiliar contexts and situations, pupils can:
Number and Algebra	**Pupils can:** • **use the advanced functions on a calculator to perform complex calculations;** *for example use the square, square root, cube root, brackets, memory, percentage, π, and inverse functions;* • **round to an appropriate number of decimal places and significant figures;** *for example round 63.128 to two decimal places or two significant figures;* • **use the four operations with fractions;** *for example calculate* $\frac{1}{2} \times \frac{3}{4}$; $\frac{7}{8} \div \frac{2}{3}$; $\frac{7}{9} - \frac{1}{3} + \frac{2}{5}$; • **calculate the original quantity given the result of a percentage change;** *for example solve the problem: "A shirt cost £18.70 after a 15% reduction. What was the original price of the shirt?";* • **calculate repeated proportional change;** *for example calculate compound interest;* • **formulate linear equations;** *for example use patterns and relationships found through an investigation to write a linear equation to represent a relationship and use the equation to calculate other unknown values;* • **manipulate simple algebraic expressions, equations and formulae;** *for example rearrange* $y = mx + c$ *to give* $x = \frac{(y-c)}{m}$, *or* $C = 2\pi r$ *to give* $r = \frac{C}{2\pi}$; • **solve two linear equations simultaneously by a graphical method;** *for example plot two straight lines on a graph and identify the coordinates at which they intersect;* • **make informed decisions involving money;** *for example investigate the factors to be considered when borrowing money: "Peter has just taken out a loan for his first car. He borrowed £4,500 from his local credit union. It is offering a borrowing rate of 5% with the option of paying it back over either 3, 4 or 5 years. What would be best time period for him to choose and why?"*
Shape, Space and Measures	**Pupils can:** • **perform length and area calculations on a composite shape including those involving the circle;** *for example find the perimeter and area of a sector;* • **solve complex problems involving perimeter, surface area and volume;** *for example use knowledge of 2-D and 3-D shapes, perimeter, area and volume to solve unfamiliar problems that require complex operations; and calculate the volume of a cylinder;* • **understand that measurements have an error margin of half the given unit;** *for example understand that a measurement of 12 cm could be as little as 11.5 cm and as much as 12.5 cm; and find the maximum possible area for a table surface in cm², that measures 40 cm by 110 cm to the nearest cm;* • **enlarge a 2-D shape by a given scale factor;** *for example enlarge a rectangle measuring 3 m by 7 m by a scale factor of 2 to produce a new rectangle;* • **use three figure bearings to define direction;** *for example find in degrees the bearing of one town from another, and plot the bearing of one town from another using a given bearing and scale;* • **understand and apply Pythagoras' Theorem;** *for example apply the formula* $a^2 + b^2 = c^2$ *to find the third side of a right-angled triangle when given two sides.*

	Level 7
	Through discussion, solving routine and non-routine problems with increasing independence in a wide range of familiar and unfamiliar contexts and situations, pupils can:
Handling Data	**Pupils can:** • **pursue their own lines of enquiry, using appropriate methods of data collection, and interpret and present their findings;** *for example choose a hypothesis, collect the relevant data, test data using appropriate methods, evaluate results and present work clearly and efficiently;* • **construct and interpret frequency tables and diagrams for sets of continuous data;** *for example draw cumulative frequency tables and graphs to help estimate the median and interquartiles and draw box plots, and draw lines of best fit on scatter diagrams;* • **estimate the mean of a set of grouped data and identify the limits of the median and modal group;** *for example calculate an estimate for the mean using mid-values to represent each class, and comment on the median and modal group(s) from a grouped frequency table;* • **choose the most appropriate average (mean, median, mode) for a given line of enquiry;** *for example use provided data and consider the range and any anomalies to identify which average to use;* • **understand and use relative frequency as an estimate of probability and calculate expected frequency;** *for example understand that when a dice is rolled there is a $\frac{1}{3}$ chance that a multiple of three will come up, and if the dice is rolled 12 times then a multiple of 3 should come up $\frac{1}{3} \times 12 = 4$ times;* • **apply their knowledge of the rules of probability to calculate an outcome or combination of outcomes;** *for example calculate the probability of two events happening at the same time by multiplying the probability of each event together, and calculate the probability of one or the other event happening by adding the probability of each event together.*

Glossary

The guidance booklet "Expansion of the Levels of Progression in Using Mathematics" also contains a 'Glossary of Terms' and accompanying 'Illustrations'.

Glossary of Terms

This provides an explanation of some of the mathematical words and terms used within the guidance.

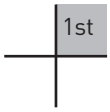
Illustrations

This provides pictorial representations of the mathematics expected at the various levels as detailed in the guidance. The accompanying illustrations are not designed as an exhaustive list, nor as a set of prescribed examples.

They also support definitions that are provided within the ‘Glossary of Terms’.

Glossary of Terms

Algebraic Form	The use of symbols or letters to represent variables combined with the use of values and operations to devise and create an expression, equation or formula.
Anomaly	Any occurrence or object that is out of place, unusual, or unique. It can also mean a discrepancy or deviation from an established rule or trend.
Bar Chart	A frequency diagram using bars of equal width. The heights or lengths of the bars are proportional to the frequency. Bars can be drawn vertically or horizontally and there are gaps between the bars. *(See the Illustrations for an example)*
Block Graph	A bar chart where the bars are divided to mark off each piece of data into blocks that represent unit frequencies or multiples of frequencies. *(See the llustrations for an example*)
Carroll Diagram	A diagram used to sort objects and numbers in a yes/no fashion, based on certain properties. *(See the llustrations for an example*)
Circumference	The distance/perimeter around the edge of a circle.
Class Intervals	The width of a group when numerical data is collected in groups is called the class interval. When grouping data, the class intervals can be either all the same size or they can differ in size depending on the type of data being collected. Class intervals can also be open-ended.
Common Measures	Measurements that are given or recorded using the same units, for example weights given in grams, lengths given in metres, and volume given in litres.
Commutative	Operations like addition and multiplication are commutative because it does not matter in which order you perform the operation, for example $6 + 2 = 2 + 6 = 8$ or $6 \times 2 = 2 \times 6 = 12$
Compound Measures	Measures which should be recorded or given using more than one unit. For example speed recorded as miles per hour (mph), density recorded as grams per cubic centimetre (g/cm^3).
Continuous Class Intervals	The upper and lower limits for which continuous data is recorded. For example $50 < \boldsymbol{t} \leqslant 55$, $55 < \boldsymbol{t} \leqslant 60$, $60 < \boldsymbol{t} \leqslant 65$, etc., where $\boldsymbol{t}$ represents the time taken, in seconds, to run 400 metres.
Continuous Data	Numerical data that can take any value within certain restrictions. Continuous data is used to record quantitative data such as height, weight, time and temperature.
Coordinates	The position of a point on a graph, using x and y axes, is given by its coordinates. They are a set of values that describe an exact position.
Correlation	An assessment of how two separate sets of data appear to be connected to one another and how strong the connection is.
Cube Numbers	If a given number is multiplied by itself and that result is multiplied further by the given number then the answer you get is a cube number. For example 27 is a cube number because $3 \times 3 \times 3 = 27$
Database	A collection of information organised into distinct headings/fields so that it can easily be accessed, managed and interrogated.
Diameter	A straight line which passes through the centre of a circle, effectively cutting it in half. Each end of the line will touch the circumference of the circle.

Discrete Class Intervals	The upper and lower limits for which discrete data is recorded, for example 1 – 5, 6 – 10, 11 – 15, etc.
Discrete Data	Data which can only be of certain definite whole values, for example shoe sizes or number of people with brown hair.
Edge	A straight line formed when two surfaces (faces) of a 3-D shape meet.
Equivalence	When two or more numbers have exactly the same value while taking a different form, for example $\frac{2}{10} = \frac{1}{5} = 0.2 = 20\%$
Estimated Mean from Grouped Data	The mean can only be estimated when data is provided in a grouped frequency table. To calculate the estimated mean, the mid-point of each class interval is multiplied by the frequency for that class interval. A summation of all these values is performed and the total is divided by the sum of the frequencies. *(See the llustrations for an example)*
Estimated Range	The range can only be estimated when data is provided in a grouped frequency table. To find the estimated range, the mid-point of the smallest class interval is subtracted from the mid-point for the largest class interval.
Expected Frequency	A theoretical predicted frequency obtained from an experiment presumed to be true until statistical evidence in the form of a hypothesis test indicates otherwise. For example the probability of getting a four when a die is rolled is $\frac{1}{6}$. The expected frequency of getting a four when a die is rolled 30 times is $\frac{1}{6}$ x 30 = 5 times.
Face	A plane surface enclosed by an edge or edges of a 3-D shape.
Factors	A number that divides exactly into another number, leaving no remainder. For example 4 and 5 are factors of 20 because 20 ÷ 4 = 5
First Quadrant	The x and y axes divide a graph into four separate quadrants. The first quadrant is where all the x and y values are positive, for example 
Four Operations	Operations are rules for processing numbers, expressions and formulae. The four operations referred to here are the basic arithmetic operations, which are addition, subtraction, multiplication and division. Each of these operations also has an associated operator, for example +, –, ×, ÷
Four Quadrants	The x and y axes divide a graph into four separate quadrants. For example  In the first quadrant all the x and y values are positive. In the second quadrant all the x values are negative and all the y values are positive. In the third quadrant all the x values are negative and all the y values are negative. In the fourth quadrant all the x values are positive and all the y values are negative.

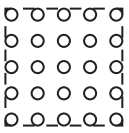
Glossary of Terms

Frequency Diagram	A graphical representation of the amount of data found in each of the categories or types being counted.
Frequency Distribution	The number of observations falling into each of several ranges of values. Frequency distributions are portrayed using frequency diagrams, such as pictograms, bar charts or histograms.
Frequency Table	A table which displays collected qualitative and quantitative data with their corresponding frequencies. Grouped frequency tables are used to record quantitative data (discrete and continuous) in class intervals. *(See the llustrations for an example)*
Function Machine	A diagram which is used to show the order in which operations should be carried out to produce a result, much like a flow diagram. They are used to solve functions and formulae. *(See the llustrations for an example)*
Grid References	Used on maps as a coordinate system. *(See the llustrations for an example)*
Hypothesis	A statement which is considered true and used as a starting point when looking for evidence to support or challenge it.
Interquartile Range	The range between the lower and upper quartiles for a set of data. It is used as a measure of dispersion. For example upper quartile – lower quartile = interquartile range.
Interrogate	To obtain information from a source, for example a database, when given certain criteria.
Irregular Shapes	A shape that is not regular. Not all sides/edges are equal and not all angles are equal. *(See the llustrations for an example)*
Language of Angle	**Acute** angle is greater than 0° and less than 90° **Right** angle is one quarter of a full turn: 90° **Obtuse** angle is greater than 90° and less than 180° **Straight** angle (same as a straight line) is half of one full turn: 180° **Reflex** angle is greater than 180° and less than 360° **Full Turn** is the size of an angle that is made by a line which has moved right around to its starting position: 360°
Language of Line	**Vertical** lines run from up to down and are straight. They are perpendicular to horizontal lines. **Horizontal** lines run from left to right and are straight. They are perpendicular to vertical lines. **Perpendicular** lines are straight lines which meet at right angles. **Parallel** lines remain the same distance apart no matter how far they are extended.
Language of Location	The compass points, relative to north, when dividing a circle into eight equal parts. North (N), South (S), East (E), West (W), North East (NE), South East (SE), South West (SW) and North West (NW).
Likelihood	The possibility/chance of an event happening. It is measured using the terms 'impossible', 'unlikely', 'even chance', 'likely', 'certain'. *(See the llustrations for an example)*
Linear Equations	An equation which can be represented as a straight line. It does not contain a squared term or a term with any power greater than one. For example $y = 5x + 2$, or $y = 1$, or $4y - 3x = 7$

Linear Sequence	A linear sequence increases or decreases in equal steps. For example the sequence 1, 4, 7, 10, ..., increases in equal steps of three.
Line of Symmetry	A line that distinguishes where to fold along a shape so that one half of the shape fits exactly on top of the other half of the shape.
Mean	A measure of central tendancy (average), also known as the arithmetic mean. It is found by adding together all the separate values of data and dividing the total by the number of pieces of data.
Measures of Average	An average is a measure of central tendency: mean, mode, median.
Median	The middle value after the data is arranged in order of size, usually smallest to biggest. If there are two middle values the mean of these two values provides the median.
Median for Grouped Data	The class interval in which the middle value appears when data has been recorded in groups.
Modal Group	The class interval which contains the most pieces of data (greatest frequency) when data has been recorded in groups.
Mode	The data which appears the most often, has the greatest frequency within a set of data.
Multiple	The number made by multiplying two numbers together. For example 16 is a multiple of 2 and 8 because $2 \times 8 = 16$
Nets	An arrangement of connected 2-D shapes, all on one flat surface, which can be folded up to make a 3-D shape. *(See the llustrations for an example)*
Nth term	An expression for a sequence with which you can find any number in the sequence without having to know the previous value. For example the nth term for a sequence is $2n + 3$. Therefore the 50th term is $2 \times 50 + 3 = 103$
Order of Precedence / BIDMAS	An established order in which operations are done. An aid to remember this is BIDMAS: Brackets Indices Division Multiplication Addition Subtraction Although Division is shown before Multiplication, either operation can be done before the other. The same is true for Addition and Subtraction.
Pictogram	A frequency diagram that uses a symbol to represent a number of units of data. The number of units of data the symbol represents will be given in a key and the symbol is usually related to the data. *(See the llustrations for an example)*
Pie Chart	A frequency diagram that uses the sectors of a circle. The angles made at the centre of the circle are in proportion to the frequency. *(See the llustrations for an example)*
Polygon	A 2-D shape with three or more straight sides.
Polyhedron	A 3-D shape with flat faces. Each flat face is a polygon.

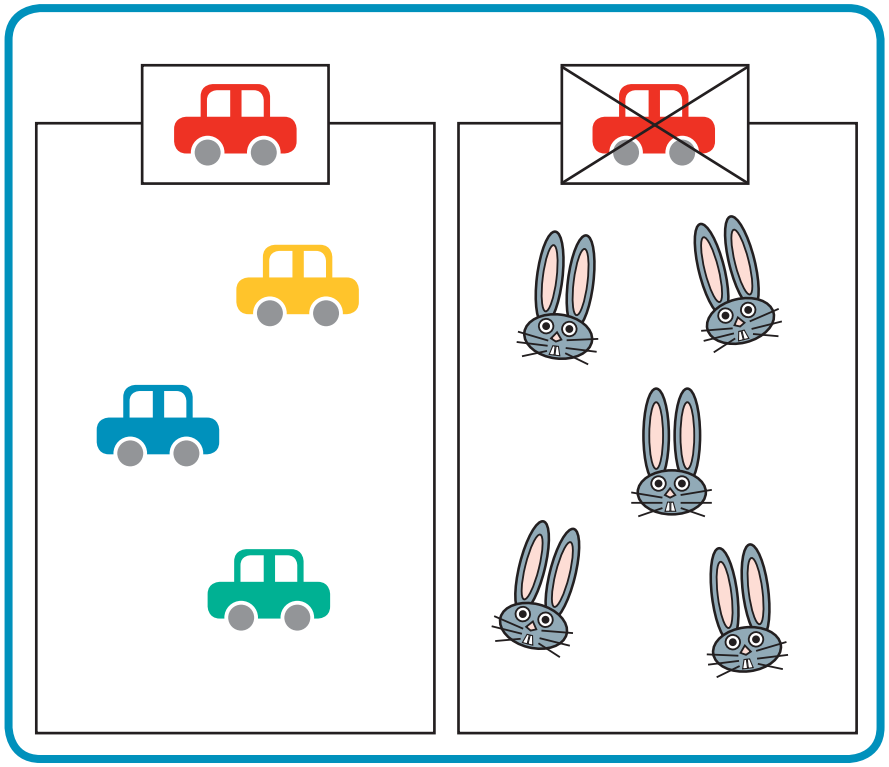
Glossary of Terms

Prime Number	A number with only two factors, itself and one. For example 17 is a prime number because the only factors of 17 are 17 and 1
Prism	A polyhedron with two identical faces, that are parallel to one another and found at each end. Prisms are named after the polygon that makes up the face at each end, for example triangular prism and pentagonal prism.
Properties of Quadrilaterals	2-D shapes that have four straight sides. All four internal angles add up to 360° *(See the llustrations for an example)*
Properties of Triangles	2-D shapes that have three straight sides. All three internal angles add up to 180° *(See the llustrations for an example)*
Proportion	The comparative relationship between elements with respect to size. If two variables are in proportion, then as one variable gets larger the other variable will also get larger and vice versa.
Quartiles	The median is considered to be the middle quartile as it is the 50th percentile for a set of data. The 25th percentile for a set of data is called the lower quartile. The 75th percentile for a set of data is called the upper quartile.
Questionnaire	A collection of questions used to gather information from a group or population.
Radius	A straight line drawn from the centre of a circle to the circumference of the circle.
Range	The difference between the largest value and the smallest value from a set of data. For example the range for the data 6, 2, 9 and 4 is 7 because 9 – 2 = 7
Rank Order	Putting a set of data into ascending or descending order.
Ratio	Used to compare the sizes of two or more quantities. For example to make orange juice you mix 1 part cordial with 20 parts water. It can be said that the ratio of cordial to water is 1:20
Regular Shapes	A shape that has all sides/edges of equal length and all the internal angles are of equal size. *(See the llustrations for an example)*
Relative Frequency	The relative frequency (also known as experimental probability) of an outcome is the value found after an activity has taken place and is given by: $\frac{\text{number of times the outcome occurred}}{\text{number of times the activity was done}}$
Repeated Proportional Change	Increases or decreases an amount by a percentage more than once. Any further change takes account of the previous calculated change, such as compound interest.
Scale	When drawing a map or a diagram, the scale is the representation of 1 cm on the map or diagram to the actual length/height.
Scale Factor	The value by which a shape or object has been, or is to be, enlarged or reduced by. For example a scale factor of 3 will make a shape or object three times bigger. A scale factor of $\frac{1}{3}$ will make a shape or object three times smaller.

Simultaneous Linear Equations	Two or more equations whose unknown variables all take the same value at the same time. As the equations are linear the variables will not have a power greater than one.
Spreadsheets	Computer software that permits calculations and functions using rows and columns. Spreadsheets can be used to work out formulae, perform complex calculations and represent data.
Square Numbers	The number you get when a number is multiplied by itself. For example 25 is a square number because $5 \times 5 = 25$ Square numbers can be represented by generating dots in the shape of a square like so: 
Survey	A method that helps to collect both qualitative and quantitative data in order to gather information and investigate a line of enquiry.
Symbolic Form	Used to represent unknown numbers and variables in such a way that the reader understands what the symbol represents.
Tally Chart	A frequency table where the frequencies are shown as tallies. This is used to record observations when carrying out an activity. *(See the llustrations for an example)*
Tessellations	An arrangement of shapes to make a pattern so that they all fit together while leaving no gaps whatsoever between the shapes and having no overlaps. *(See the llustrations for an example)*
Theoretical Probability	The probability of an outcome which is based on a prediction made by using the following rule: $\frac{\text{number of ways in which the outcome can occur}}{\text{total number of possible outcomes}}$
Three Figure Bearings	Used to describe the direction one point is from another, when traveling in a straight line. The angles of direction are measured in degrees and clockwise from 0° (North) to 359° inclusive. The angles are recorded using three figures so that North East is written as 045° and East as 090° *(See the llustrations for an example*)
Tree Diagram	Used to display all the possible results for an event when several outcomes are combined. The diagram is referred to as a tree, as it has branches showing each possible result based on the combined outcomes. *(See the llustrations for an example)*
Trial and Improvement	The method of looking for a solution by choosing a value to use in a problem and then, based on the outcome of the calculation, choosing a different value to improve the solution until a final solution is obtained.
Variable	A symbol, usually in the form of a letter, that can take on a range of values.
Venn Diagram	A representation of the relationships of sets within a universal set. The universal set is enclosed by a rectangle. Each set is represented by a circle and when there is a union/overlap in the properties of the sets, the circles intersect. *(See the llustrations for an example)*
Vertex	A corner of a 2-D shape where two or more sides meet or a corner of a 3-D shape where three or more edges meet. The plural of vertex is vertices.

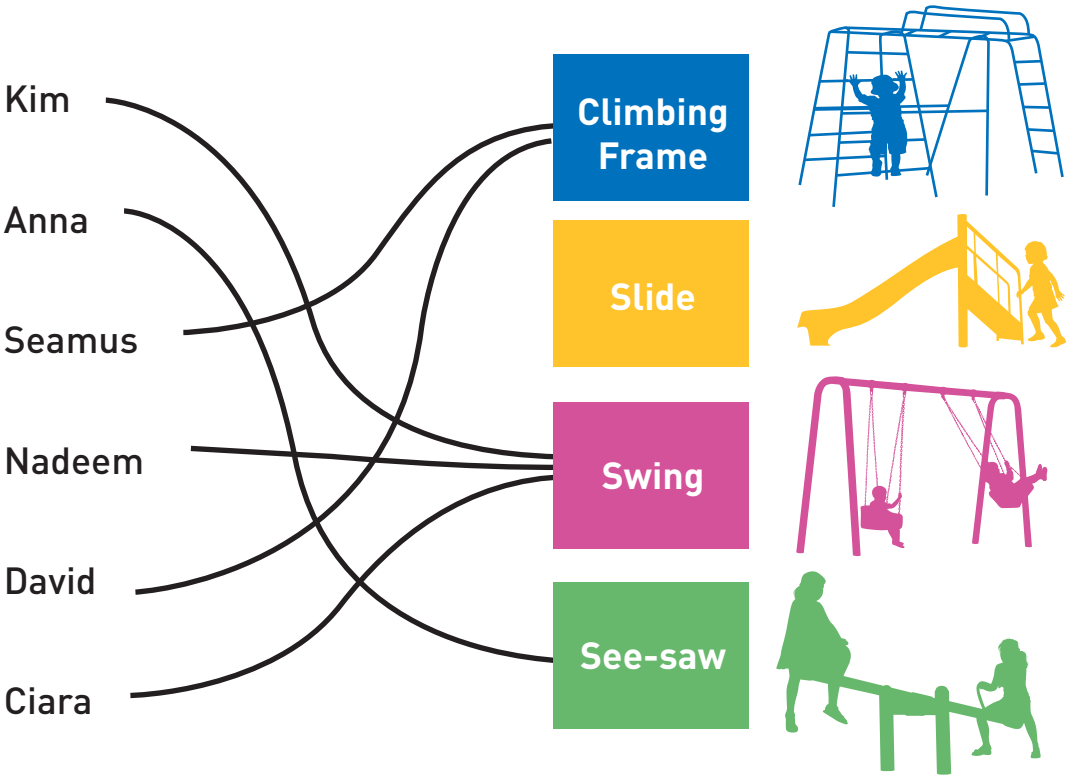
Carroll Diagram

Pupils sort and classify cars and not cars using a Carroll diagram.



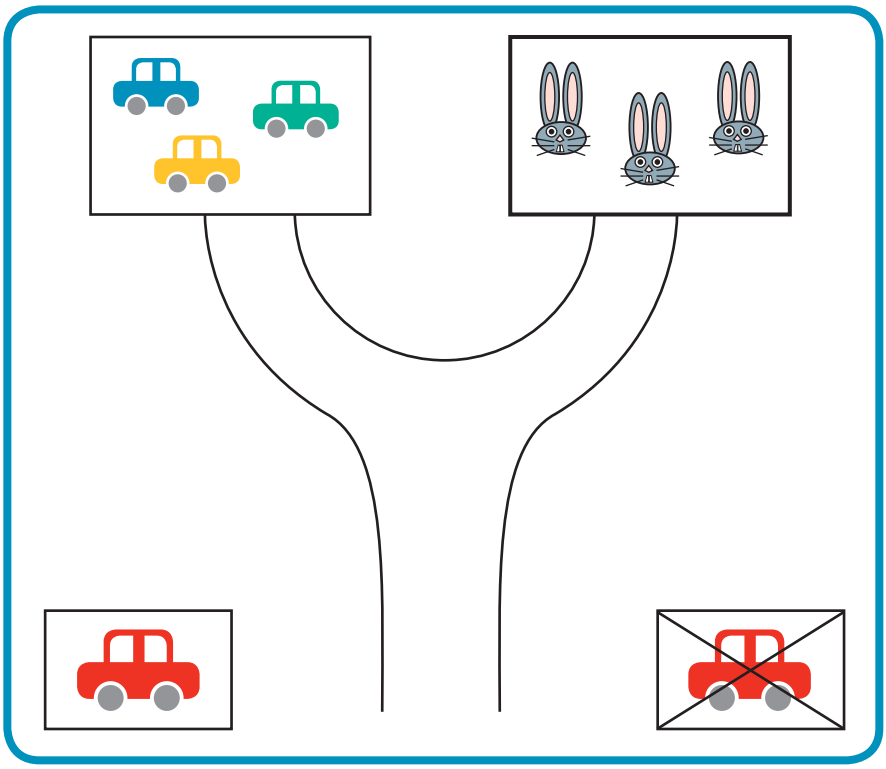
Mapping Diagram

Pupils map their favourite park activity to their name.



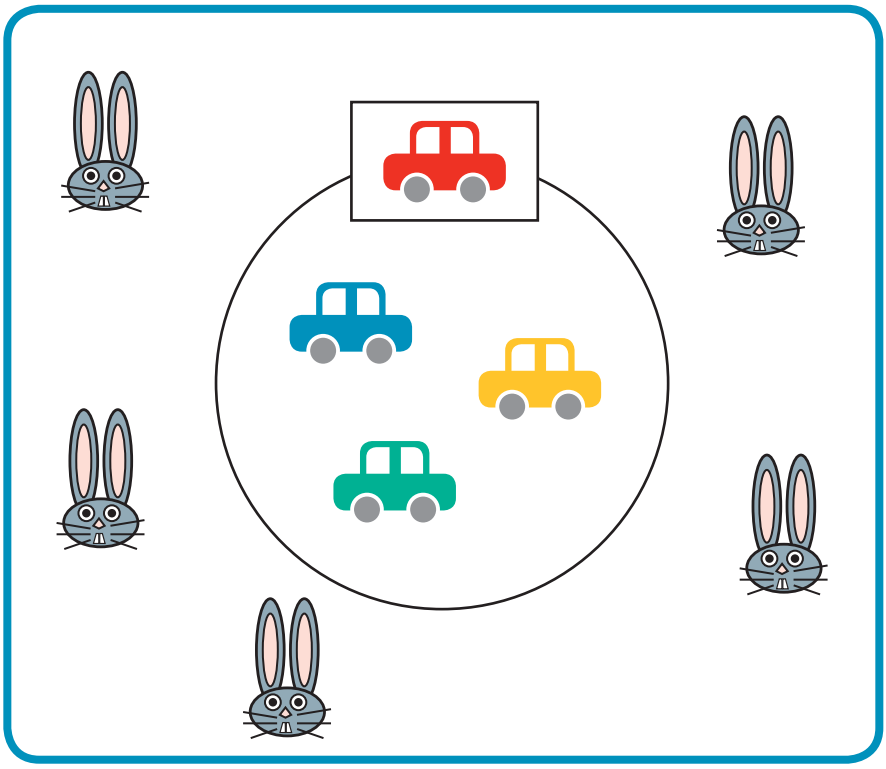
Tree Diagram

Pupils sort and classify cars and not cars using a Tree diagram.



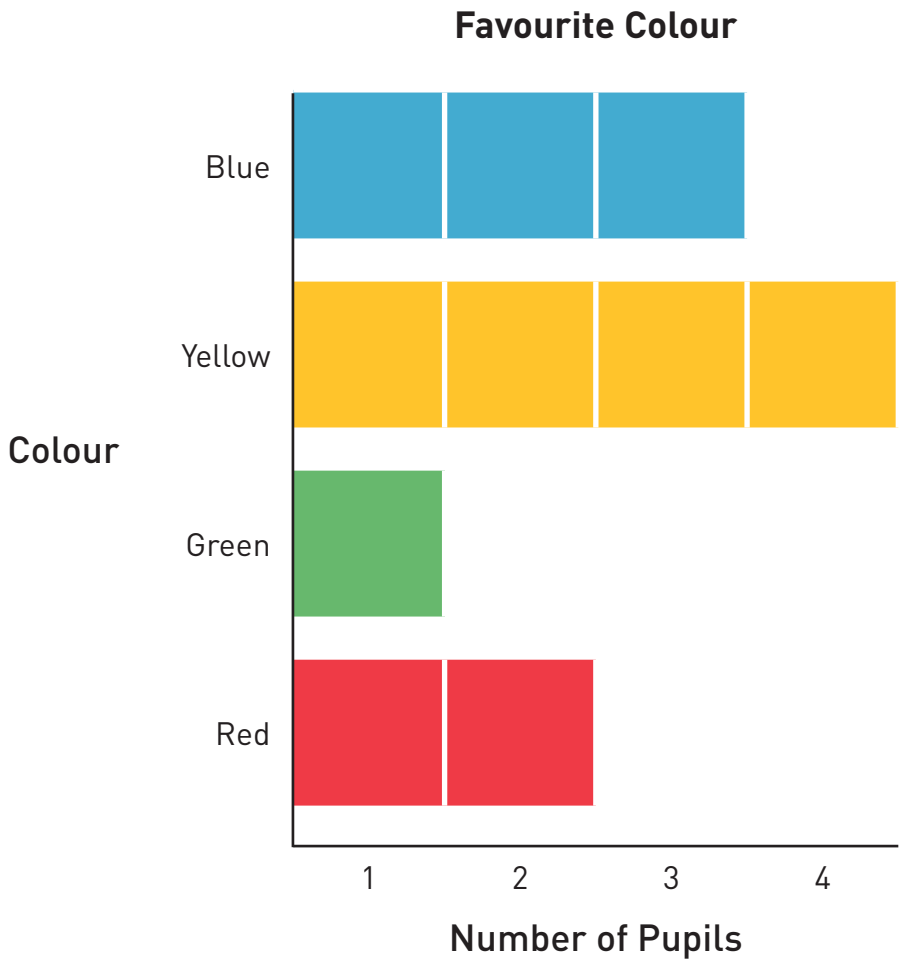
Venn Diagram

Pupils sort and classify cars and not cars using a Venn diagram.



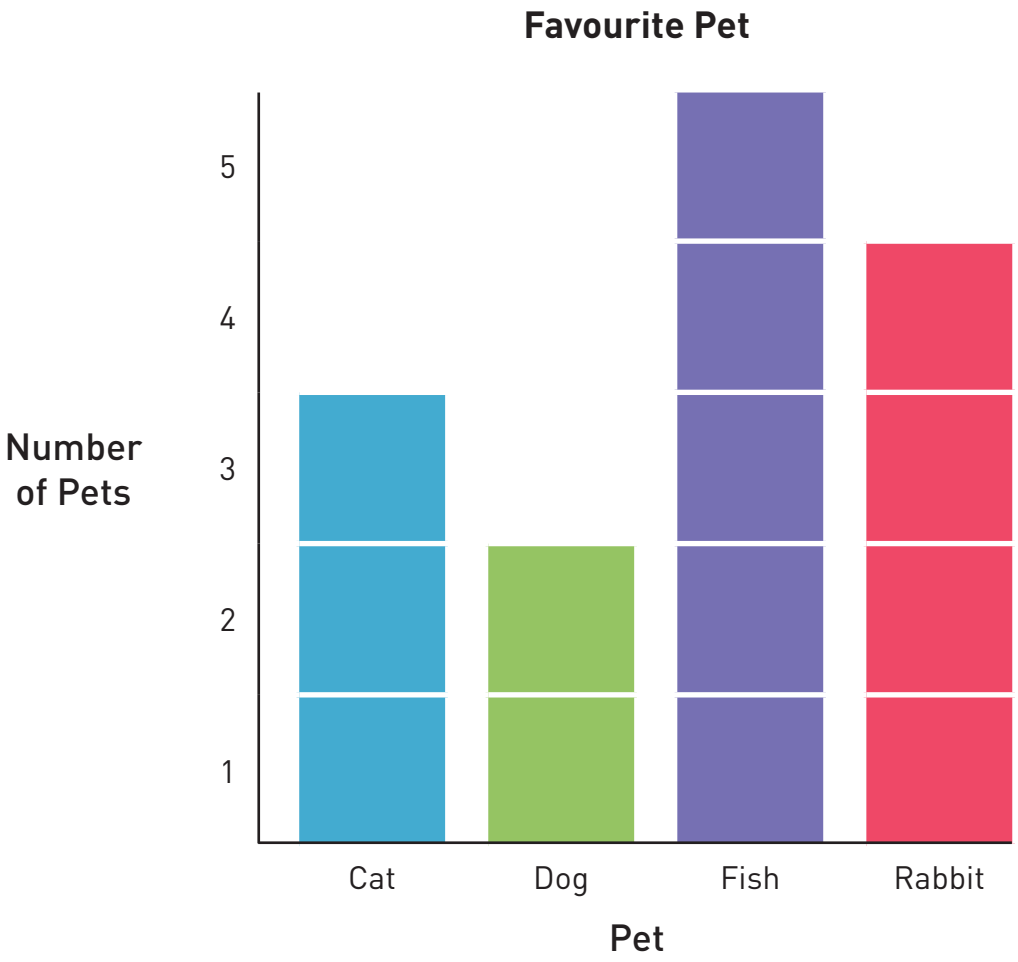
Block Graph

Pupils complete a **horizontal** block graph showing the favourite colour for each pupil in their class.



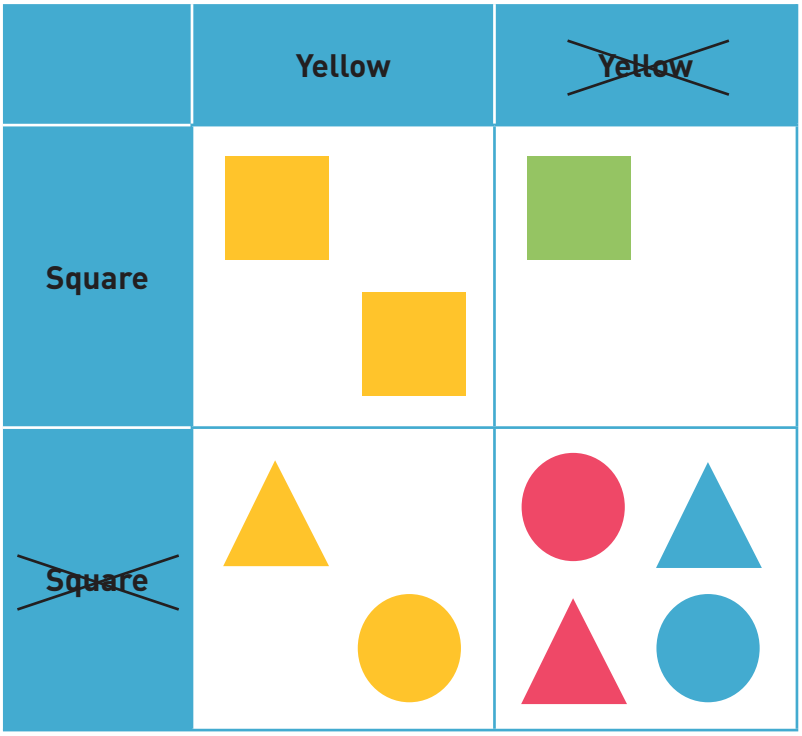
Block Graph

Pupils complete a **vertical** block graph showing the favourite pet for each pupil in their class.



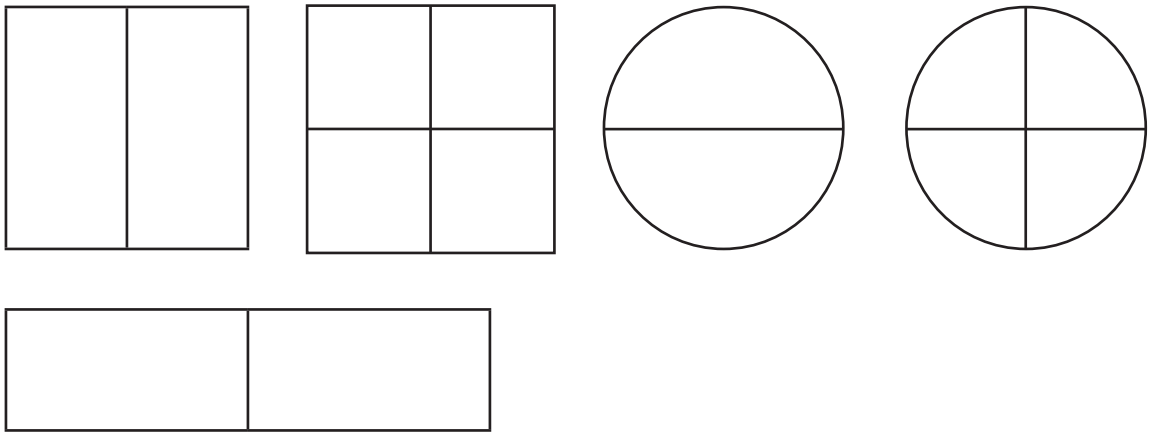
Carroll Diagram

Pupils sort and classify squares and not squares, and yellow and not yellow using a Carroll diagram.

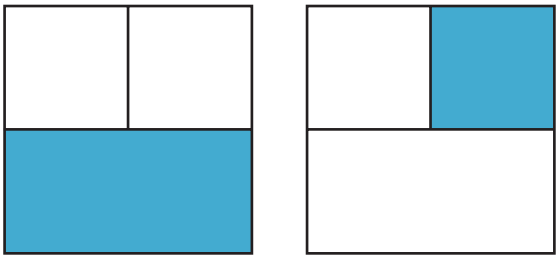


Halves and Quarters

Pupils colour one half or one quarter of a shape.



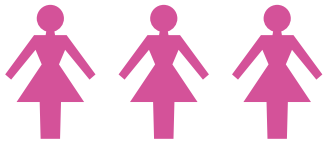
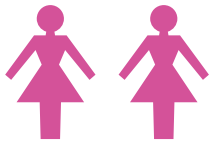
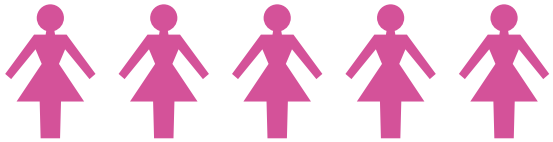
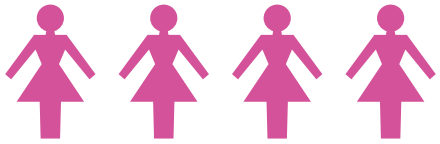
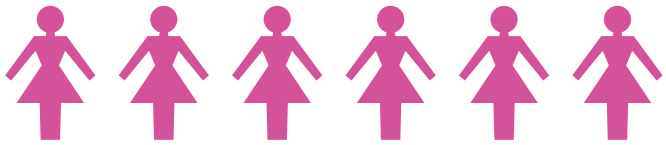
Pupils select a diagram where one half or one quarter of the shape is shaded.



Pictogram

Pupils complete a pictogram with a key, where the symbol represents one object, and discuss information from the pictogram.

Girls Using the Breakfast Club

Day	Number of Girls
Monday	
Tuesday	
Wednesday	
Thursday	
Friday	

Key
 = 1 girl

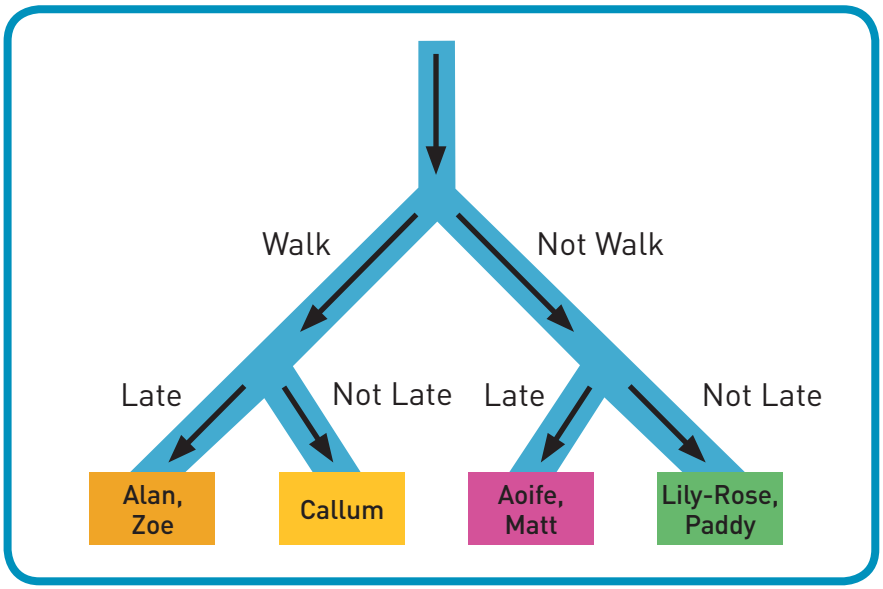
Simple Table

Pupils read information from simple tables.

Team	Number of Pupils
A	
B	
C	

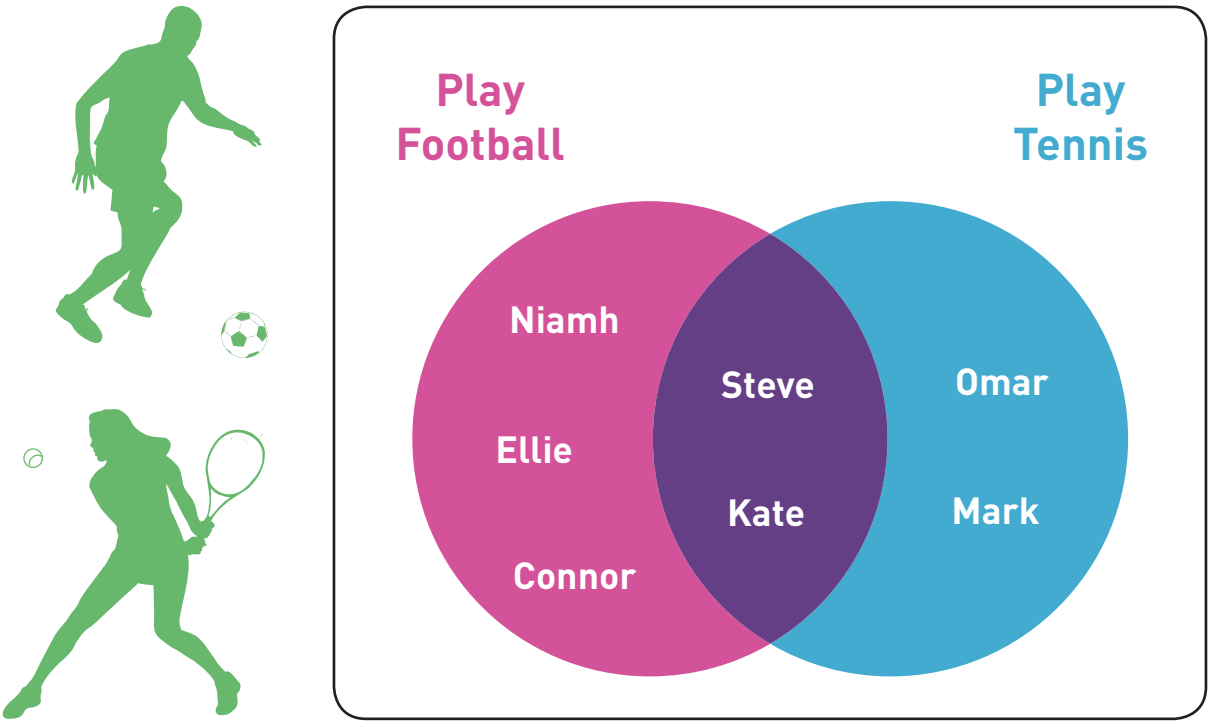
Tree Diagram

Pupils sort and classify children who walk to school or don't walk and who are late or not late using a Tree diagram.



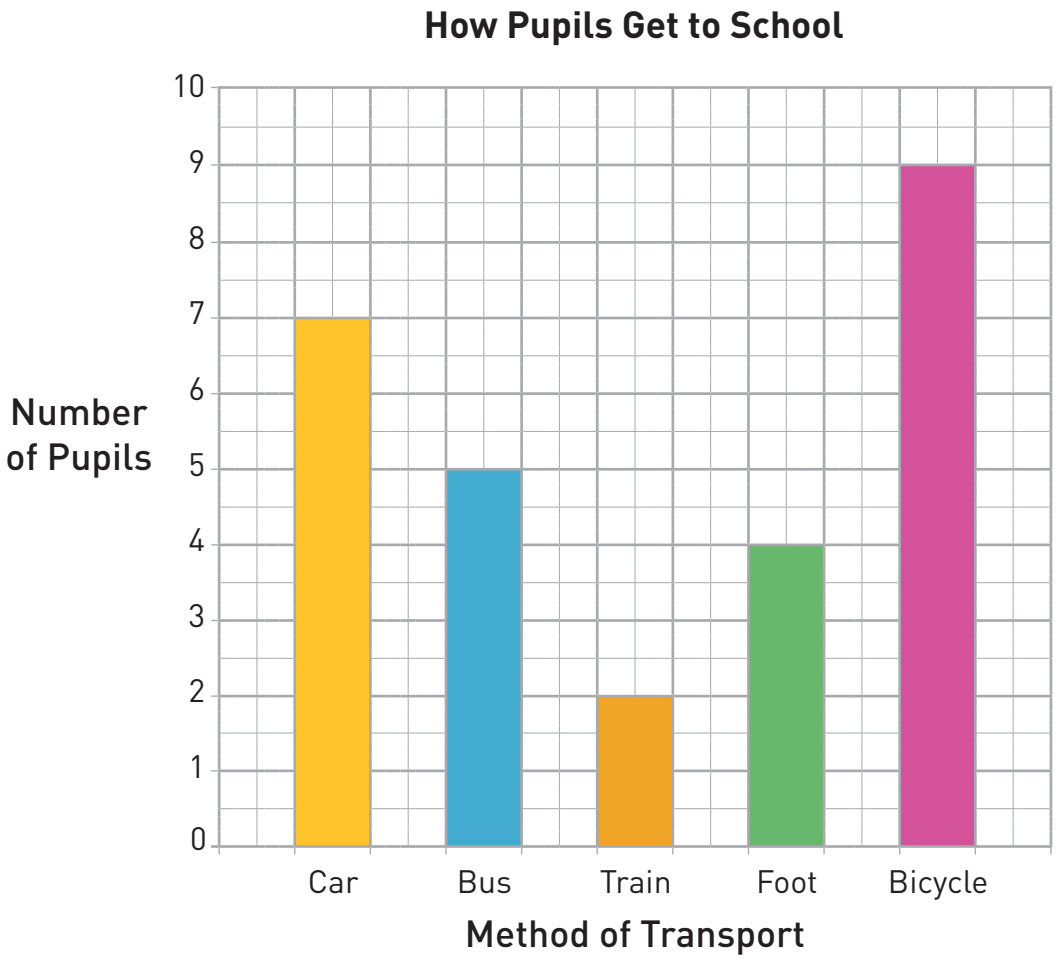
Venn Diagram

Pupils sort and classify for children who play football, play tennis and play football and tennis using a Venn diagram.



Bar Chart

Pupils complete a bar chart, where the axes are given, by labelling the axes and drawing the missing bars.



Data Collection Sheet

Pupils complete simple data collection sheets.
The template and column headings are given.

Month	Temperature (°C)	Rainfall (cm)

Level 3

Frequency Table

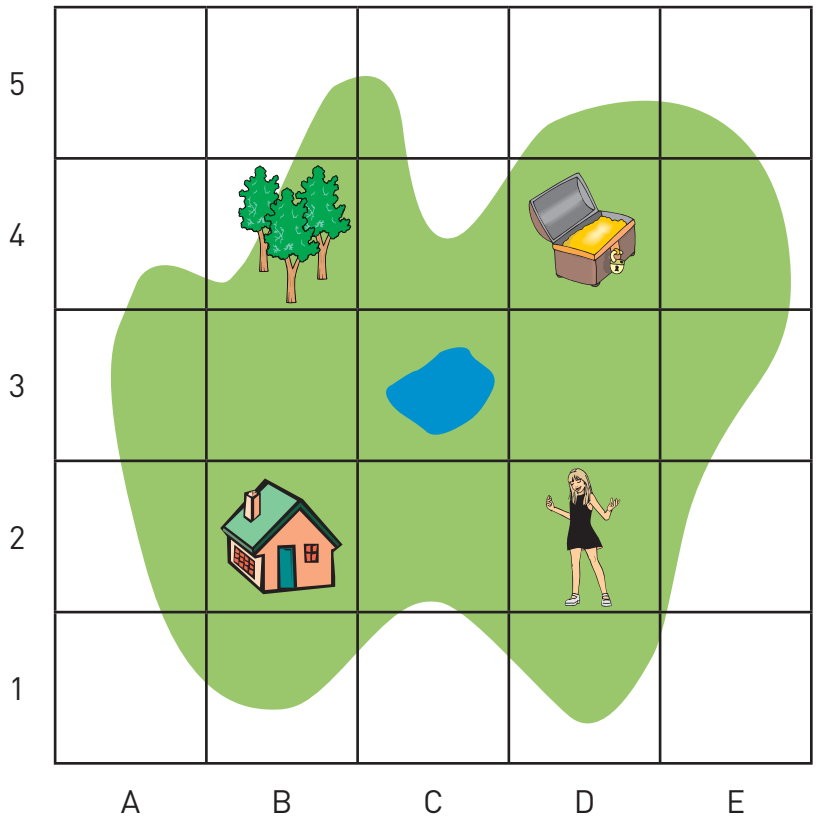
Pupils use a tally chart and complete a further column to show the frequencies.

Column headings are given.

Number of Pets	Tally	Number of Pupils (Frequency)
0	𝍸 𝍸 ||||	14
1	𝍸	5
2	𝍸 |||	8
3	|||	3

Grid Reference

Pupils can locate points of interest on a map using a grid, where the grid is provided and labelled.



Pictogram

Pupils are given an unlabelled pictogram template with a key, where the symbol represents more than one object. They can complete and interpret the pictogram.

What are you afraid of?

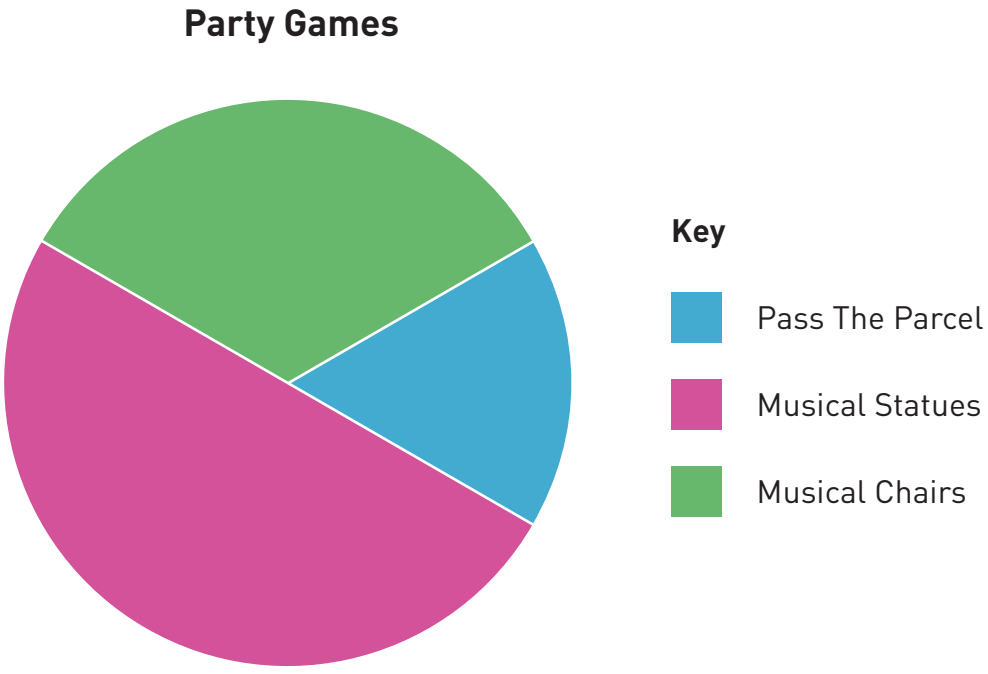
Item	Number of Children
The Dark	☹ ☹ ☹ ☹ ☹
Loud Noises	☹ ☹
Barking Dogs	☹ ☹ ☹ ☹ ☹ ☹ ☹ ☹ ☹ ☹
Clowns	☹ ☹ ☹ ☹ ☹ ☹
Ghost Stories	☹ ☹ ☹ ☹ ☹ ☹ ☹

Key
☹ = 2 children

Pie Chart

Pupils interpret a simple pie chart.

For example pupils say which is the most popular party game.



Level 3

Simple Database / Table

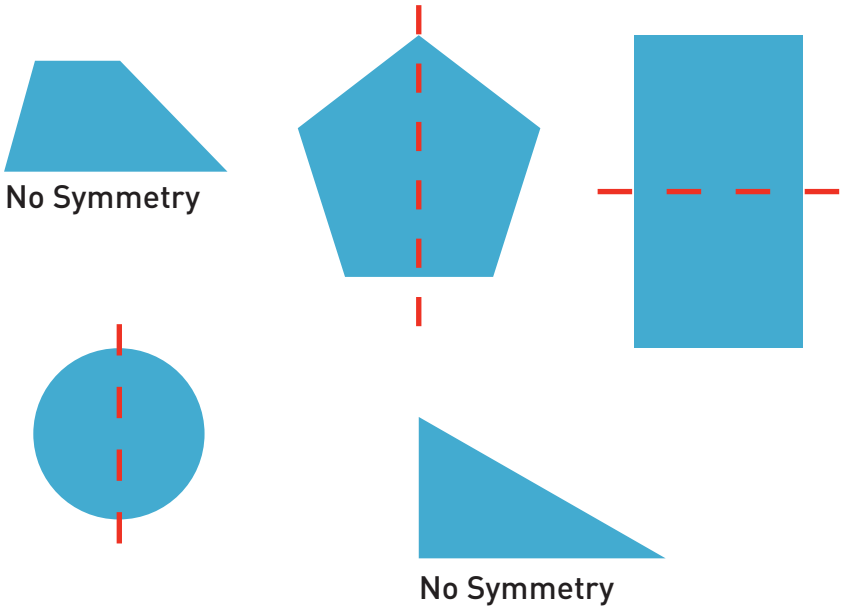
Pupils interpret a simple database/table.

For example pupils list the animals that are mammals.

Animal	Type	Lives
Grizzly Bear	Mammal	North America
Fruit Bat	Mammal	Asia
Green Lizard	Reptile	Europe
Alligator	Reptile	North America

Line of Symmetry

Pupils recognise one line of symmetry on common 2-D shapes.



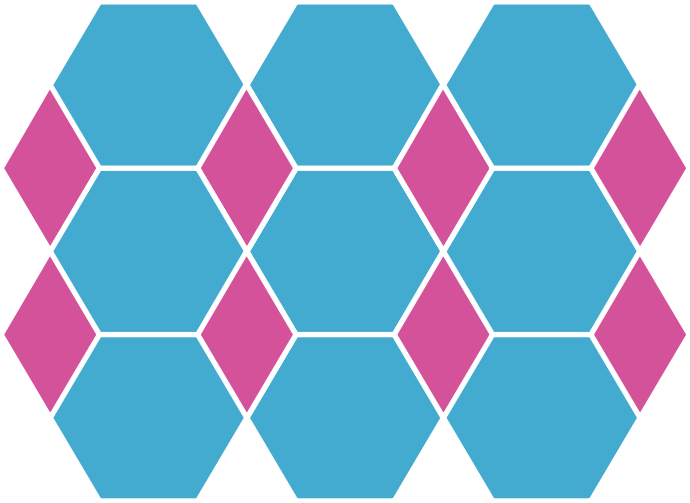
Tally Chart

Pupils complete a tally chart on a given template with column headings.

Number of Pets	Tally
0	
1	
2	
3	

Tessellation

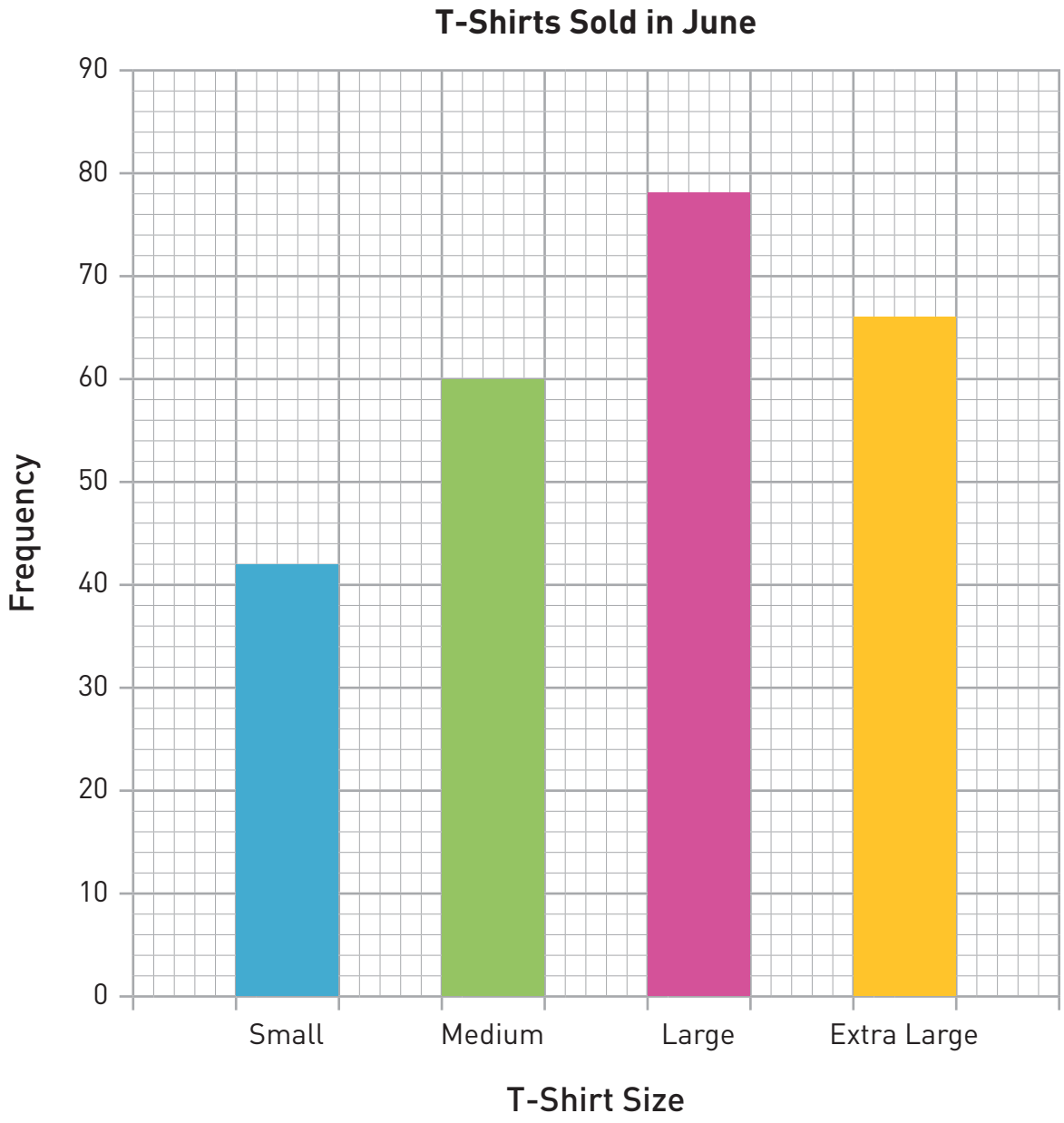
Pupils create a tessellation by tiling with common 2-D shapes.



Bar Chart

Bar Charts for Qualitative Data or Ungrouped Quantitative Data

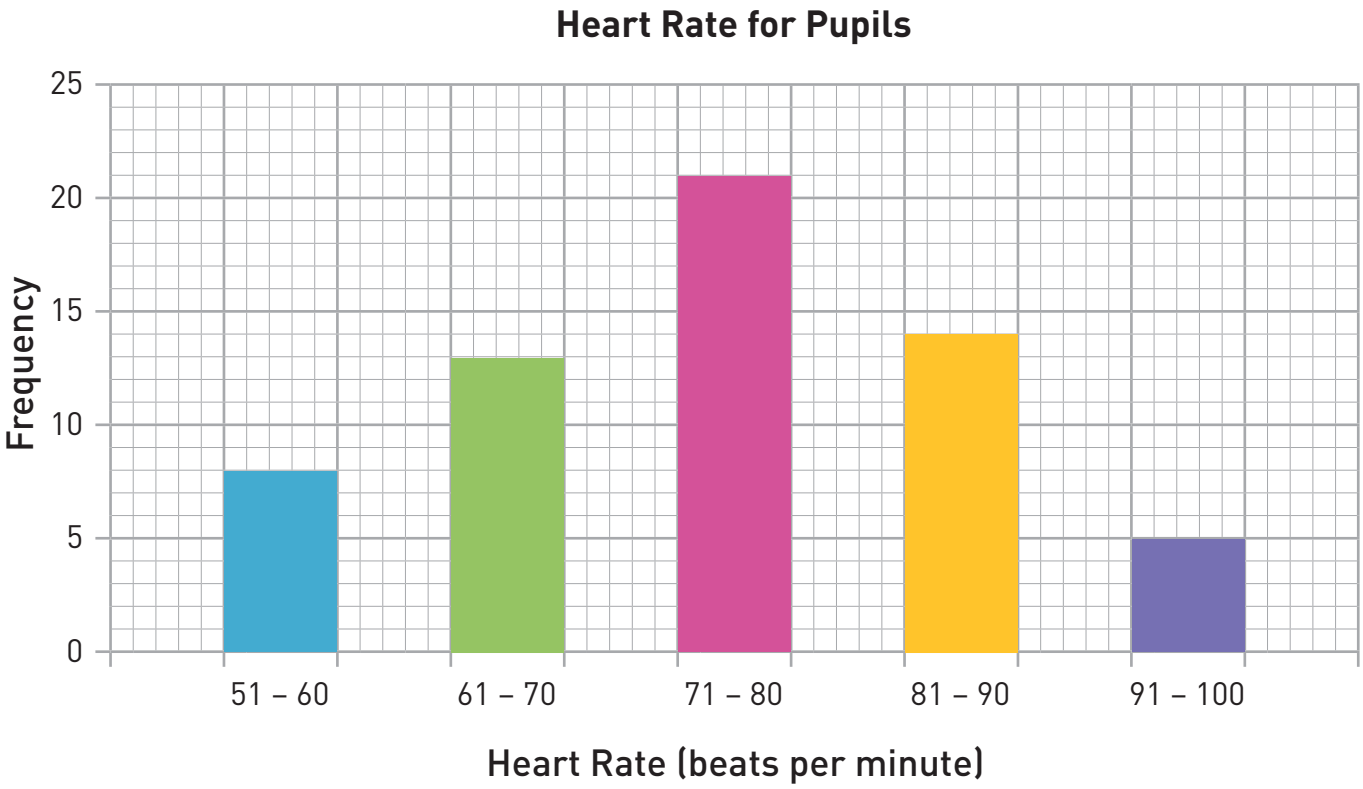
Pupils present their own bar chart by drawing and labelling their own axes and drawing the bars. (Axes are not given).



Bar Chart

Bar Charts for Discrete Grouped Data

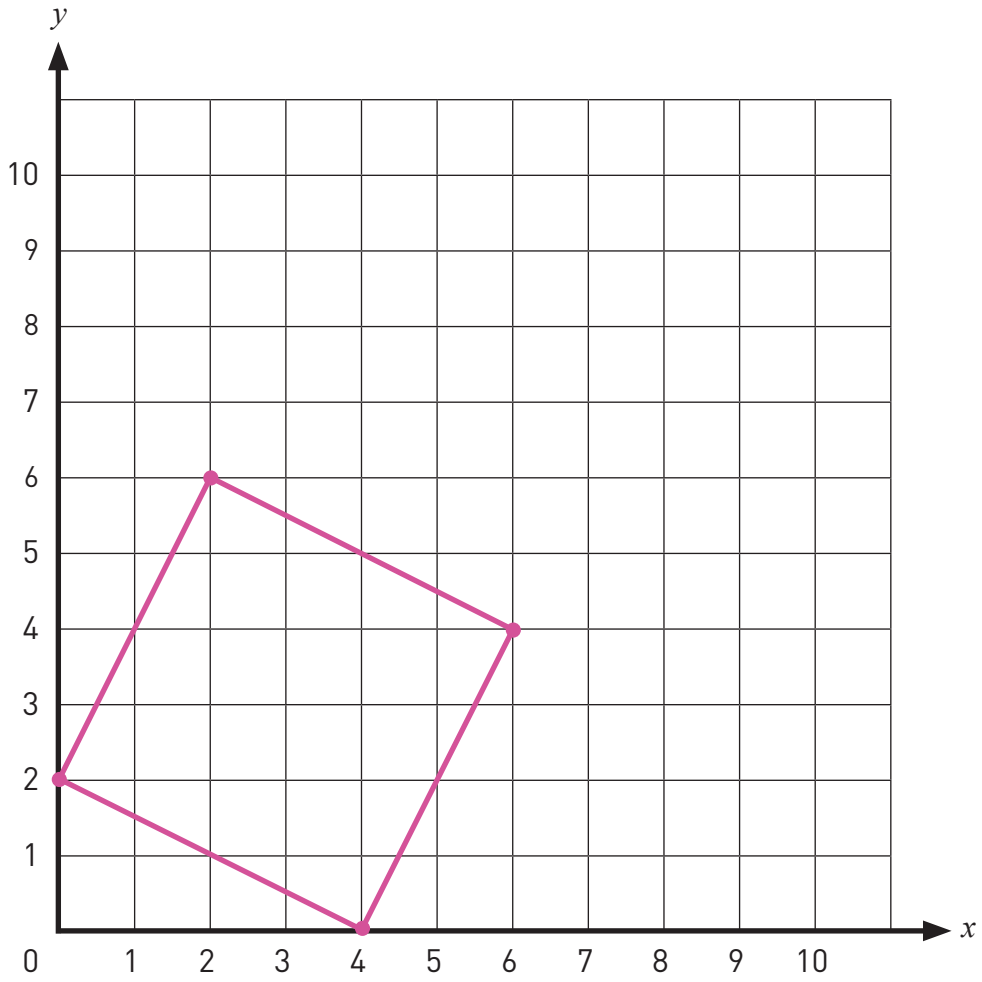
Pupils are given the class intervals. Pupils then draw and label their own axes and draw the bars. (Axes are not given).



Coordinates in the First Quadrant

Pupils plot any set of coordinates where both values are positive, using axes with only positive scales.

For example pupils plot the positive sets of coordinates (0, 2), (2, 6), (4, 0) and (6, 4) to make a square.



Database

Pupils interrogate a database to answer questions.

For example pupils list the animals which are hibernating mammals.

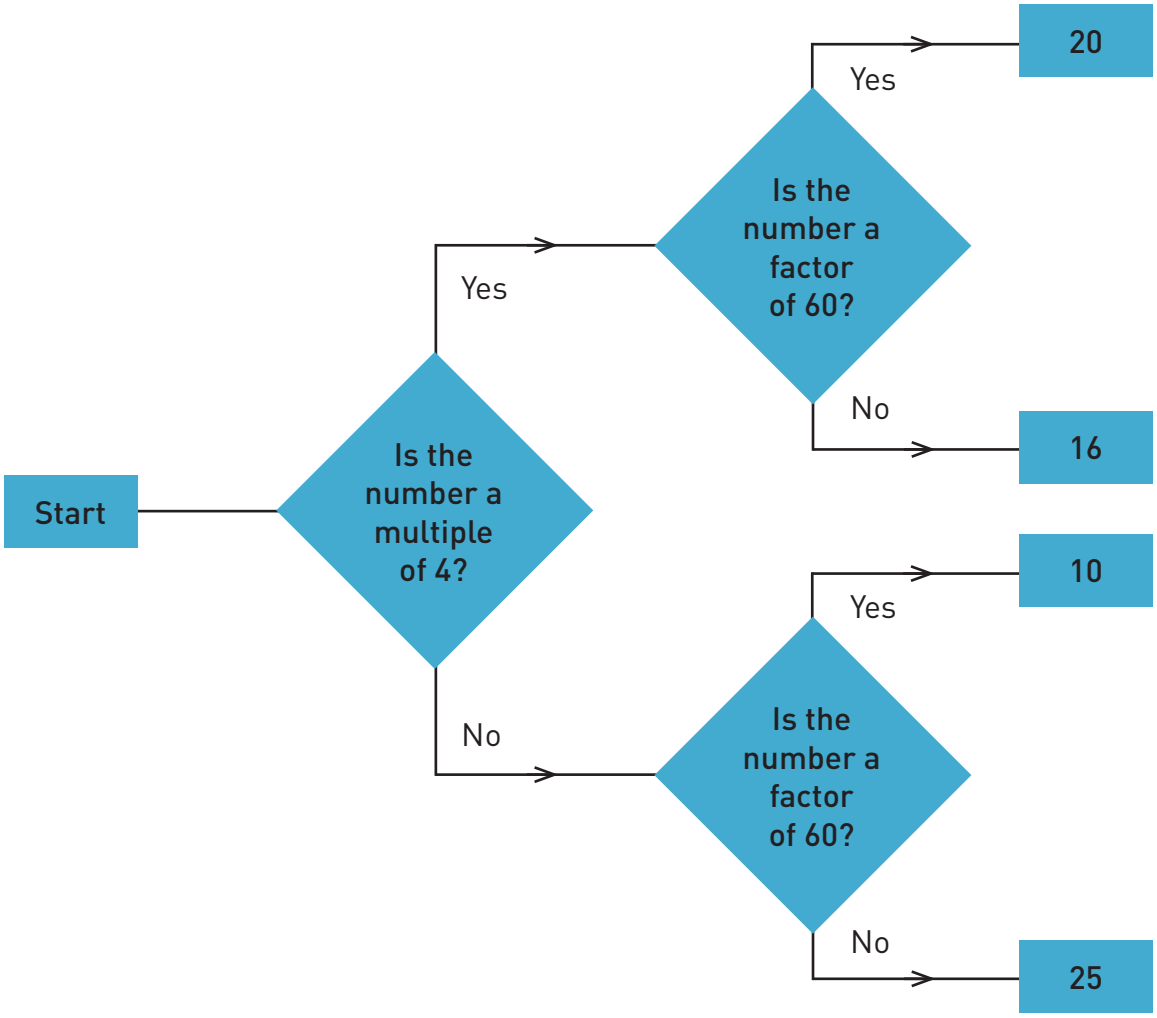
Animal	Type	Lives	Diet	Hibernates
Grizzly Bear	Mammal	North America	Deer	Yes
Fruit Bat	Mammal	Asia	Fruit	No
Green Lizard	Reptile	Europe	Insects	Yes
Alligator	Reptile	North America	Birds	Yes
Emu	Bird	Australia	Fruit	No

Decision Tree Diagram

Pupils sort using a Decision Tree diagram.

For example pupils decide which of the following numbers are a factor of 60 and/or a multiple of 4.

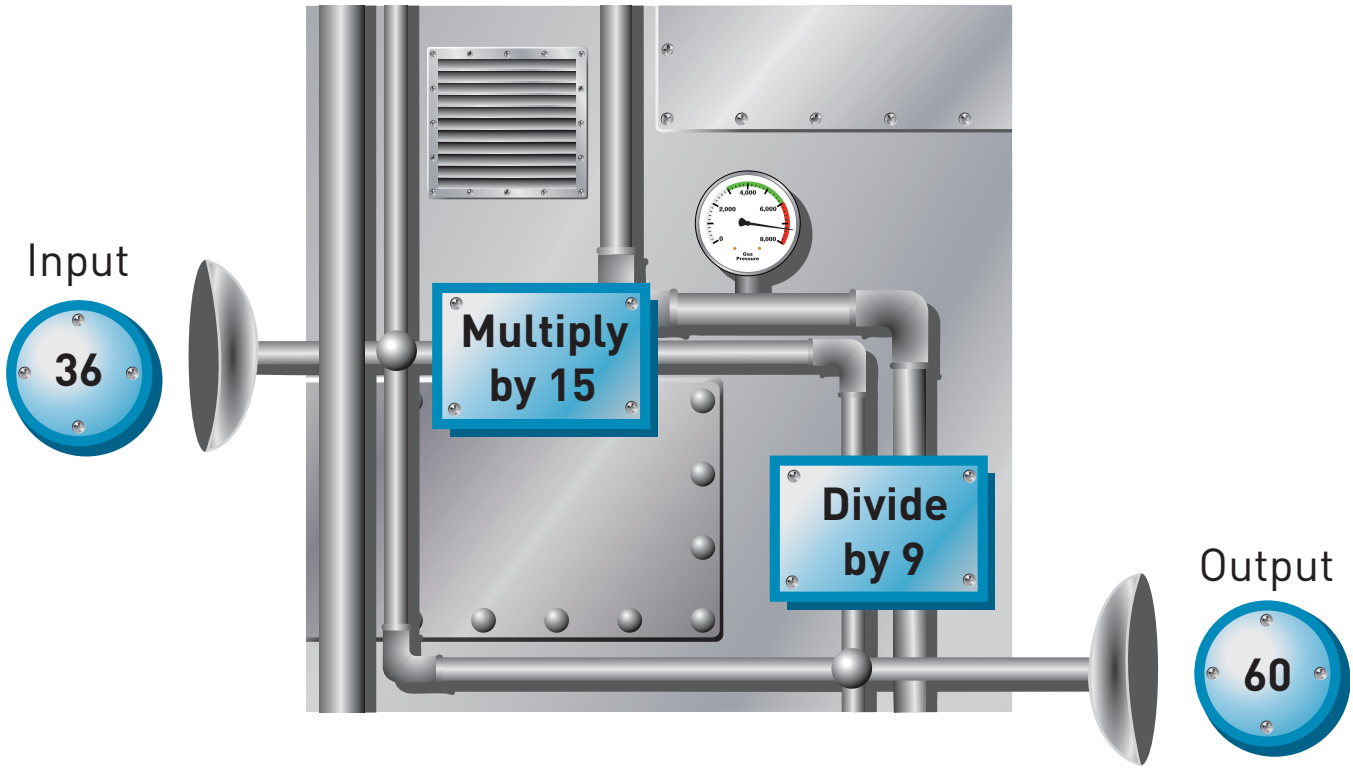
10 16 20 25



NB: Although the second question (Is the number a factor of 60?) is the same on each branch of this Decision Tree diagram, these questions do not have to be the same.

Function Machine

Pupils use a function machine to apply rules in order to find solutions.



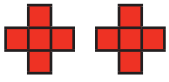
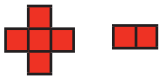
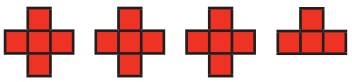
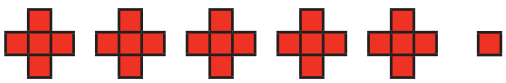
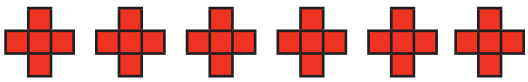
Grouped Frequency Table

Pupils draw a grouped frequency table where class intervals are given.

Mark	Tally	Frequency
51 – 60	||	2
61 – 70	𝍸 ||	7
71 – 80	𝍸 ||||	9
81 – 90	𝍸	5
91 – 100	|||	3

Pictogram

Pupils present and interpret information using a pictogram where the key contains more than one symbol.

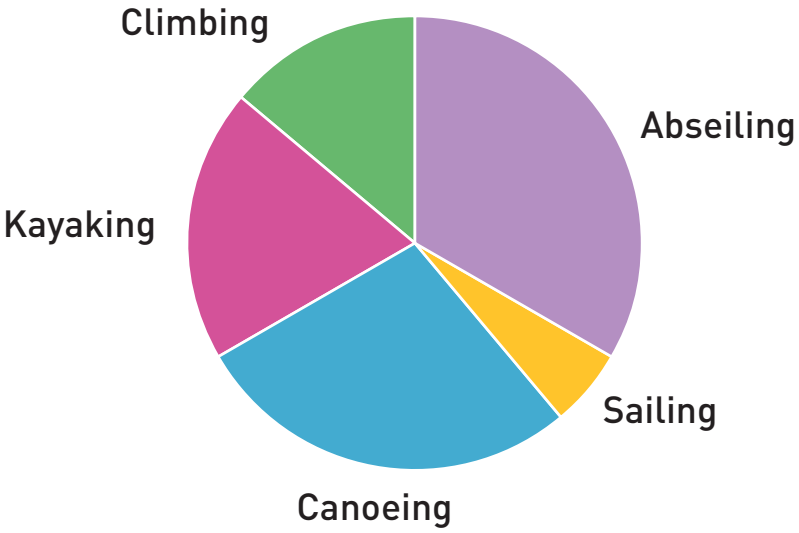
Day	Number of Ambulance Call-Outs
Sunday	
Monday	
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	

Key	
	= 5 Call-outs
	= 1 Call-out

Pie Chart

Pupils interpret a pie chart.

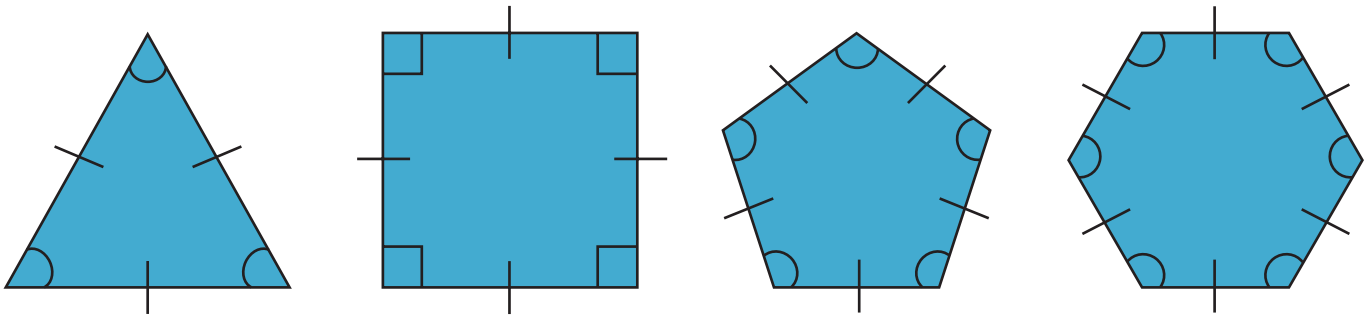
For example pupils list the activities in order from most popular to least popular.



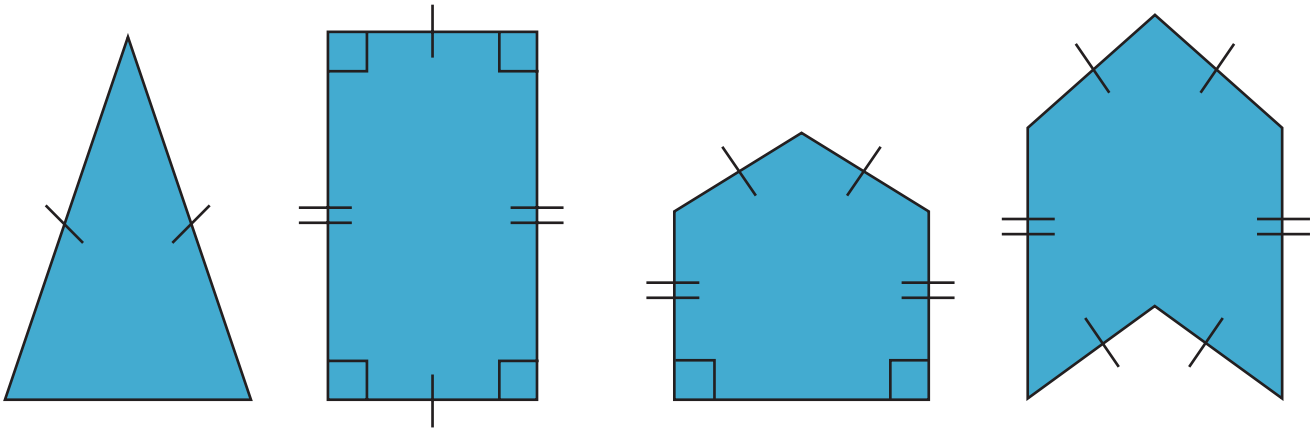
Regular and Irregular Shapes

Pupils measure sides and angles of 2-D shapes and decide if they are regular or irregular.

For example regular shapes – all angles equal, all sides equal.

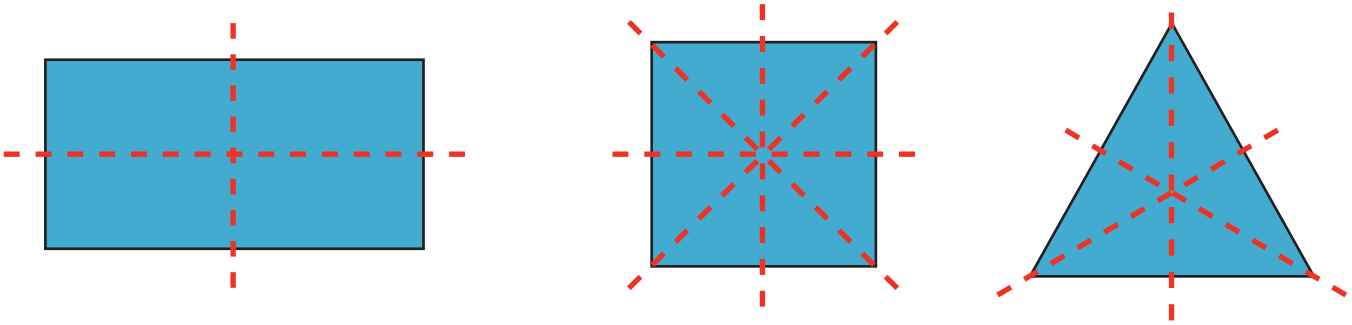


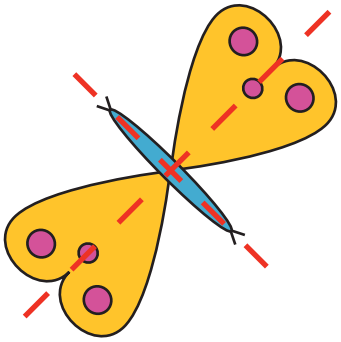
For example irregular shapes – angles and/or sides have different values.



Line of Symmetry

Pupils draw more than one line of symmetry on a variety of 2-D shapes.

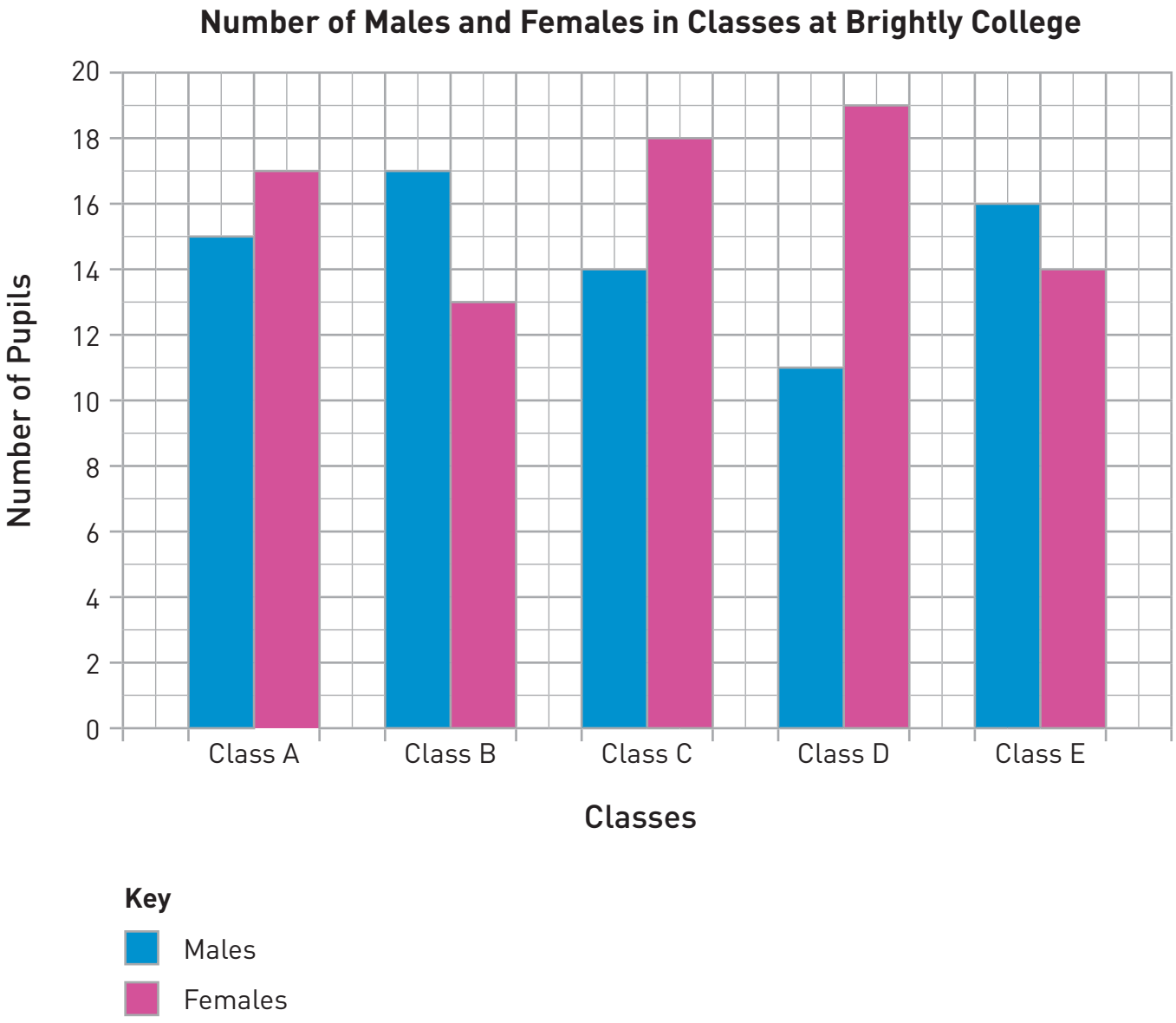




No symmetry

Bar Chart

Pupils construct a dual bar chart by drawing and labelling their own axes and drawing the bars. They also include a key.



Data Collection Sheet

Pupils design and use their own data collection sheet.

Today's Date	Time	Current Temperature	Today's High	Today's Low	Wind Speed	Wind Direction	Precipitation Amount	Precipitation Type

Database

Pupils interrogate a large database in order to obtain information based on a number of requirements.

For example which mammal, that does not hibernate, lives in Asia and eats vegetation?

Animal	Type	Lives	Diet	Lifespan (Years)	Hibernates
Grizzly Bear	Mammal	North America	Deer	15 –30	Yes
Fruit Bat	Mammal	Asia	Fruit	20–30	No
Green Lizard	Reptile	Europe	Insects	2–3	Yes
Indian Elephant	Mammal	Asia	Vegetation	60–80	No
Alligator	Reptile	North America	Birds	40–50	Yes
Emu	Bird	Australia	Fruit	10–20	No
African Elephant	Mammal	Africa	Vegetation	60–80	No

Grouped Frequency Table

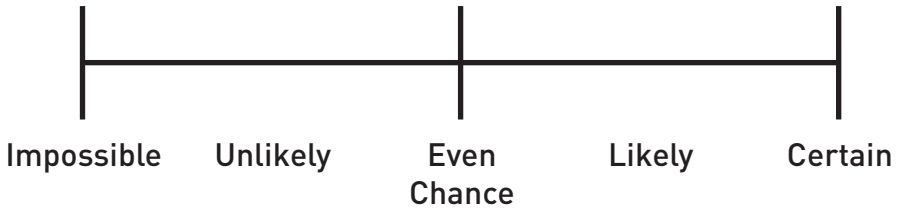
Pupils construct a grouped frequency table for a set of discrete data by selecting discrete class intervals of their own.

For example pupils use raw data that shows how many leaves plants have and group it into suitable class intervals.

Leaves On Plants	Frequency
1 – 5	9
6 – 10	7
11 – 15	11
16 – 20	4
21 – 25	15
26 – 30	2

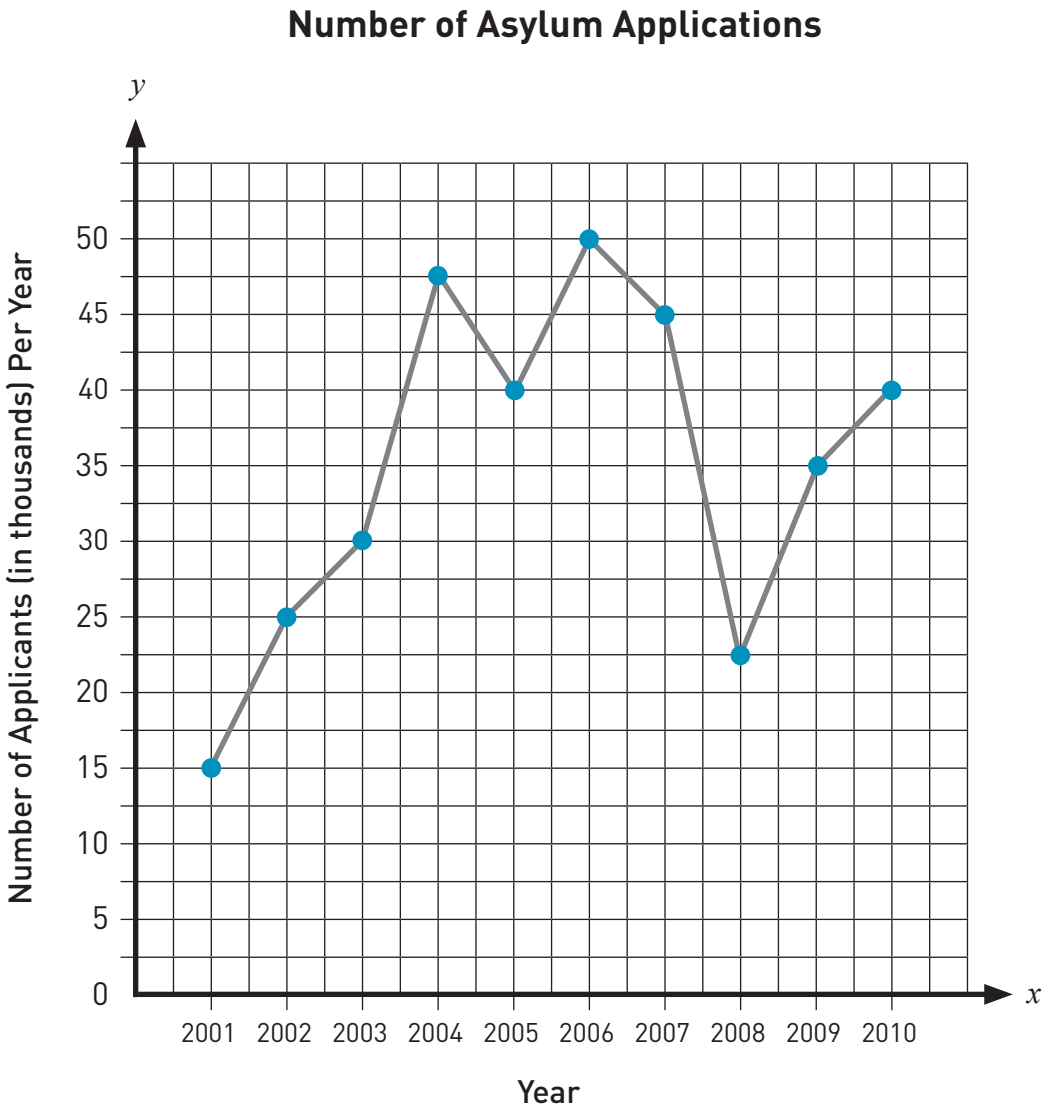
Likelihood Scale

Pupils record the likelihood of events on a scale.



Line Graph

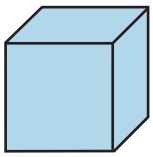
Pupils draw a line graph to present information. They draw their own axes using their own scale and include their own title and labels.



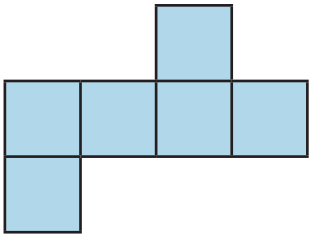
Nets

Pupils draw the nets of 3-D shapes.

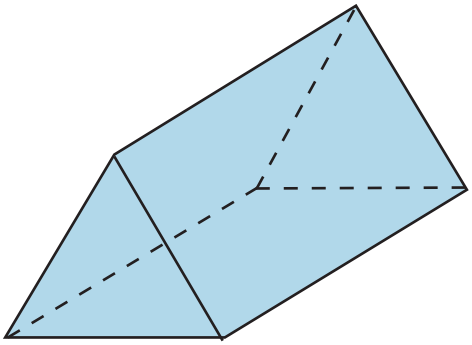
The following are 3-D shapes and their corresponding nets.



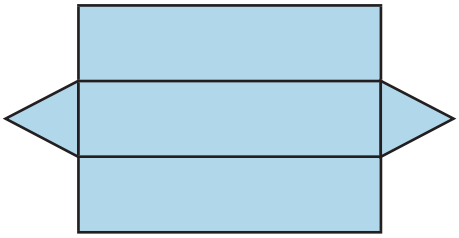
Cube



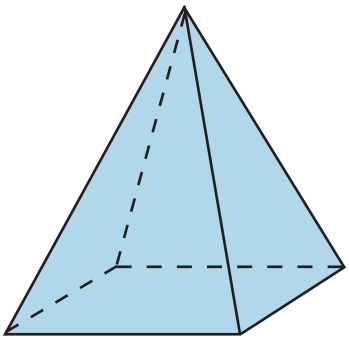
Cuboid



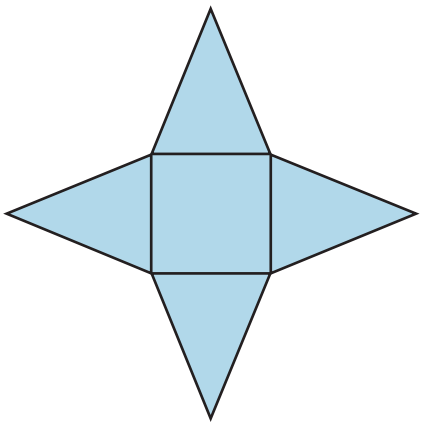
Triangular Prism



Cylinder

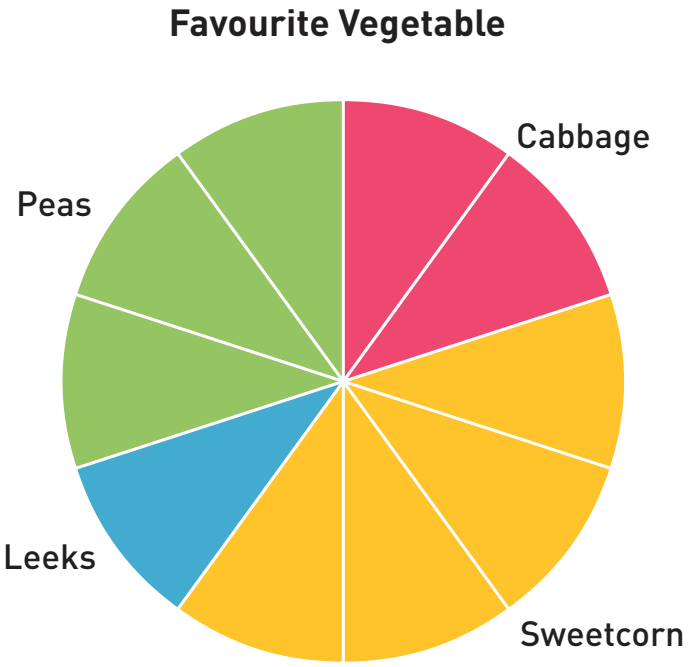


Square Based Pyramid



Pie Chart

Pupils complete a pie chart with sectors given to present and interpret data.



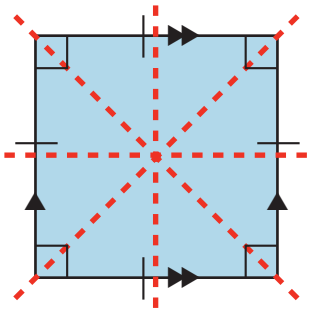
Properties of 3-D Shapes

Pupils describe the properties of 3-D shapes in terms of faces, edges and vertices.

Shape	Faces	Edges	Vertices
Cube/Cuboid	6	12	8
Triangular Prism	5	9	6
Square Based Pyramid	5	8	5
Triangular Based Pyramid (Tetrahedron)	4	6	4

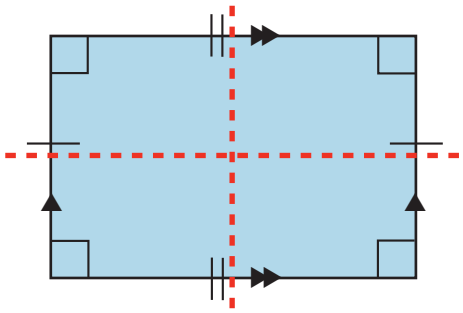
Properties of Quadrilaterals

Pupils describe the properties of different quadrilaterals using appropriate terminology.



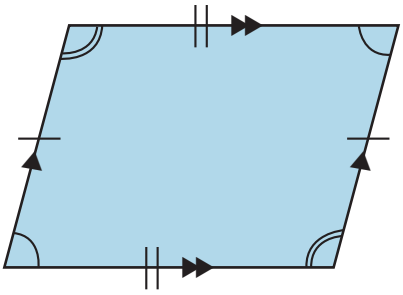
Square

- Regular quadrilateral
- All sides equal in length
- All angles equal to 90°
- Opposite sides are parallel
- Four lines of symmetry



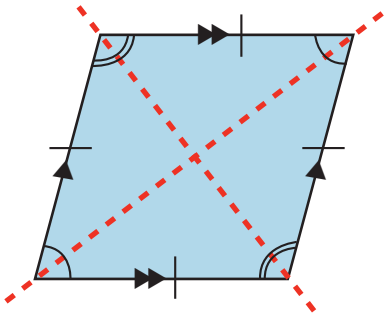
Rectangle

- Opposite sides equal in length
- All angles equal to 90°
- Opposite sides are parallel
- Two lines of symmetry



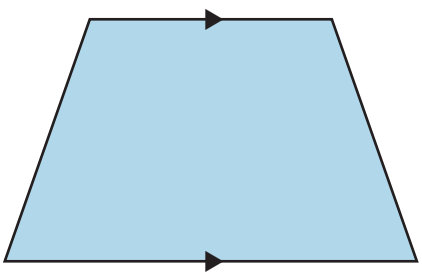
Parallelogram

- Opposite sides equal in length
- Opposite angles equal in size
- Opposite sides are parallel
- No lines of symmetry



Rhombus

- All sides equal in length
- Opposite angles equal in size
- Opposite sides are parallel
- Two lines of symmetry

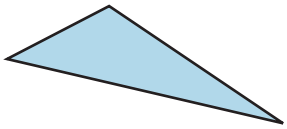


Trapezium

- One pair of opposite sides is parallel

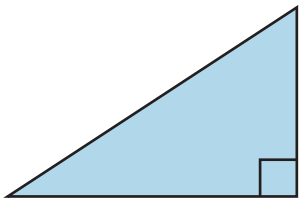
Properties of Triangles

Pupils describe the properties of different triangles using appropriate terminology.



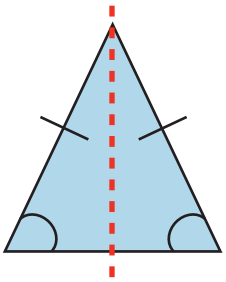
Scalene Triangle

- No sides equal in length
- All angles different
- No lines of symmetry



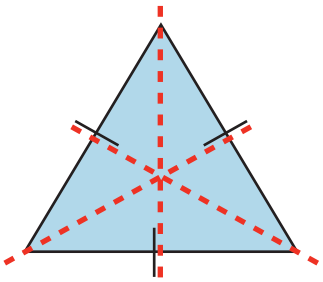
Right-Angled Triangle

- One angle equal to 90°



Isosceles Triangle

- Two sides equal in length
- Two angles equal in size
- One line of symmetry



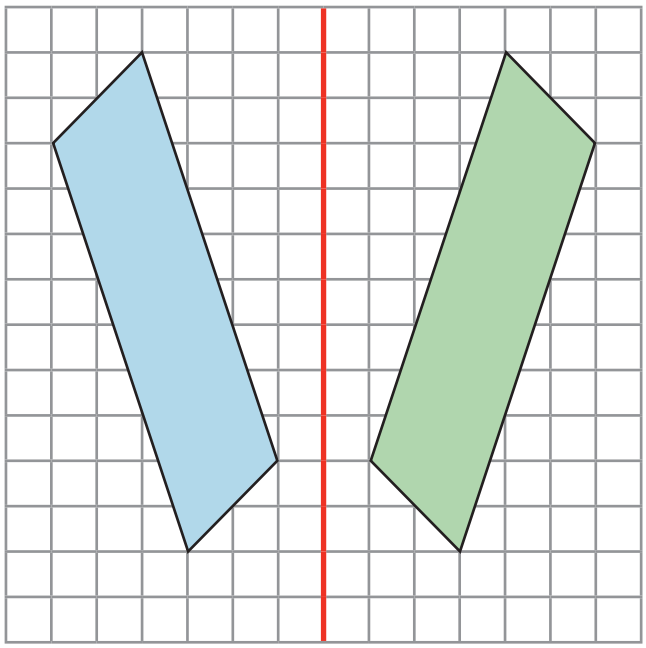
Equilateral Triangle

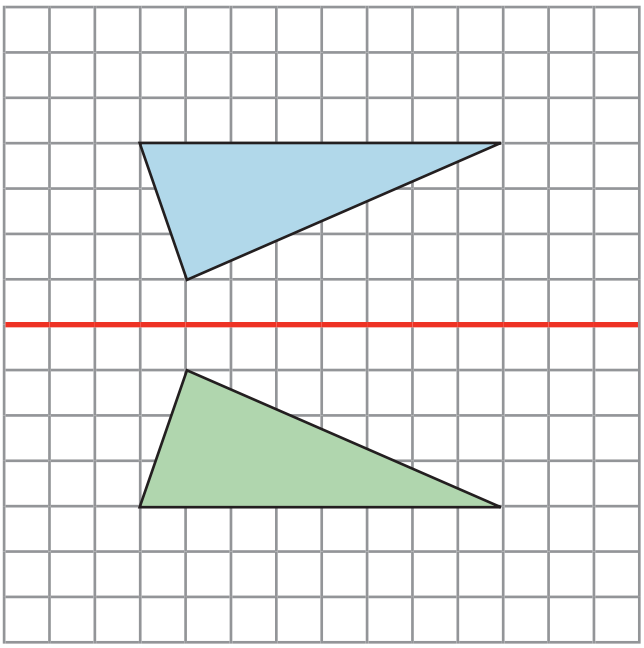
- Regular triangle
- All sides equal in length
- All angles equal to 60°
- Three lines of symmetry

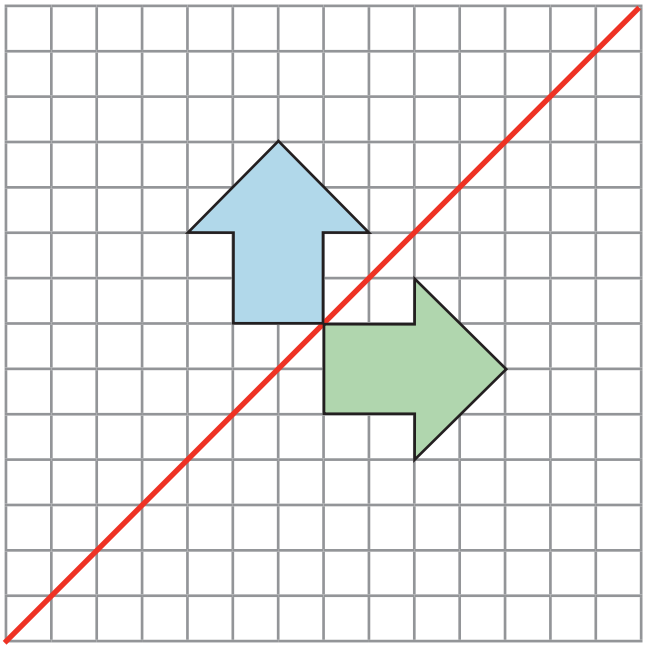
Reflect 2-D Shapes

Pupils reflect shapes in a vertical, horizontal or diagonal line.

For example the blue object shapes are reflected to give the green image shapes.







Spreadsheets

Pupils input data into a spreadsheet. They input simple formulae to calculate results.

For example pupils input formula into a spreadsheet to calculate babysitting wages over a four week period, where the rate is £5 an hour.

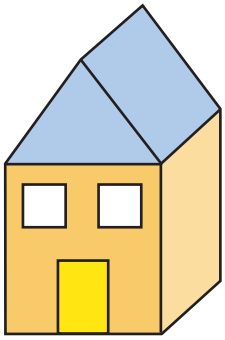
	A	B	C	D	E	F	G	H	I	J	K	L
1	Week	Mon	Tues	Wed	Thur	Fri	Sat	Sun		Total Hours		Pay
2	1	0	4	1	2	6	6	0		=SUM(B2:H2)		=J2*5
3	2	1	2	4	1	5.5	7	0		=SUM(B3:H3)		=J3*5
4	3	0	2.5	1	1	4	5	0		=SUM(B4:H4)		=J4*5
5	4	3	1	2	4	3.5	6	0		=SUM(B5:H5)		=J5*5
6												
7										Total Pay		=SUM(L2:L5)

(the above formula will generate the following results)

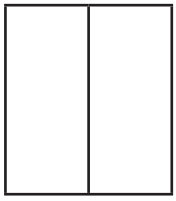
	A	B	C	D	E	F	G	H	I	J	K	L
1	Week	Mon	Tues	Wed	Thur	Fri	Sat	Sun		Total Hours		Pay
2	1	0	4	1	2	6	6	0		19		£95.00
3	2	1	2	4	1	5.5	7	0		20.5		£102.50
4	3	0	2.5	1	1	4	5	0		13.5		£67.50
5	4	3	1	2	4	3.5	6	0		19.5		£97.50
6												
7										Total Pay		£362.50

2-D Representations of 3-D Shapes

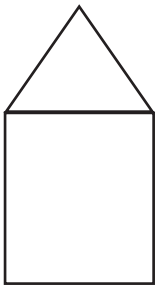
Pupils recognise the plan, front elevation and side elevation and net of a 3-D shape.



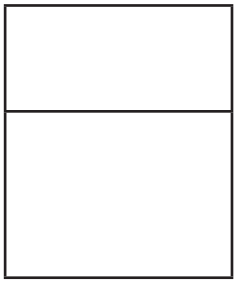
3-D Shape



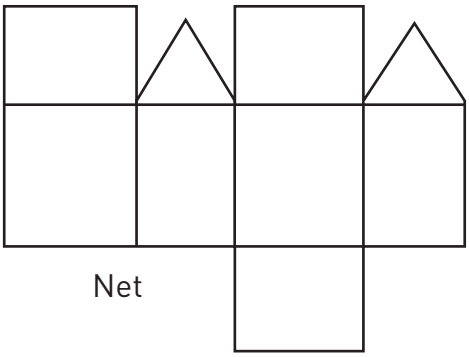
Plan



Front Elevation



Side Elevation



Net

Calculate the Mean from a Frequency Table

Pupils calculate the mean for quantitative data recorded in a frequency table.

For example pupils calculate the mean number of goals scored by a football team over 38 matches.

Number of Goals Scored Per Match (G)	Frequency (F)	G × F
0	5	0 × 5 = 0
1	9	1 × 9 = 9
2	8	2 × 8 = 16
3	13	3 × 13 = 39
4	3	4 × 3 = 12
Total	**38**	**76**

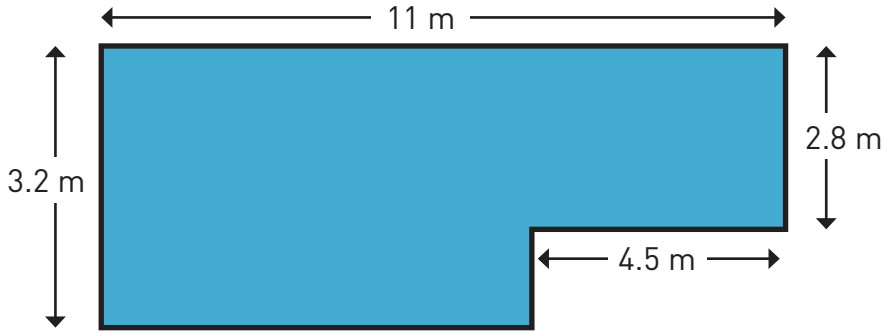
To calculate the mean **divide** the **total** for the **G × F** column **by** the **total** for the **Frequency** column

mean = 76 ÷ 38 = **2 goals**

Composite Shapes

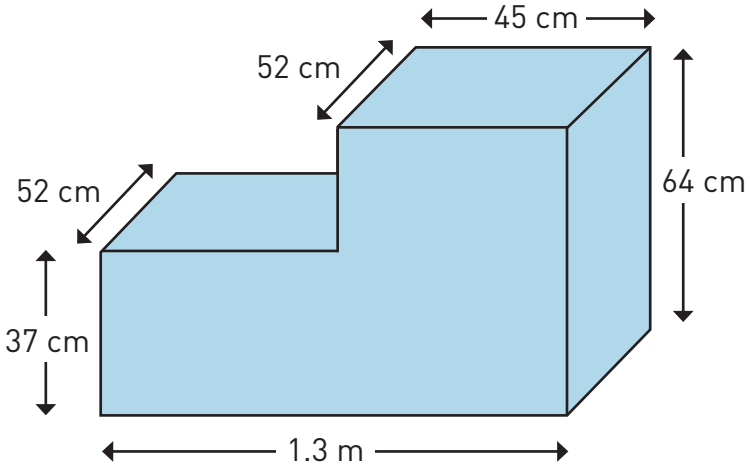
Pupils calculate the area of composite 2-D shapes by splitting the shape into two or more common 2-D shapes.

For example pupils calculate the area and perimeter of this patio.



Pupils calculate the volume of composite 3-D shapes by splitting the shape into two or more cubes/cuboids.

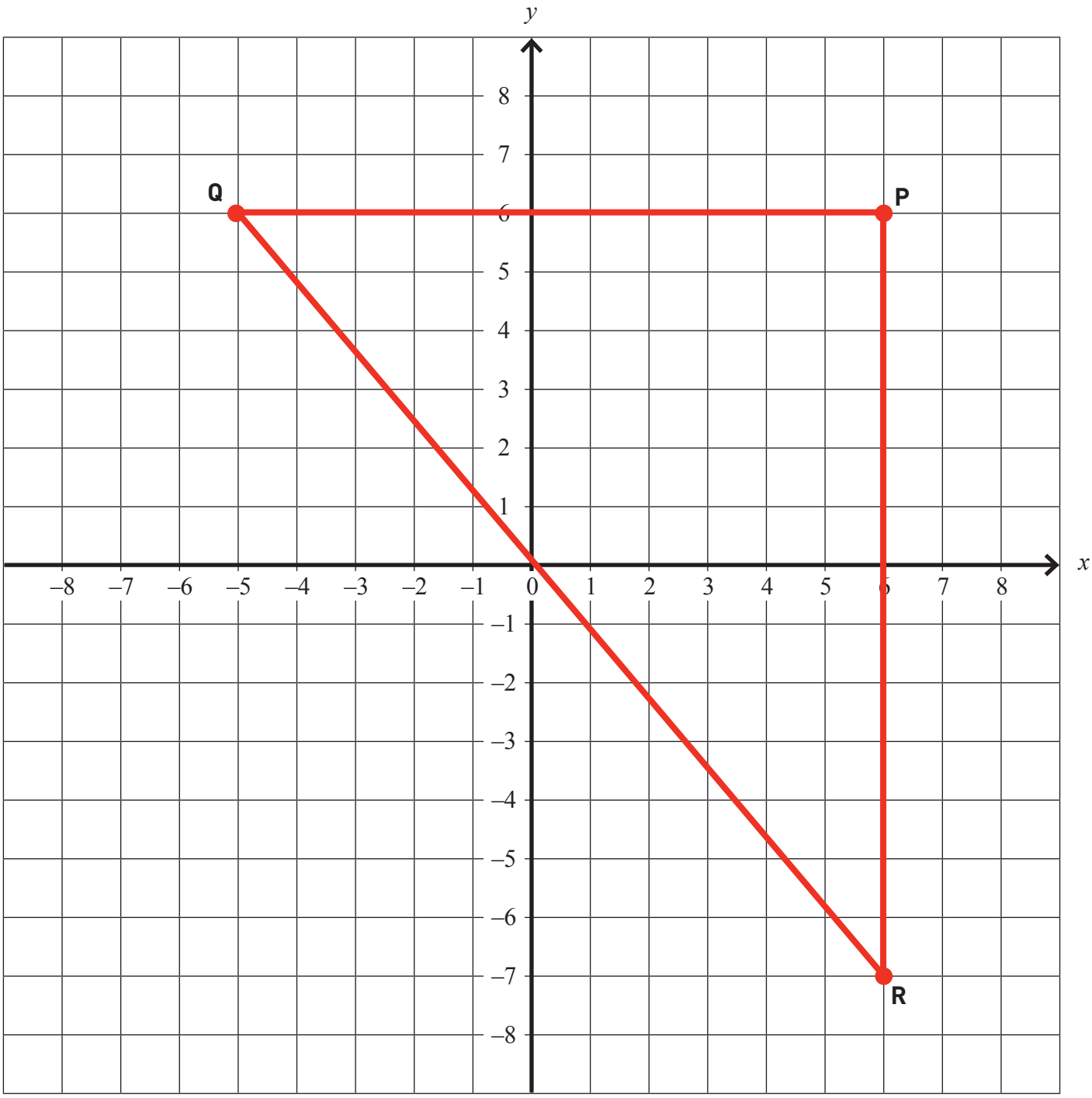
For example pupils calculate the volume of this steel container.



Coordinates in all Four Quadrants

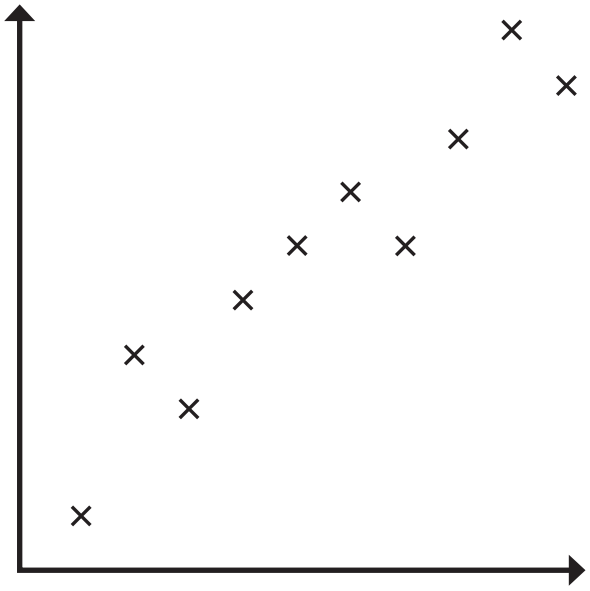
Pupils plot any set of coordinates with positive and/or negative values, using axes with positive and negative scales.

For example pupils plot the sets of coordinates (-5, 6), (6, 6) and (6, - 7) to make a triangle.

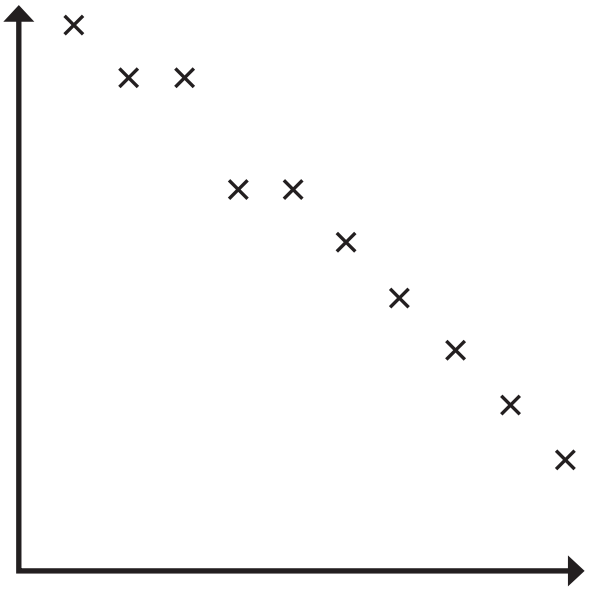


Correlation

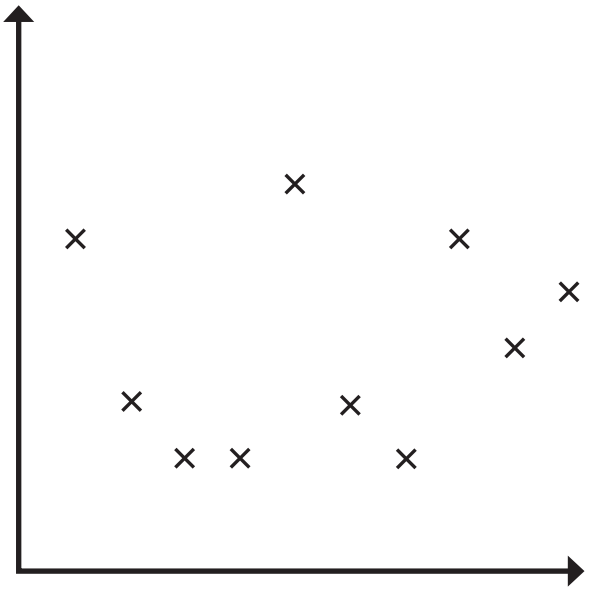
Pupils test the relationship between two different variables by identifying the correlation shown on a scatter diagram.



Positive Correlation



Negative Correlation



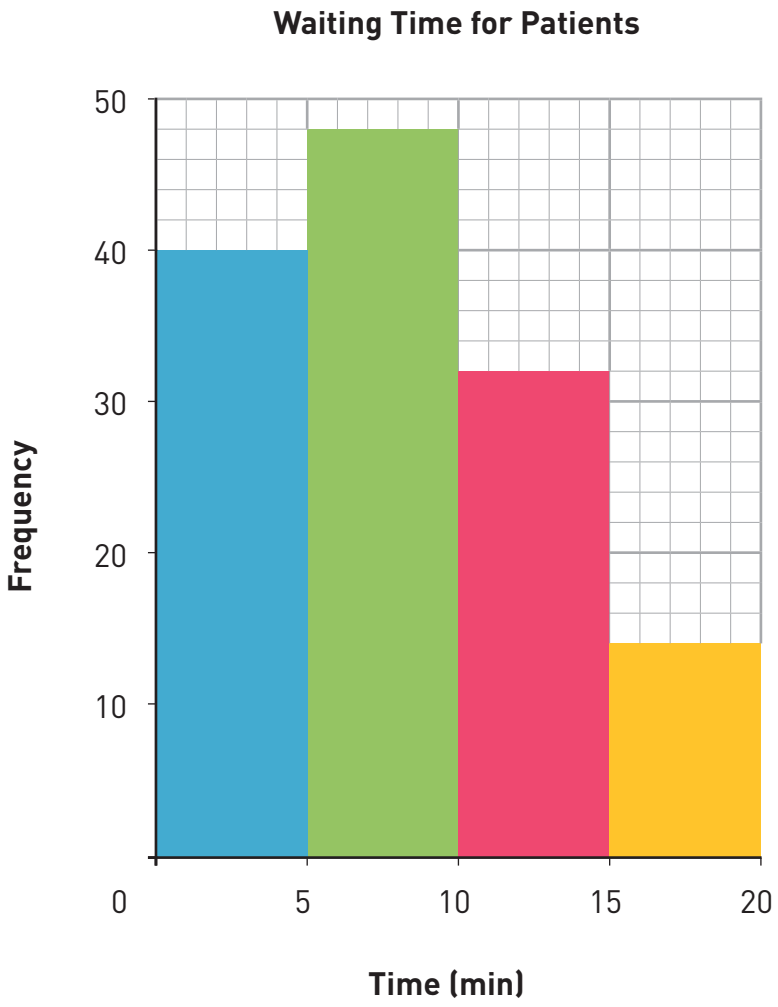
No Correlation

Frequency Diagram

Pupils construct frequency diagrams for continuous grouped data.

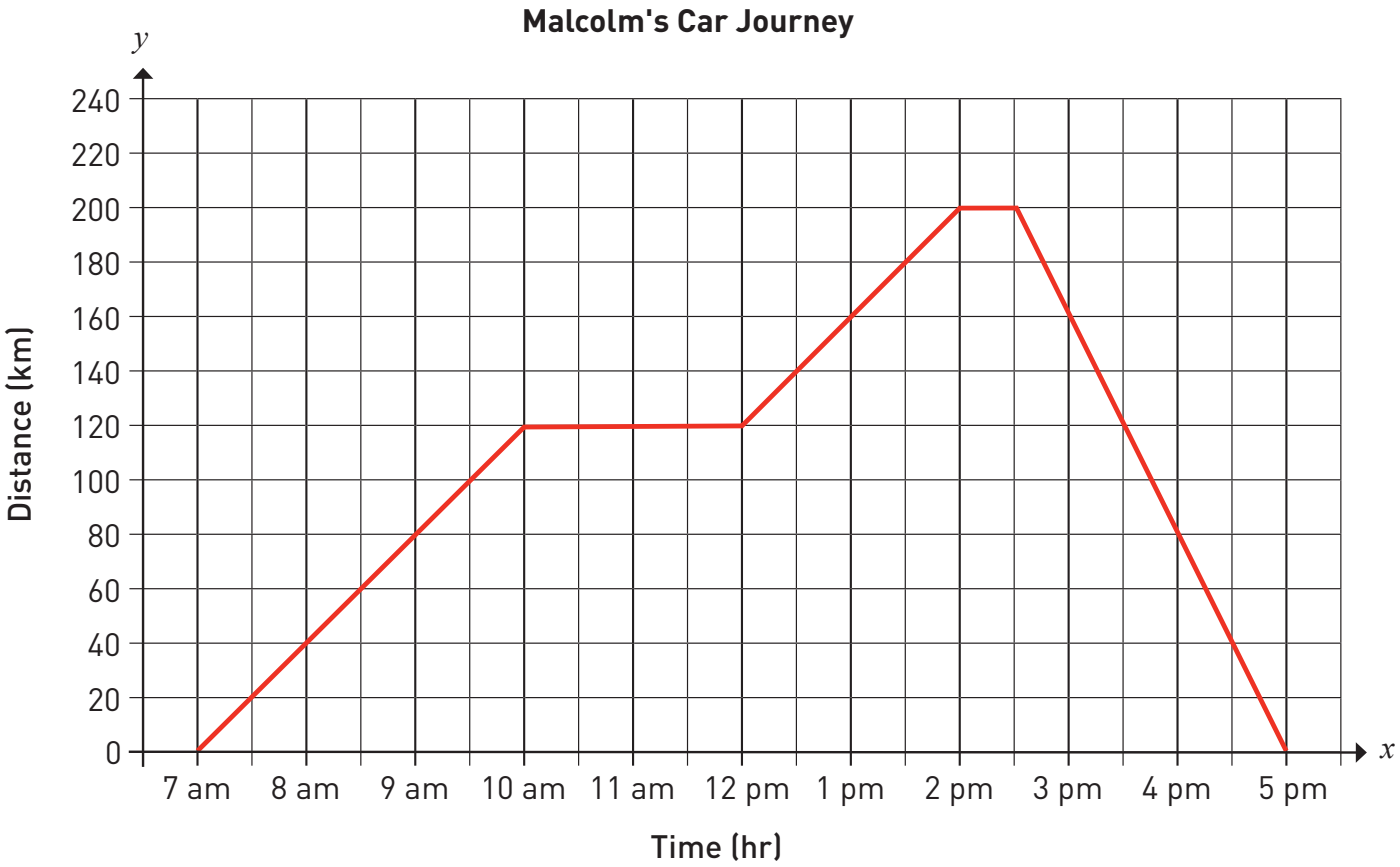
For example pupils draw the appropriate frequency diagram when continuous data is recorded.

Waiting Time (mins)	Frequency
$0 < T \leqslant 5$	40
$5 < T \leqslant 10$	48
$10 < T \leqslant 15$	32
$15 < T \leqslant 20$	14



Line Graph

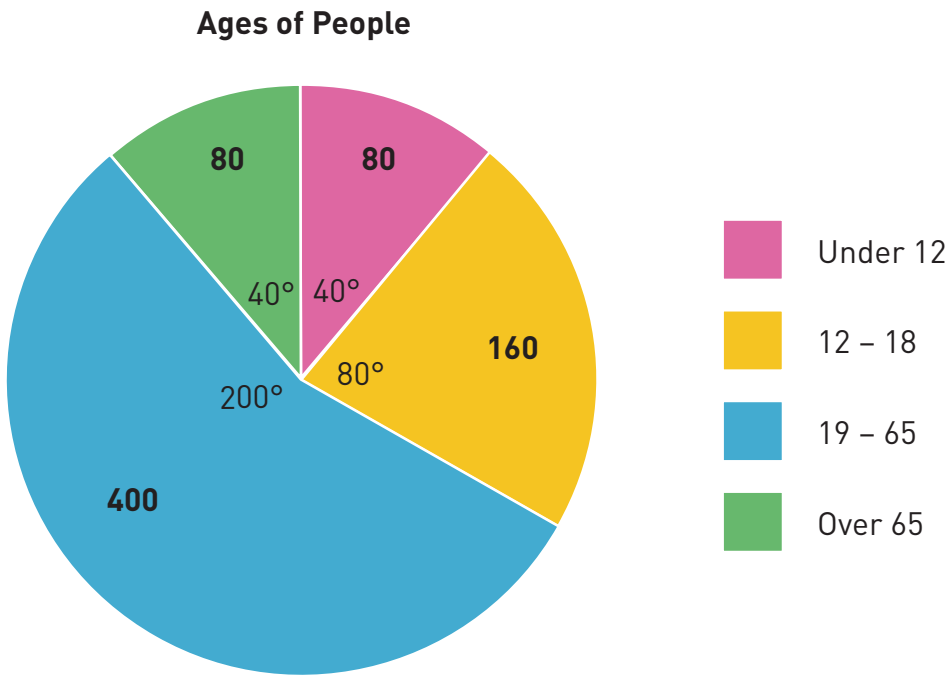
Pupils draw and interpret line graphs from real situations.



Pie Chart

Pupils draw a pie chart by working out the size of the angle for each sector that represents the associated frequency.

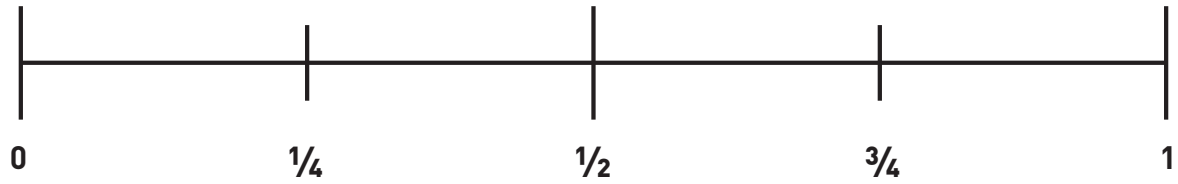
Ages of People	Frequency	Angle
Under 12	80	40°
12 – 18	160	80°
19 – 65	400	200°
Over 65	80	40°



Level 6

Probability Scale

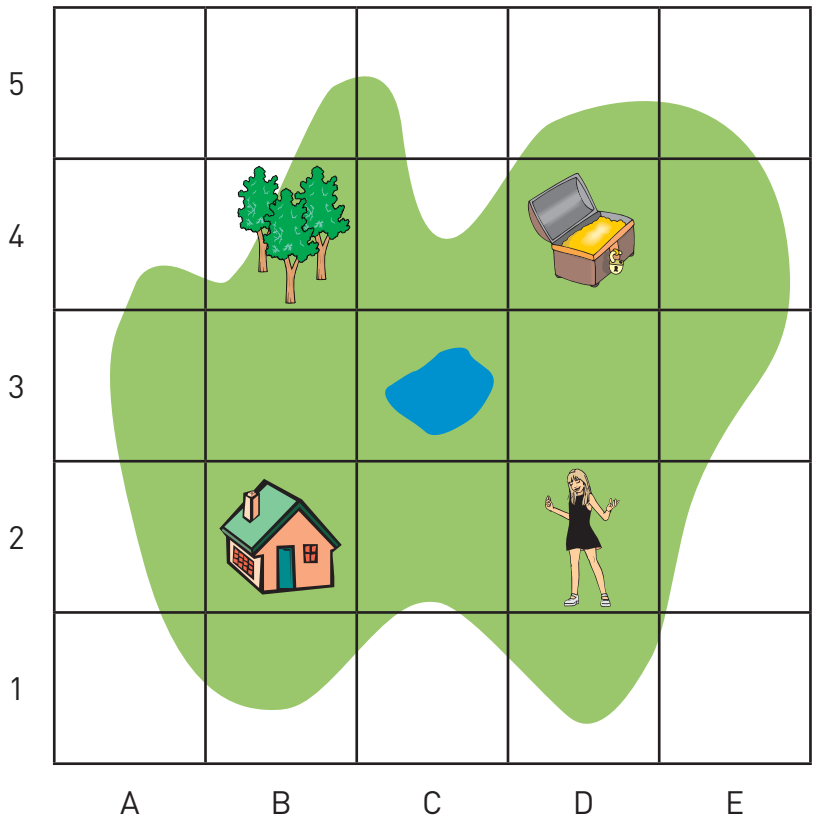
Pupils record the probability of events on a scale from 0 to 1 using fractions, decimals or percentages.



Scale Ratio

Pupils measure a distance on a map and use the scale to calculate the actual distance.

For example pupils calculate the actual distance between the girl and the house.



Scale Ratio = 1 : 25 000

Stem and Leaf Diagram

Pupils group data using a stem and leaf diagram. The diagram has two columns – the stem which groups the data and the leaf which details the frequency of the group. The values for each leaf must be ordered numerically.

For example temperatures (°C) in Jack's green house over the last two weeks are as follows:

23, 25, 19, 26, 24, 18, 30, 28, 29, 22, 19, 31, 28, 25, 19

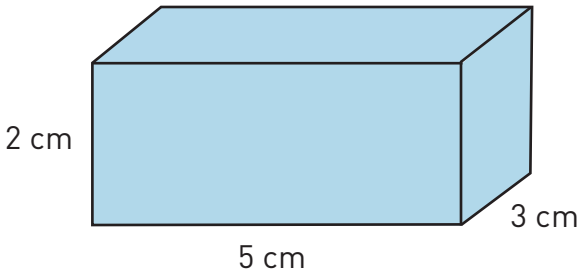
Stem	Leaf								
1	8	9	9	9					
2	2	3	4	5	5	6	8	8	9
3	0	1							

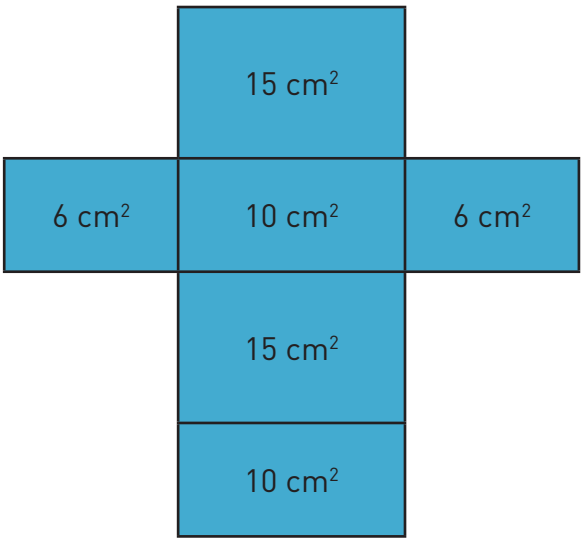
Key

2|4 means 24°C

Surface Area

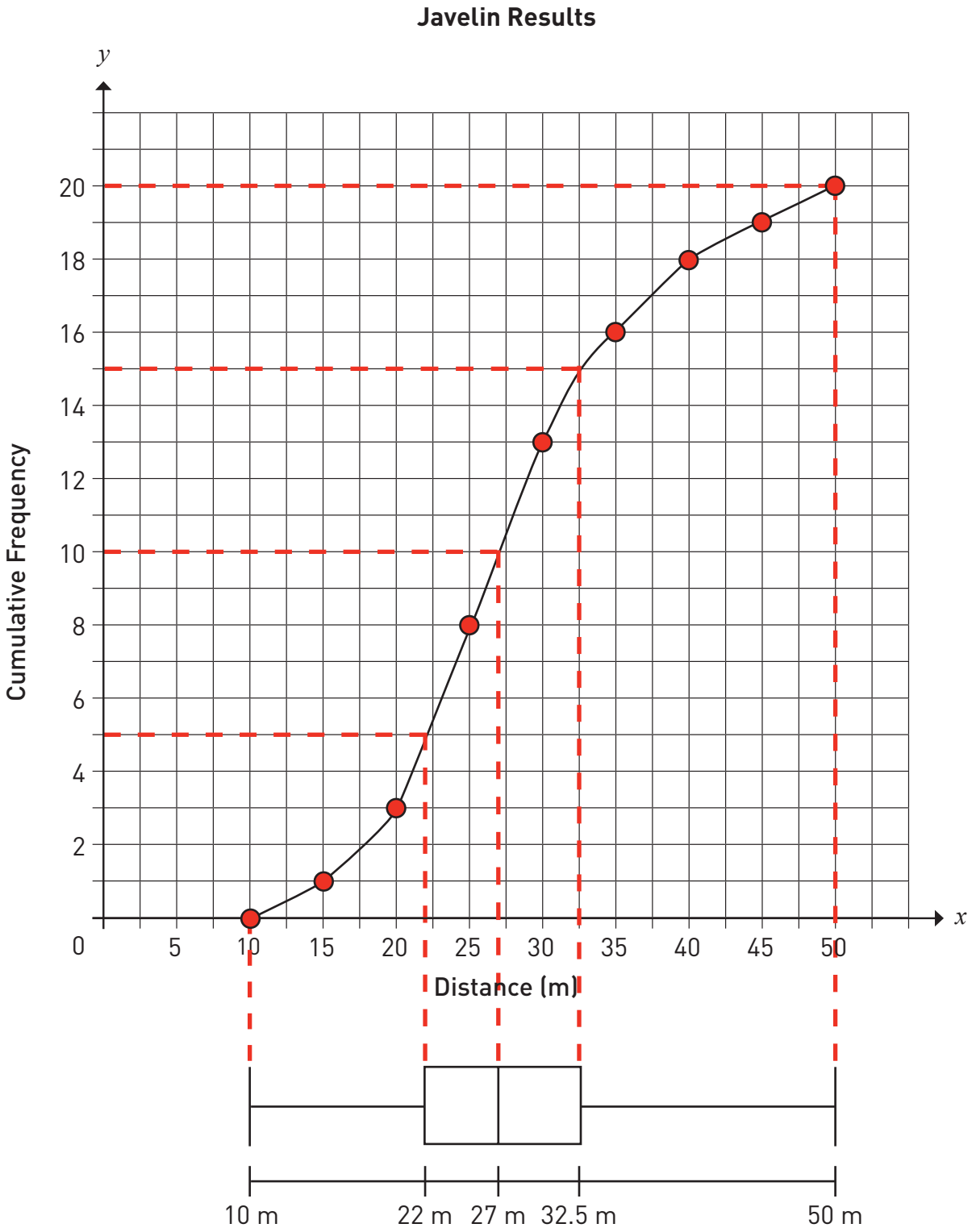
Pupils work out the surface area of a prism by calculating the area of each face and adding them together.





Box Plots and Quartiles

Pupils use the data from a cumulative frequency table and construct a cumulative frequency graph. Using the graph they can estimate the quartiles and draw a box plot.

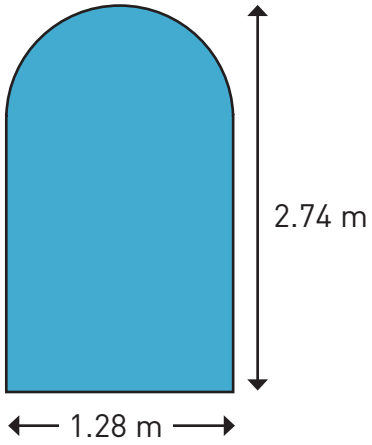


Lower Quartile is 22 m
Middle Quartile (median) is 27 m
Upper Quartile is 32.5 m
Interquartile range = Upper Quartile – Lower Quartile = 32.5 m – 22 m = 10.5 m

Composite Shapes

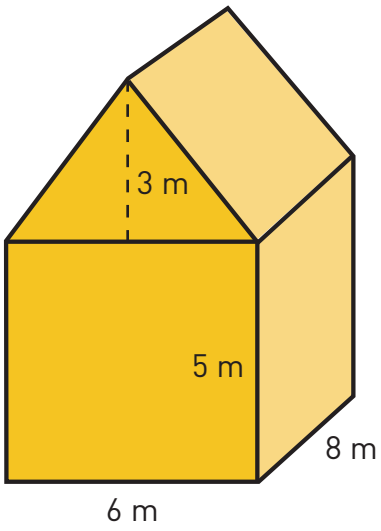
Pupils calculate the area and perimeter of composite 2-D shapes which involve a circle.

For example pupils calculate the area and perimeter of this doorway.



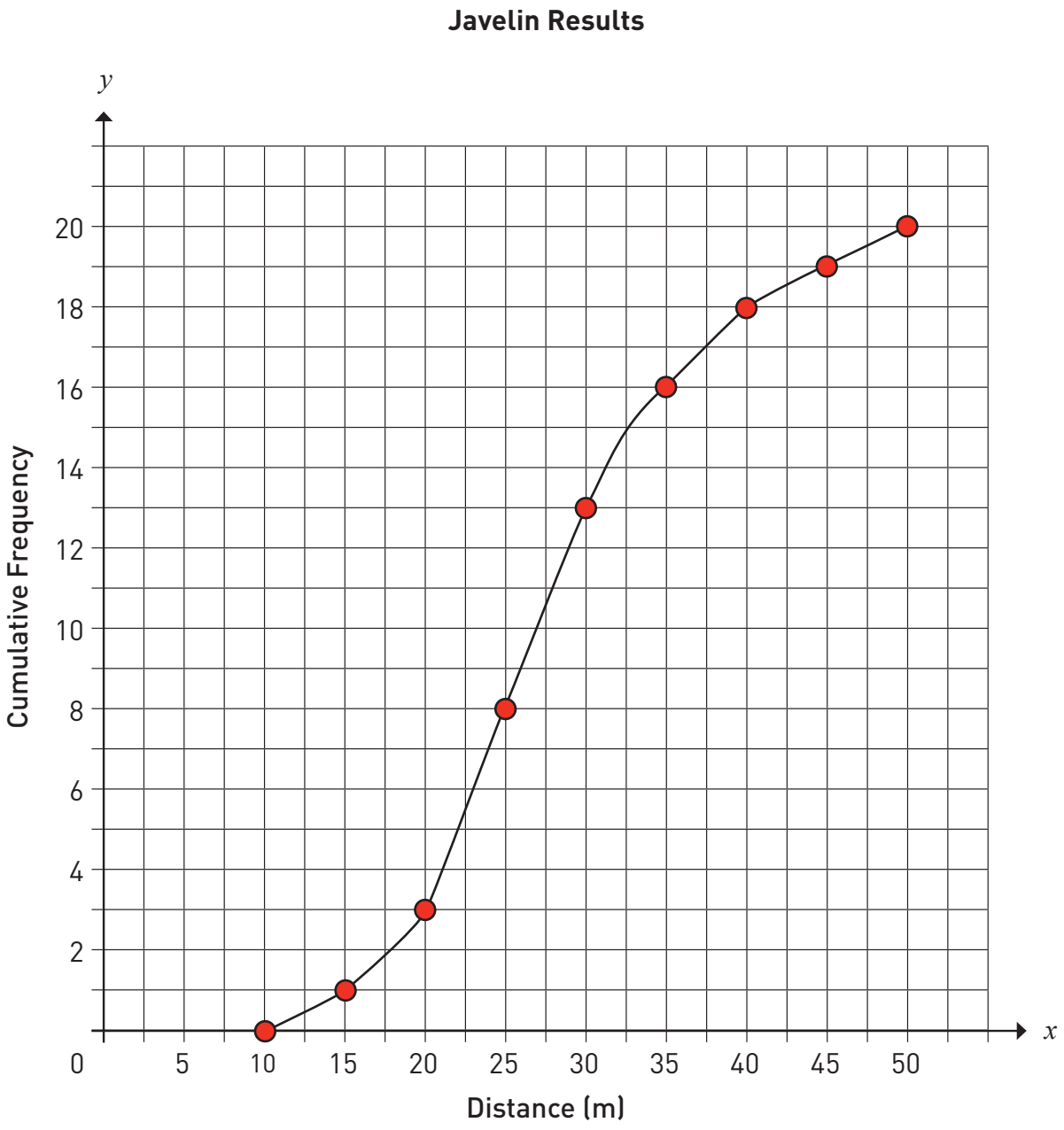
Pupils calculate the volume of composite 3-D shapes by splitting the shape into two or more common 3-D shapes.

For example pupils calculate the volume of this barn.



Cumulative Frequency Graph

Pupils use the data from a cumulative frequency table and construct a cumulative frequency graph.



Estimate the Mean from a Grouped Frequency Table

Pupils estimate the mean for a set of grouped data from a grouped frequency table. They identify the mid-point of each class interval and multiply each mid-point by the corresponding frequency.

For example pupils estimate the mean height for pupils in a Year 10 class.

Height (cm)	Frequency	Mid-Point (cm)	Frequency × Mid-Point
$130 < h \leqslant 140$	3	135	405
$140 < h \leqslant 150$	7	145	1015
$150 < h \leqslant 160$	9	155	1395
$160 < h \leqslant 170$	5	165	825
$170 < h \leqslant 180$	4	175	700
Total	**28**	**–**	**4340**

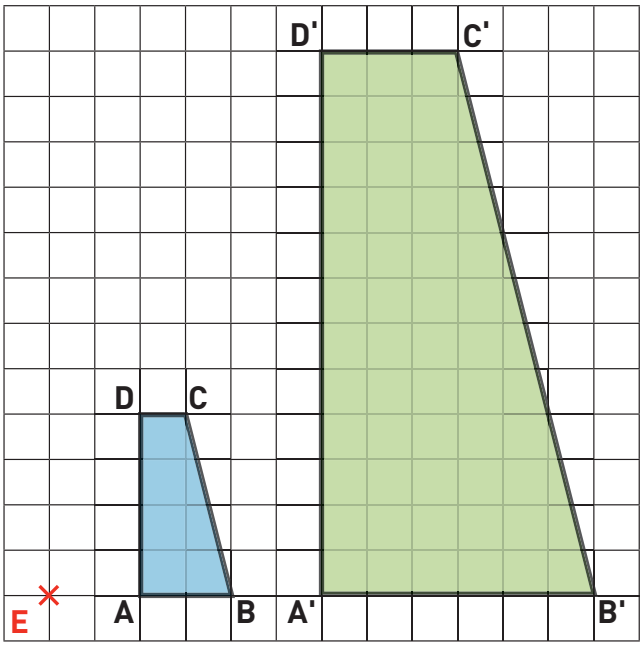
To estimate the mean **divide** the **total** for the **Frequency x Mid-Point** column by the **total** for the **Frequency** column

estimated mean = 4340 ÷ 28 = **155 cm**

Enlargement

Pupils enlarge 2-D shapes given a centre of enlargement and a scale factor.

For example pupils enlarge the object (blue trapezium) using a scale factor of 3 and the centre of enlargement (E) to get the image (green trapezium).

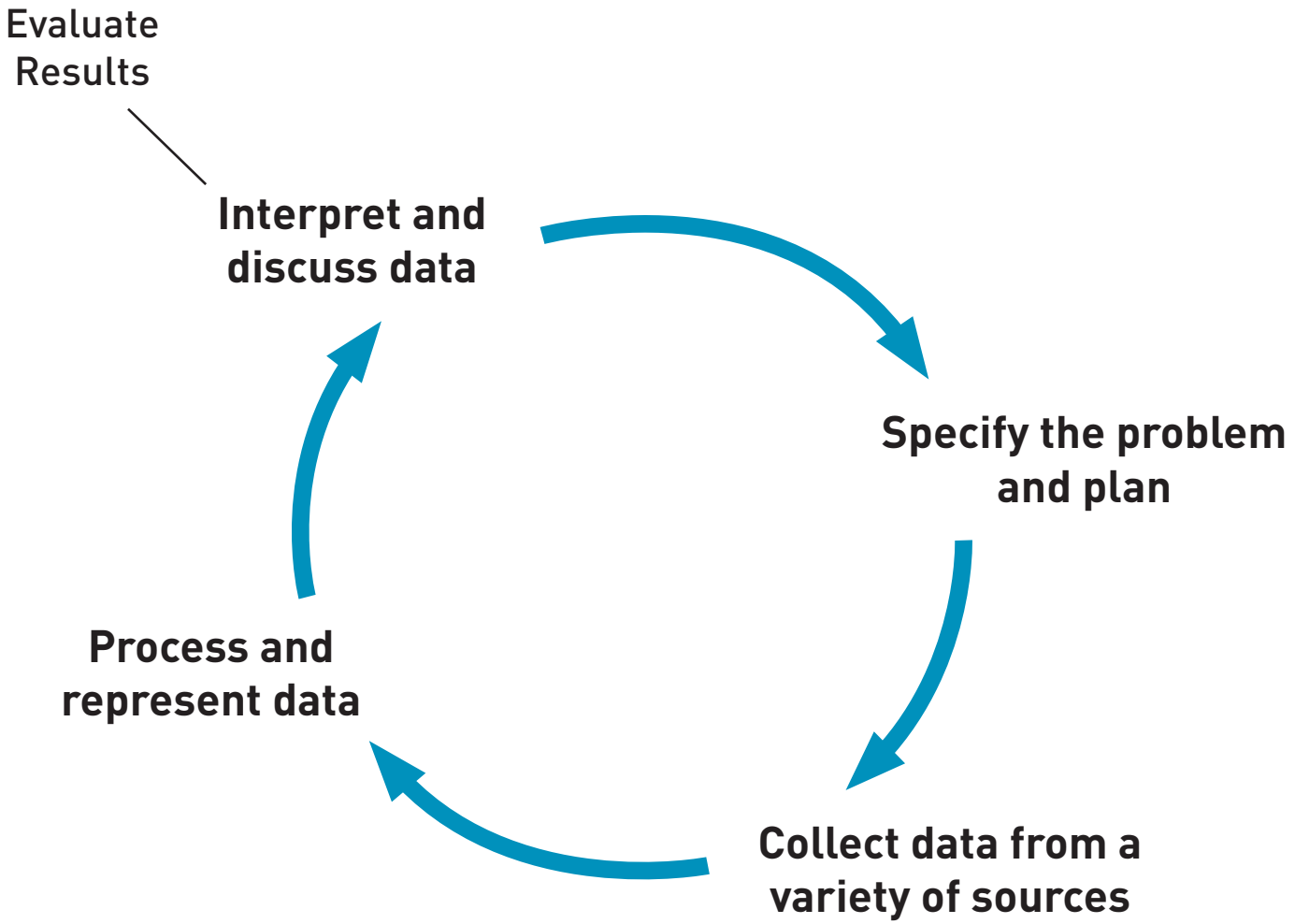


E is the **centre of enlargement.**

The **scale factor** is **3**.

Handling Data Cycle

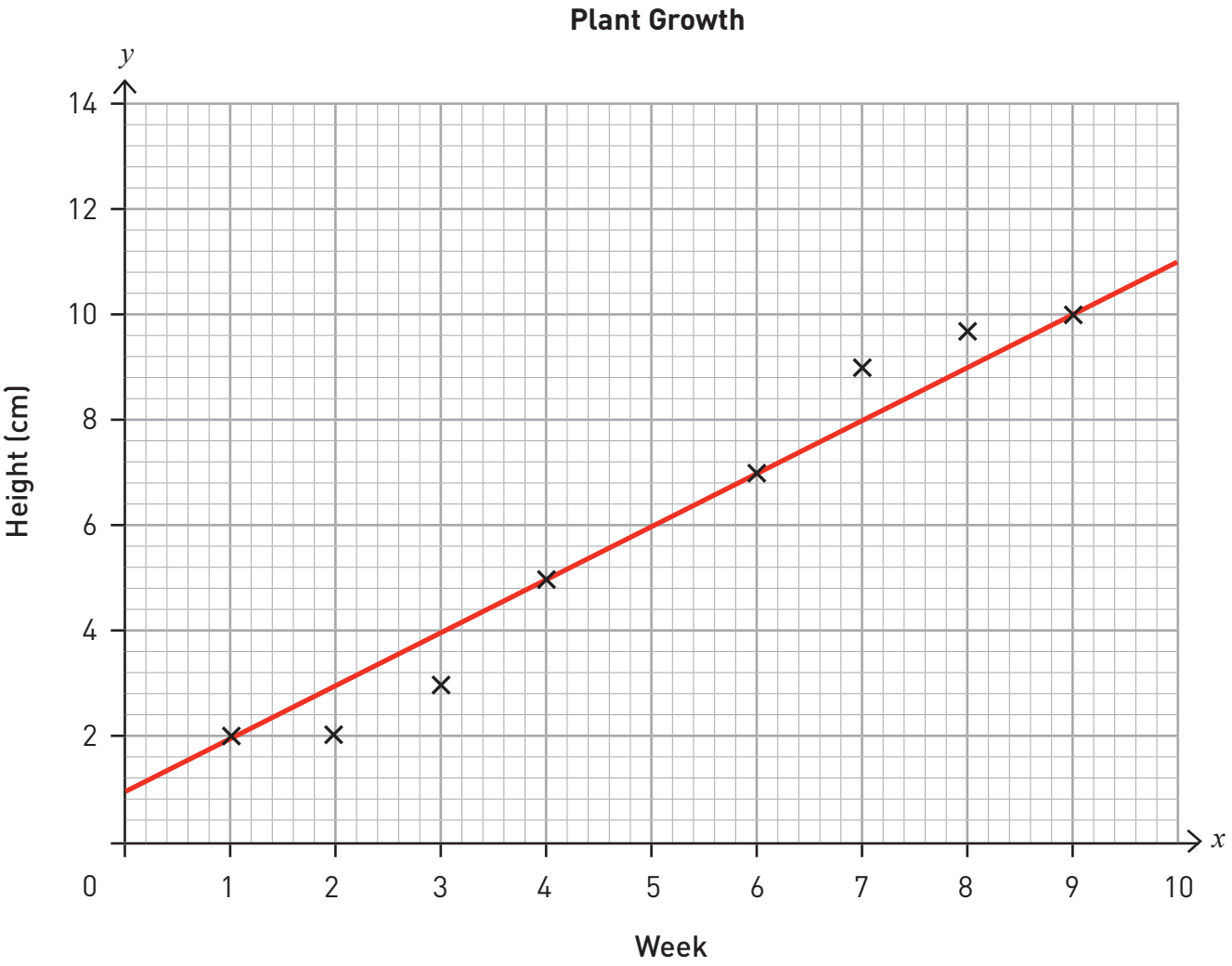
Pupils use the handling data cycle when investigating a line of enquiry.



Line of Best Fit

Pupils draw an appropriate line of best fit on a scatter diagram and use their line to identify intermediate values.

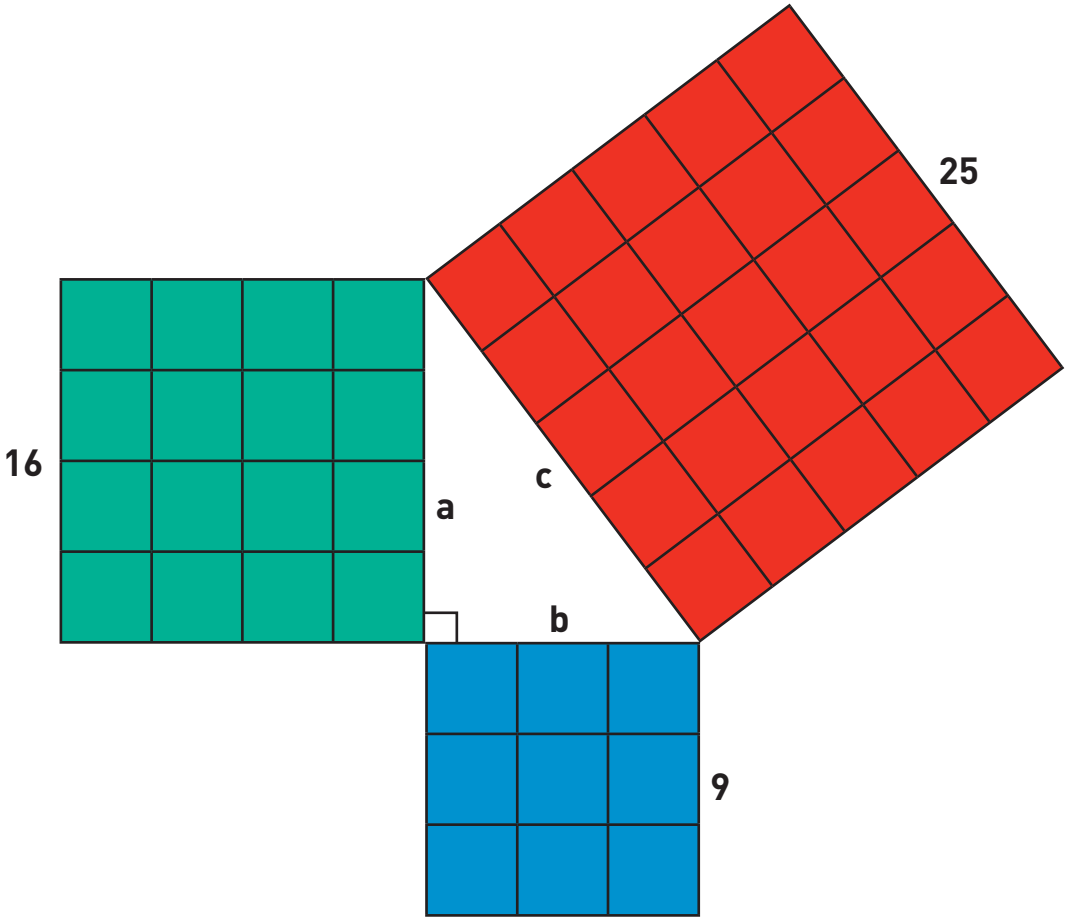
For example pupils use a line of best fit to estimate the height of a plant in the fifth week.



Pythagoras' Theorem

Pupils use Pythagoras' theorem to identify the length of the third side of a right-angled triangle when two lengths are known.

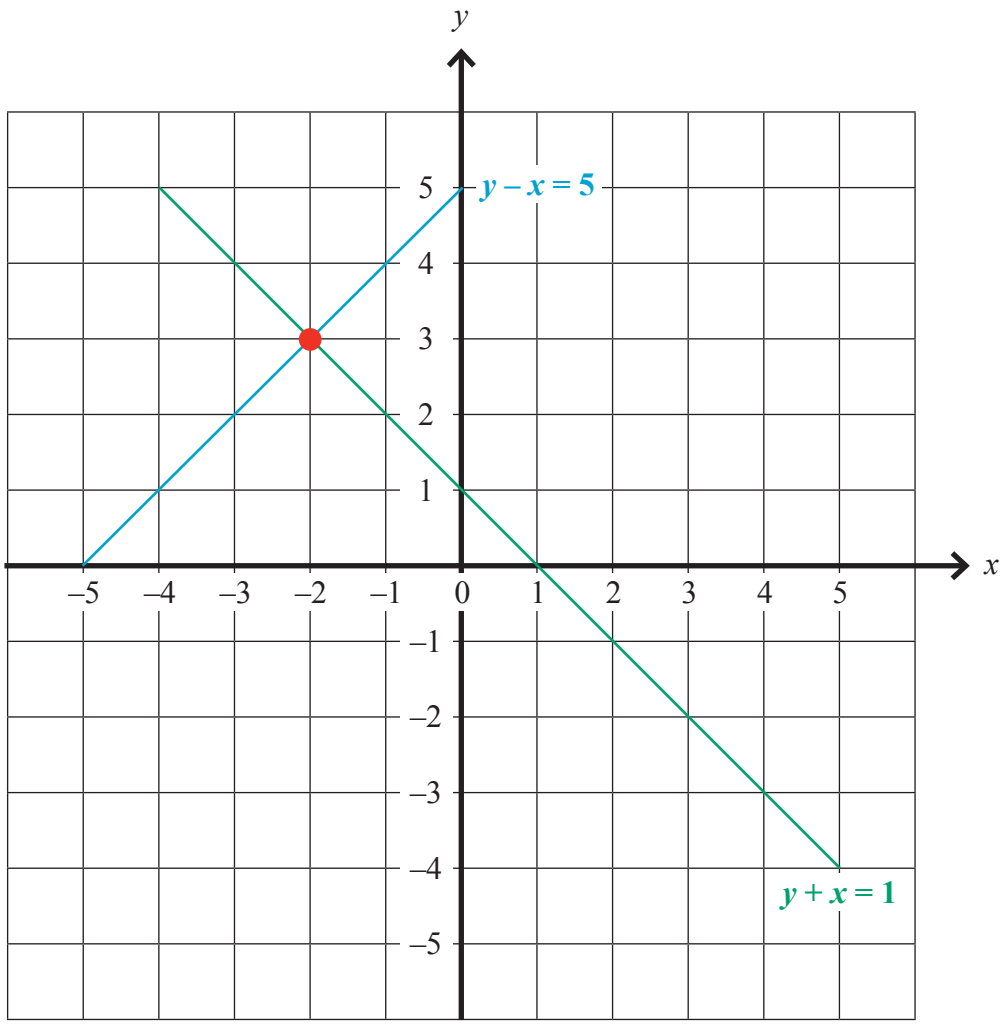
Pupils know that the area of the square drawn on the length of the longest side (hypotenuse) is equal to the sum of the squares drawn on the other two shorter sides.



$$a^2 + b^2 = c^2$$

Solve Two Linear Simultaneous Equations by a Graphical Method

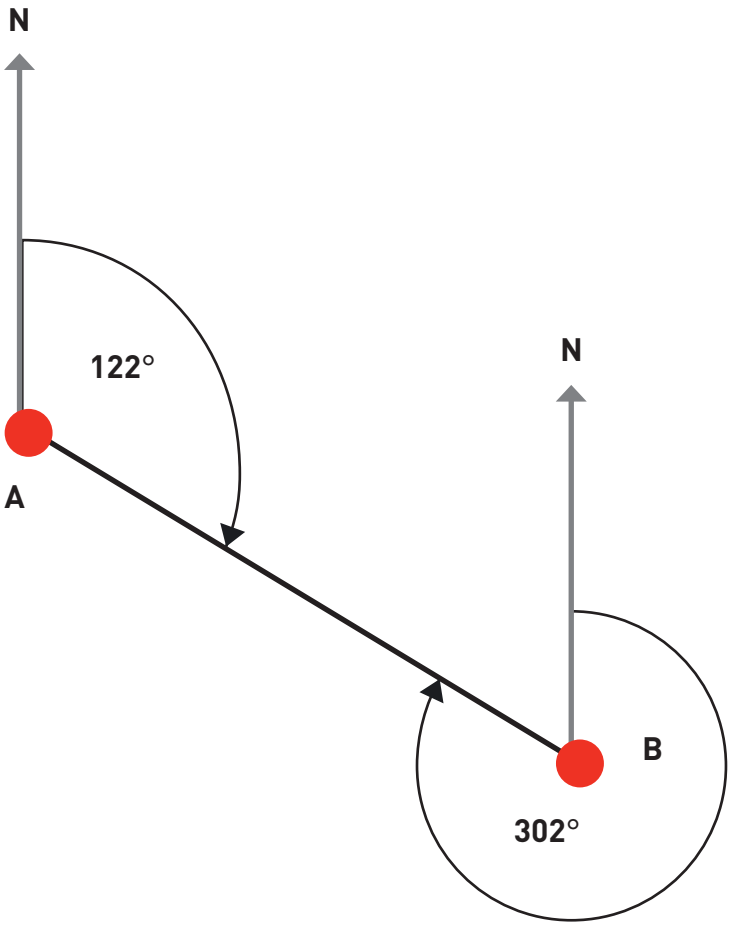
Pupils solve two unknown variables by plotting two straight lines on a graph using the corresponding linear equations.



$x = -2$ and $y = 3$

Three Figure Bearings

Pupils draw and measure three figure bearings. They also determine the size of bearings when they are not drawn to scale.



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