

# Programme of Study for Mathematics at Key Stage 2

## Introduction

Key Stage 1 and Key Stage 2 should be seen as a continuum. Pupils will come to Key Stage 2 with a spread of mathematical ability and attainment and should be allowed to continue to learn at their own individual pace.

Time should be allowed for pupils to develop and consolidate their mathematical ideas using practical materials before moving on to more formal recording. They should be given opportunities to develop their skills in estimation and approximation and encouraged to make predictions in all areas of mathematics.

The sections of the programme of study interrelate. Processes in Mathematics should pervade the entire mathematics programme. Pupils should use and apply mathematics in practical tasks, in real-life situations and within mathematics itself.

## Mathematical Activities

Throughout the whole mathematics programme, pupils should be engaged in a wide range of purposeful activities. These activities should:

- involve pupils in different modes of learning, including playing, exploring and investigating, doing and observing, talking and listening, discussing and asking questions, reflecting, drafting, reading and recording;
- match the ability and stage of development of the pupil;
- include both independent and co-operative work;
- bring together different areas of mathematics;
- develop mental skills;
- use, where appropriate, pupils' own interests or questions, either as a starting point, or as further lines of development;
- be balanced between tasks which develop knowledge, skills and understanding and those which develop the ability to tackle problems;
- be balanced between those which are short in duration and those which have scope for development over an extended period;
- include those which have an exact result or answer and those which have many possible outcomes.

## Contexts for Learning

Pupils should have opportunities to develop and consolidate their knowledge, skills and understanding of mathematics through activities in various aspects of the curriculum, the environment, the everyday experiences of the classroom, home and wider world.

## Communication in Mathematics

Pupils should communicate in oral, pictorial and written form. They should use and extend their mathematical language by discussing, describing, comparing and explaining all aspects of their mathematics, progressing from the use of informal personal language to effective use of appropriate mathematical language.

## Computation

The mental approach should be a pupil's first resort when a calculation is needed. The ability to adopt mental methods of calculation should be developed systematically as pupils acquire the basic arithmetical skills. They should be involved in regular, varied and imaginative activities through which they will:

- explore numbers and become aware of their properties and relationships;
- develop quick recall of basic number facts;
- use number facts in context;
- learn to make a reasonable estimate when dealing with larger numbers;
- discuss and develop their own personal methods of calculating.

Pupils should develop more standard forms of recording than those used earlier, as the need for mathematical notation and symbols is appreciated. In developing skills in pencil and paper calculation, pupils should have opportunities to develop their own personal ways of recording calculations. They should compare and discuss these, and ultimately refine and practise pencil and paper methods that are agreed and understood.

Pupils should use calculators in extended investigations in mathematical and real-life situations. When using a calculator, pupils should:

- explore how a calculator works through play and number games;
- appreciate the operations possible on a calculator and their proper order;
- check calculator results by making an estimate, by repeating the operation in a different order or by using a different operation;
- learn to interpret calculator results including rounding errors.

## Contribution to Educational (Cross-curricular) Themes

Pupils should be given opportunities, where appropriate, to develop and apply their knowledge, skills and understanding of information technology and to use calculators sensibly at a level appropriate to their ability.

They should have opportunities to use computer databases to store and process information and to produce and interpret a variety of graphical representations. They should be introduced to a programming language, *for example, LOGO*, to create pictures and patterns, and to generate mathematical shapes and designs.

Pupils should be given opportunities to extend their understanding of cultural heritage by considering the historical aspects of our number and measuring systems.

In handling data, pupils should use real data, *for example, data drawn from health, road safety and environmental statistics.*

## Resources

Throughout Key Stage 2, pupils should continue to use a wide variety of materials, games and tools to develop their mathematical skills and concepts. In addition to non-structured materials, structured apparatus should be used where appropriate. They should come to appreciate the special characteristics of these materials.

## PROCESSES IN MATHEMATICS

### Using Mathematics

Pupils should have opportunities to:

- a appreciate the special characteristics of the materials and equipment they handle and so take increasing responsibility for selecting and using the materials and equipment required for their work;
- b select and use the mathematics appropriate to the current work, *for example, counting squares to find the shape with the greatest area;*
- c gather information for an activity, initially with help from the teacher; progress to identifying and obtaining the information needed to carry out their work, *for example, measure the dimensions of the classroom in order to draw a simple scale plan;*
- d plan and organise their work, learning to work systematically, *for example, draw all the possible arrangements of six squares in order to find which ones are nets of a cube;*
- e try different mathematical approaches to problems and look for ways to overcome difficulties;
- f develop their own mathematical strategies for solving problems, initially through discussion with the teacher, *for example, use trial and improvement methods; work backwards; make organised lists; simplify the task; look for patterns;* review progress, making changes where necessary.

### Communicating Mathematically

Pupils should have opportunities to:

- a understand and use the language of
  - number;
  - shape;
  - measures;
  - simple probability;
  - relationships, *for example, 'multiple of', 'factor of' and 'parallel to';*
- b interpret situations mathematically using appropriate symbols or diagrams, *for example*
  - % (percentage);
  - > (greater than);
  - < (less than);
- c discuss their work; compare their ideas and methods with others, *for example*
  - when finding ways to measure the capacity of your lungs or the thickness of a magazine;
  - when investigating the number of children crossing the road to school in order to establish the need for a crossing patrol;
- d record results, initially in a given format; choose the most appropriate format and use it to present information and results clearly; explain the reasons for their choice of presentation.

## Mathematical Reasoning

Pupils should have opportunities to:

- a recognise general patterns and relationships and make predictions about them;
- b ask and respond to open-ended questions; follow alternative suggestions;
- c explain their thinking;
- d understand general statements and investigate whether particular cases match them, *for example*
  - *odd number + even number = odd number;*
  - *the taller people are, the more they 'weigh';*
- e make a general statement based on evidence, *for example*
  - *from a road safety survey, most pupils are injured on the road between 3.00 and 4.00 in the afternoon;*
  - *all triangles will tessellate;*
- f check their results and consider whether they are reasonable, *for example, using inverse operations and estimating to find the approximate answer.*

## NUMBER

### Understanding Number and Number Notation

Pupils should have opportunities to:

- read, write and order whole numbers, initially to 100 and progressing to using any whole number, understanding that the position of a digit signifies its value; use their understanding of place value to develop computational methods;
- extend understanding of place value to include decimals, initially to one decimal place and then up to two decimal places; use this to multiply and divide numbers by 10, 100 and 1000;
- estimate within calculations, initially with numbers within 100 and extending to all whole numbers; approximate numbers to the nearest 10 or 100; estimate and approximate to gain a feeling for the size of a solution to a problem, *for example, understand that  $32 \times 9$  is approximately  $30 \times 10$* ;
- understand and use, in context, vulgar fractions, decimal fractions and percentages; understand the equivalence of simple fractions; explore the relationships between fractions and percentages, *for example, understand that half price is the same as 50% off.*

### Patterns, Relationships, and Sequences

Pupils should have opportunities to:

- explore and predict patterns and sequences of whole numbers initially within 100 and extending to larger numbers, including counting in different sizes of step, doubling and halving numbers, finding multiplication patterns in the hundred square, predicting subsequent numbers in a sequence; follow simple sets of instructions to generate a sequence; devise rules for determining sequences;
- understand and use multiples and factors and terms, including prime, square and cube; appreciate that multiplication and division are inverse operations;
- interpret, generalise and use simple relationships expressed in numerical, spatial and practical situations, *for example, finding equivalent forms of two digit numbers; understanding square and triangular numbers; understand and use simple function machines*;
- understand that a letter can stand for an unknown number, *for example,  $6 + a = 24$ .*

### Operations and their Applications

Pupils should have opportunities to:

- consolidate knowledge of addition and subtraction facts to 20; understand and use this knowledge to calculate quickly facts that they cannot recall; add mentally two two-digit numbers up to 100 and subtract mentally one two-digit number from another; know the multiplication facts to  $10 \times 10$ ; use these facts when solving problems;

- b engage in a range of activities to develop understanding of the four operations of number and their interrelationships; appreciate the use of brackets; develop a range of non-calculator methods of computation to include addition and subtraction with up to two decimal places and multiplication and division of decimals by whole numbers; use these operations to solve problems, using a calculator where necessary.

### **Money**

Pupils should have opportunities to:

- a understand and use the conventional way of recording money; use the four operations to solve problems;
- b estimate and approximate to gain a feeling for the size of a solution to a problem before carrying out a calculation;
- c interpret a calculator display in relation to money.

## MEASURES

Pupils should have opportunities to:

- a develop skills in estimation of length, 'weight', volume/capacity, time, area and temperature through practical activities, using metric units where appropriate;
- b develop the language associated with a wider range of metric units and be confident with the terms metre, gram and litre, and their relevant prefixes of kilo, centi, milli;
- c appreciate important ideas about measurement including the continuous nature of measurement and the need for appropriate accuracy;
- d choose and use appropriate metric units and measuring instruments in a variety of situations, interpreting numbers on a range of measuring instruments, *for example, measure the perimeter of the playground to the nearest metre using a trundle wheel;*
- e understand the relationship between units, *for example, know that kilograms and grams are used to weigh food; convert from one metric unit to another, for example, know that 175 centimetres is 1.75 metres; use the four operations to solve problems, working with up to three decimal places, where appropriate;*
- f know the Imperial units still in common use including foot, yard, mile, pound and pint;
- g understand and use negative numbers in context, *for example, know that if the temperature rises during the day from  $-3^{\circ}\text{C}$  to  $4^{\circ}\text{C}$ , the temperature has risen by 7 degrees;*
- h understand the concept of perimeter and calculate the perimeter of simple shapes; find areas by counting squares and volumes by counting cubes; calculate areas and volumes of simple shapes in two and three dimensions;
- i understand and use scale in the context of simple maps and drawings, *for example*
  - *draw a simple plan of the classroom and know that one centimetre square represents one square metre;*
  - *calculate the actual distance as the crow flies between two places on a map using the scale of 1 cm to 1 km;*
- j know the units of measurement of time and the relationship between them;
- k recognise times on the analogue clock, including the hour, half and quarter hours, five minute intervals and one minute intervals; understand the relationship between the twelve and twenty-four hour clocks, including am and pm; read analogue and digital displays and understand the relationship between them; use timetables involving the twenty-four clock and perform simple calculations related to the timetables;
- l know the months of the year; explore calendar patterns.

## SHAPE AND SPACE

### Exploration of Shape

Pupils should have opportunities to:

- a use materials, *for example, geoboards, construction sets and paper*, to construct and handle a wide range of regular and irregular 2-D shapes; classify these through examination of angles and sides; look for line and rotational symmetries in practical situations; reflect shapes, *for example, by using a mirror*; use shapes to explore and create tessellations; name and describe common 2-D shapes including squares, rectangles, circles, triangles, hexagons and pentagons; begin to understand the meaning of congruence in 2-D shapes;
- b use materials, *for example, blocks, construction sets and cereal packets*, to construct various 3-D shapes; investigate the number of faces, edges and vertices on these shapes; name and describe common 3-D shapes including cubes, cuboids, cones, cylinders, spheres, triangular prisms and pyramids; use nets to explore the relationship between 2-D and 3-D shapes;
- c recognise geometrical properties and use these to solve problems.

### Position, Movement and Direction

Pupils should have opportunities to:

- a investigate practically,  $\frac{1}{4}$  turns,  $\frac{1}{2}$  turns and whole turns to understand the notion of angle in the context of turning; find right angles in 2-D and 3-D shapes in the environment; understand clockwise and anticlockwise; know the eight points of the compass; use a programmable device, *for example, a Roamer*, to extend understanding of movement and turning;
- b develop the language associated with line and angle, including vertical, horizontal, perpendicular, parallel, acute, obtuse and reflex;
- c recognise properties of acute, obtuse and reflex angles, *for example, know that an acute angle is less than a right angle and that a reflex angle is greater than two right angles*;
- d investigate angles in triangles, including scalene, right angle, equilateral and isosceles, and quadrilaterals including square, rectangle, rhombus, kite, parallelogram, trapezium; measure and draw angles to the nearest degree up to  $360^\circ$  with reasonable accuracy;
- e use co-ordinates to plot points and draw shapes in the first quadrant;
- f be introduced to a programming language *for example, LOGO*, and use it to create pictures and patterns and to generate mathematical shapes.

## HANDLING DATA

### Collect, Represent and Interpret Data

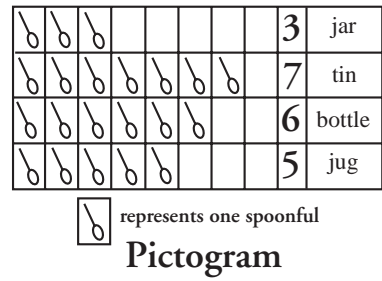
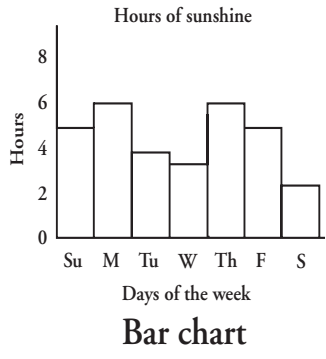
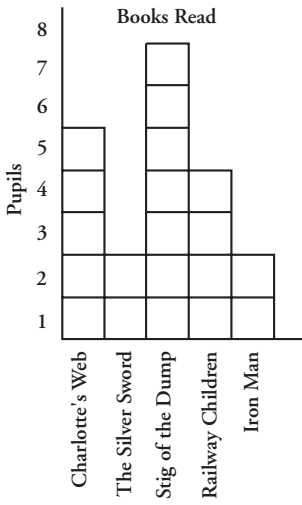
Pupils should have opportunities to:

- a use data drawn from a range of meaningful situations, *for example, those arising in other subjects*;
- b collect, classify, record, represent and interpret discrete numerical data, using graphs, tables and diagrams, including Venn, Decision tree and Carroll diagrams, pictograms, block graphs, bar charts, bar-line graphs and line graphs with the axis starting at zero (initially with given intervals), (for examples, see page 11); explain their work orally or through writing and draw conclusions;
- c interpret tables and lists used in everyday life, *for example, those found in a catalogue or road safety accident report*; interpret a wide range of graphs and diagrams including a pie chart; create and interpret frequency tables, including those for grouped discrete data, *for example, birthdays*; use tallying methods, including the 5-bar gate;
- d design an observation sheet and use it to record a set of data leading to a frequency table; collate and analyse the results; progress to designing and using a data collection sheet, interpreting the results;
- e enter information in a database and interrogate it, using at least two criteria; use an appropriate computer package to produce a variety of graphical representations of data;
- f understand, calculate and use the mean and range of a set of discrete data, *for example, calculating the mean score of two teams that have played different numbers of games in order to compare their performance*.

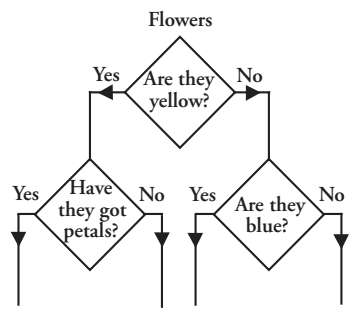
### Introduction to Probability

Pupils should have opportunities to:

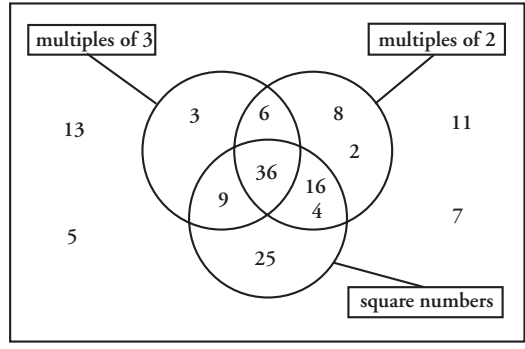
- a become familiar with and use the language of probability including certain, uncertain, likely, unlikely, impossible and fair, by participating in games and other practical activities;
- b understand possible outcomes of simple random events, *for example, that buttered toast will fall with either the buttered side up or the buttered side down*; understand that there is a degree of uncertainty about the outcome of some events, while others are certain or impossible, *for example, it is*
  - *certain to get dark tonight*;
  - *impossible for a person to turn into a fish*;
  - *uncertain whether or not it will rain tomorrow*;
- c place events in order of 'likelihood'; understand and use the idea of 'fifty-fifty' or 'evens' and know whether events are more or less likely than this, *for example, know that if a die is thrown there is an equal chance of an odd or even number but the chance of getting a 5 is less than an even chance*.



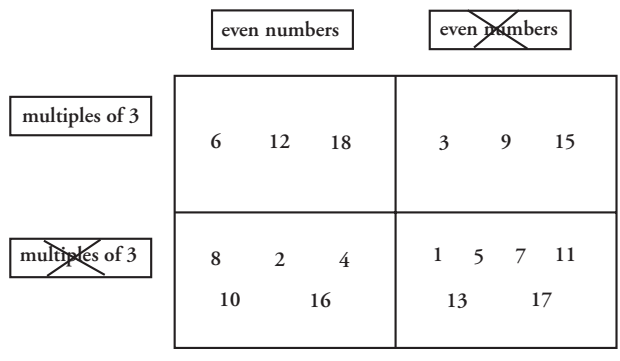
Block graph



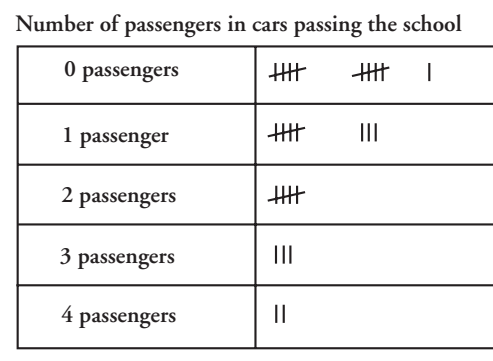
Decision tree



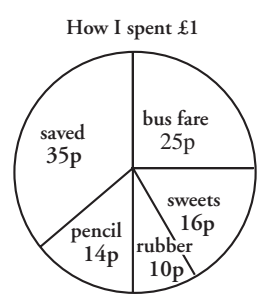
Venn diagram



Carroll diagram



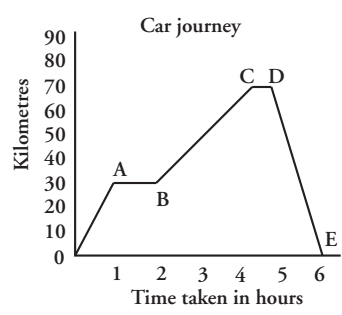
Frequency table



Pie chart



Bar-line graph



Line graph