



# Mathematics

Learning

## A World of Maths series

<p>01. Barcelona's Big Church Duration: 14 Minutes</p>	<p>These 11 short sequences, shot in and around Gaudí's La Sagrada Familia church in Barcelona, each display a different aspect of mathematics for pupils to explore, investigate and discuss.</p> <p>Each short sequence in these programs poses a question intended to stimulate mathematical discussion rather than to elicit a correct answer to a computation. The programs are intended to be used in sections, stopping and replaying the video to analyse the information.</p>
<p>02. Cricket Match Duration: 14 Minutes</p>	<p>These 10 short sequences, shot during a Saturday cricket match, each display a different aspect of mathematics for students to explore, investigate and discuss.</p>
<p>03. Hotel Duration: 14 Minutes</p>	<p>Shot behind the scenes at a London hotel, these 12 short sequences each display a different aspect of mathematics for pupils to explore, investigate and discuss.</p>
<p>04. Ice Rink Duration: 14 Minutes</p>	<p>These 10 short sequences, all shot during the construction of a new outdoor ice rink at the Old Naval College in Greenwich, feature a different aspect of mathematics for students to explore and investigate.</p>
<p>05. Night Train Duration: 14 Minutes</p>	<p>These 12 short sequences, shot behind the scenes on the overnight sleeper train from London to Scotland, each display a different aspect of mathematics for student to explore, investigate and discuss.</p>
<p>06. The Mini Duration: 14 Minutes</p>	<p>Shot at the BMW Mini assembly plant in Oxford and out on the road, these ten short sequences all feature a different aspect of mathematics for pupils to explore and investigate.</p>

## Enter the Maths Zone series

<p>01. Order of Operations Duration: 14 Minutes</p>	<p>This series is set in a mythical world, the Garden of Reason, where three characters engage each other in challenges and puzzles. In each episode Lisa, the heroine, encounters the Guard and the Wizard.</p> <p>The Guard bars Lisa's progress through the garden unless and until she has solve a mathematical riddle. Lisa is then joined by the Wizard, a kindly but absent-minded master of the subject and together they explore other mathematical problems.</p> <p>Every program is interwoven with astounding mathematical facts that will entertain and amaze.</p>
<p>02. Negative Numbers Duration: 14 Minutes</p>	

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03. Decimals, Fractions and Percentages Duration: 14 Minutes	
04. Ratio and Scale Duration: 14 Minutes	
05. Patterns on a Number Grid Duration: 14 Minutes	
<b>Maths 4 Real series</b>	
01. Percentage Changes Duration: 14 Minutes	<p>Sales and special offers in the high street provide an opportunity to explore percentage increases and decreases. We see how to:</p> <ul style="list-style-type: none"><li>* calculate a discount</li><li>* work out a percentage change</li><li>* compare different offers expressed as percentages</li><li>* find the original value of something before a percentage change</li></ul> <p>It includes tips for answering exam questions, and a discussion of a typical exam error ('Tick or Trash'). The program uses familiar contexts that students will have met in real life. It assumes a basic understanding of how to calculate a percentage of a quantity and how to convert a fraction to a percentage. Common fraction-percentage equivalents are used, and both mental and mechanical means of calculation are illustrated.</p> <p>The program could be used either as an introduction to more involved calculations with percentage changes, or as revision of the types of problems that may be set within the topic and their methods of solution.</p>

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02.  
Standard Form  
Duration: 14 Minutes

The very large and very small numbers that arise in the mass production of confectionery are used to show how numbers can be simplified using standard form. The program also shows how astronomers use standard form in calculations involving the huge dimensions of outer space. We see how to:

- \* express large and small numbers in standard form
- \* simplify real situations by using standard form notation
- \* multiply two numbers in standard form
- \* solve a problem by division of one number by another in standard form
- \* appreciate the size of numbers given in standard form

The program could be used either to introduce or to review the topic, but some knowledge of index notation and the rules of indices is assumed. Students may benefit from some revision of how to combine powers before watching the program. The examples show working with both positive and negative powers of 10, and use real-life problems to demonstrate the methods of multiplication and division with numbers in standard form. Mental calculation and use of a calculator are both shown. The program avoids detailed descriptions of complex calculator functions relevant to the topic, although this may be a worthwhile area for discussion after watching the program.

The program demonstrates the relevance of the topic to people performing their jobs in real working environments.

03.  
Ratio and Proportion  
Duration: 14 Minutes

Ben and Katie are called upon to sample some tasty treats, as they learn how ratios are used in the food industry to get recipes just right. Later, Tony Robinson explains how the charity Comic Relief used ratios to share out the huge amounts donated to last year's campaign. We see how to:

- \* express relationships between quantities as ratios
- \* keep ingredients in the same proportions when scaling up a recipe
- \* solve ratio problems using a unitary method for calculation
- \* share an amount in a given ratio

The program shows how understanding of ratio and proportion is applied in different contexts in the real world. Clear visual demonstrations develop the concepts and explain the techniques. Calculators are used where appropriate, but many of the examples are tackled mentally, and use values that are simple enough for most pupils to follow.

Ratio notation and equivalence are mentioned but not developed in detail: it is assumed that pupils will have some knowledge of these before viewing. Although the idea of units is included, it is not specifically discussed: this could be treated more fully after viewing.

The program should help pupils to appreciate that these methods are widely used to solve problems in the real world.

# Mathematics

04.  
Straight Line Graphs  
Duration: 14 Minutes

Graphs based on real life are used to explore the ideas of gradient and intercept. The general equation of a straight-line graph is explained. Examples show how straight-line graphs can be used to compare mobile phone charges, to investigate fuel consumption, and to model the emptying of water from a bath. We see how to:

- \* complete tables of values
- \* represent initial values and rates of change, both graphically and algebraically
- \* plot points and read values from a graph
- \* find the gradient,  $m$ , and the value of the  $y$ -axis intercept,  $c$ , of a graph
- \* write down the equation of a straight-line graph in the form  $y = mx + c$
- \* compare and interpret graphs
- \* distinguish between graphs with positive and negative gradients

The program demonstrates how graphs drawn from the real world are expressed in abstract, algebraic form. Some prior experience of finding gradients is assumed. Although the effects of varying  $m$  and  $c$  are demonstrated, students would benefit from a fuller treatment of these ideas.

The program could be used to summarise the main features of straight-line graphs, to help students appreciate the application of mathematics to modelling real situations, and to provide real contexts for a relatively abstract topic.

05.  
Distance/Time Graphs  
Duration: 14 Minutes

Ben and Katie are required to undertake contrasting journeys in order to gather data to demonstrate the construction of distance-time graphs. We follow Ben's experiences with the pop group Atomic Kitten and Katie's flying visit to Belgium via the Channel Tunnel, gathering the material to draw distance-time graphs and to discuss their properties. We see how to:

- \* choose sensible scales for the axes and plot significant points
- \* find the average speed for a section of a journey and relate this to the gradient of the graph
- \* calculate the speed using the formula 'speed = distance  $\div$  time', taking values from the graph
- \* show a period of rest as a horizontal line segment
- \* represent return journeys and understand negative gradients in this context
- \* calculate using appropriate units for distance, time and speed

The content includes how real journeys can be plotted and analysed using graphs and aims to demonstrate the mathematical ideas using contexts that are appealing and readily understood by the student.

# Mathematics

06.  
Pythagoras' Theorem  
Duration: 14 Minutes

The program shows how Pythagoras' Theorem can be used to find unknown lengths in right-angled triangles and to prove that a triangle is right-angled. It draws on the history of mathematics to show how this important theorem has been used for thousands of years to solve practical problems. Ben and Katie explore the relevance of Pythagoras' Theorem in our own world, witnessing the construction of an aerial slide by the army, the positioning of equipment at a wind farm, and measurement of a corner on a football pitch. We see how to:

- \* express Pythagoras' Theorem both algebraically and geometrically
- \* find the length of the hypotenuse of a right-angled triangle
- \* work with squares and square roots
- \* use the converse of the theorem to prove that a triangle is right-angled
- \* rearrange the formula to change the subject of the equation
- \* calculate the length of a shorter side of a right-angled triangle

The program aims to enhance students' understanding of the topic by providing clear visual explanations, dynamic geometrical demonstrations, and relevant applications from the real world.

If students have covered the content elsewhere, the program could be used to review the techniques and facts and provide meaningful contexts. It can be used either as a revision tool or to enrich other work on the topic. It could be shown in short sections to support students' progress through stages of the work, and then be shown in full to summarise the topic. Students new to the topic would benefit from some introductory practical or investigative work before watching the program.

# Mathematics

07.

The Sine Ratio

Duration: 14 Minutes

Fire-fighters using ladders in emergency situations, a young water-skier preparing for a competition, and a champion Paralympic athlete show how important the relationships between sides and angles in right-angled triangles are within each of their disciplines. The program concentrates on the sine ratio and its applications. It shows how appropriate triangles and dimensions can be drawn from real-life situations. Clear views of the real objects, along with helpful graphics and careful explanations, demonstrate how the necessary information is selected and used. We see how to:

- \* draw an appropriate right-angled triangle
- \* identify and name sides in relation to the angle being worked with
- \* substitute values in the formula 'sin = opposite / hypotenuse'
- \* calculate the length of a side opposite to a known angle in a right-angled triangle
- \* calculate the length of the hypotenuse
- \* select appropriate calculator functions
- \* substitute lengths of sides into the formula in order to calculate an angle

Although the program deals only with the sine ratio, it would still be relevant to students who have been introduced to all three ratios. Similar triangles and the constant ratios that they produce are mentioned. It is assumed that students will have done a fair amount of preparatory work within the topic prior to viewing. The program would be most useful as a means of showing students how the theory relates to the real world. It could be used to build and consolidate understanding of the topic alongside other work. It could also be helpful in reinforcing, or revising, the techniques needed to solve the types of problem relating to the topic that are most often encountered.

# Mathematics

08.

Bearings

Duration: 14 Minutes

Bearings are introduced through demonstrations of how they are applied to navigation in real life. The program shows how even the most sophisticated technology on ships and aeroplanes uses simple three-figure bearings to plot a course. We see how to:

- \* use both compass points and angles to describe a direction
- \* express a bearing as a three-digit number
- \* construct a 'north line' and measure three-figure bearings clockwise from north
- \* describe a journey using bearings
- \* use scale drawings to represent real journeys

The program could be used to introduce this topic, or to revise the key points. It may be helpful as preparation for students studying Pythagoras' Theorem or trigonometry, before they tackle questions within these topics involving bearings. The program emphasises the importance of bearings for modern transportation systems. Clear diagrams and dynamic graphics are used throughout to aid understanding of the necessary techniques.

Detailed protractor-and-compass work are not covered in depth, partly because of the wide variations in the scales used on these instruments. Revision of the relevant skills, using the equipment that students are most familiar with, could usefully be done in the classroom prior to viewing. Scale drawings and maps are used, but the program does not provide detail on drawing and measuring to a given scale. Practical activities with maps and other relevant scale drawings could be incorporated into follow-up activities after watching the program.

# Mathematics

09.

Questionnaires

Duration: 14 Minutes

A new roller-coaster ride is about to open at Blackpool Pleasure Beach and Ben and Katie set out to find out just how much the public would be prepared to pay for the experience. Having tested, on an unsuspecting public, their own initial attempts at designing a questionnaire, they realise that they need advice, and turn to BMRB, one of the country's leading market-research organisations. They find out how large-scale surveys are conducted, and commission one themselves. The results are analysed and they return to Blackpool with good news for the ride's owners — and Ben gets another thrilling ride. We see how to:

- \* identify a subject for a survey
- \* construct an appropriate question
- \* use a pilot survey to test questions and identify problems
- \* construct a data-capture sheet to record responses
- \* select a representative sample
- \* carry out a survey using a questionnaire
- \* criticise and amend questions and recognise bias
- \* analyse the results of a survey and draw conclusions

The program aims to highlight the types of difficulties and the common pitfalls that students are likely to encounter when carrying out their own surveys. It also shows how questionnaires are frequently used in the commercial world to gather a wide variety of information.

The program uses a real-life survey, on a subject that students should find appealing, in order to engage their interest and to demonstrate the commercial importance of constructing a good questionnaire.

The program is self-contained and it could be used to support and enrich other work on data handling. It should be particularly helpful to students preparing to undertake their own surveys.

# Mathematics

10.  
Combined Probability  
Duration: 14 Minutes

Competitions and marketing campaigns offering prizes are used to develop ideas about probability through consideration of the chance of being a winner. We see how probability concerns both the people who devise competitions and the people who enter them. A simpler scenario of randomly choosing a snack is used to introduce the necessary concepts and to illustrate relevant calculations for combining probabilities. We see how to:

- \* represent probability, as a fraction or a decimal, on a scale from 0 to 1
- \* calculate the probability of a single event
- \* calculate the combined probability of two mutually exclusive events (using the 'or rule')
- \* calculate the combined probability for two independent events (using the 'and rule')
- \* use tree diagrams to illustrate all possible outcomes and to assist with calculation, both for a single event and for two events
- \* check that the sum of probabilities is 1 for all possible outcomes of a single event

The program develops the basic ideas of combining probabilities using simple cases and straightforward arithmetic, mainly with fractions. The construction and use of tree diagrams to illustrate events and to calculate probabilities is covered in easy stages. The program offers relevant examples, illustrated with clear graphics that will help students appreciate how tree diagrams are built and used. The program could be used as an introduction to combined probability, particularly tree diagrams. While there is some revision of simple probability, it is assumed that students will have already met the basic ideas before viewing.

## Maths 4 Real 2 series

01.  
Calculating Interest  
Duration: 14 Minutes

Two teenagers who have saved their summer earnings explore ways of making their money grow. With the help of the presenters, Katie and Jamie, we see how percentages are the key to understanding investments. They look in detail at the world of finance, explain the two types of interest and show their calculation. We see a visual demonstration of the difference between simple and compound calculations and Richard Whiteley, of 'Countdown' fame, offers a tip on calculation techniques. The problems of poor countries accumulating debt through interest charges are examined on a visit to the Jubilee Debt Campaign.

The program aims to present the topic of calculating interest in a lively, interesting and entertaining style. Calculations and methods are demonstrated in detail. Appropriate mental arithmetic strategies and efficient use of a calculator are both specifically addressed. Clear graphic and visual explanations are used to reinforce understanding of the mathematics covered. The program draws on real-life examples and settings. These are chosen to engage the student audience, as well as to support teachers by bringing the outside world into the classroom.

# Mathematics

02.  
Quadratic Functions  
Duration: 14 Minutes

The program explores the main features of quadratic functions and their graphs. The exciting sports of speed skydiving and quad bike jumping provide examples of situations that can be modelled using quadratic functions. We see how to complete tables of values and how to plot points from the table. Presenters Katie and Jamie explore ways of recognising quadratic functions (from the graph or the equation). They also interpret information about the daring activities shown, using their graphs to make predictions about distances and times.

The program aims to present the topic of quadratic functions in a lively, interesting and entertaining style. The substitution of values and plotting from a table are demonstrated in detail. Clear graphic and visual explanations are used to reinforce understanding of the mathematics covered. The program uses dynamic real-life contexts and draws the core mathematical ideas from these settings. The content is chosen to engage the student audience, as well as to support teachers by bringing the outside world into the classroom.

03.  
Rearranging Formulae  
Duration: 14 Minutes

Presenters Jamie and Katie explore some situations in which mathematical formulae can be used to work things out. They discover that by rearranging the formulae they can make further calculations. Jamie investigates how organisers of a big rock concert work out the number of toilets they will need to hire for the event and also how divers calculate the relationship between the air in their tank and the time they can stay under water. Katie hires a car for the day and uses a formula to find out how many miles she can travel.

The program aims to present the topic of rearranging formulae in a lively, interesting and entertaining style. The algebraic steps required to transform the given formulae are demonstrated in detail and there is a steady progression in the complexity of the examples given. Clear graphic and visual explanations are used to reinforce understanding of the mathematics covered. The program uses simple real-life contexts and draws the core mathematical ideas from these settings. The content is chosen to engage the student audience, as well as to support teachers by bringing the outside world into the classroom.

04.  
Scatter Graphs  
Duration: 14 Minutes

The program looks at how scientists collect data and analyse relationships using scatter graphs. Presenters Jamie and Katie discover how these research techniques can be used to investigate the size of black cab drivers' brains, marathon runners' times and the causes of acne. Within these contexts we see how to plot scatter graphs, draw lines of best fit and describe types of correlation using real data.

The program aims to present the topic of scatter graphs in a lively, interesting and entertaining style. Emphasis is placed on achieving a good line of best fit and describing the type of correlation. Relationships between sets of data are analysed and we see how to use the graphs to make predictions. Clear graphic and visual explanations are used to demonstrate the techniques covered. The program uses real research data to build an understanding of the principles of correlation. The content is chosen to engage the student audience, as well as to support teachers by bringing the outside world into the classroom.

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<p>05. Cumulative Frequency Duration: 14 Minutes</p>	<p>Jamie records the scores at the UK Snakeboard Championships and draws a cumulative frequency graph to see how well a competitor has done compared with the rest. Median and quartiles are introduced and we see in detail how to find these. Katie reveals how cumulative frequency graphs and box plots can be used to summarise large sets of data. She uses results from the UK National Sizing Survey and finds out from a member of the team how the data is analysed.</p> <p>The program aims to present the topic of cumulative frequency in a lively, interesting and entertaining style. Completing tables and plotting points are shown, but the program focuses on analysing the data, using medians, quartiles and box plots. Graphs are interpreted within the real contexts shown and clear graphic and visual explanations are used to develop the concepts covered. The content is chosen to engage the student audience, as well as to support teachers by bringing the outside world into the classroom.</p>
<p>06. Area of Circles and Composite Shapes Duration: 14 Minutes</p>	<p>Presenters Jamie and Katie compare pizza prices, and with some clever work with pizza slices they come up with and use the formula for finding the area of a circle. Drinks cans start out as a metal disc, and at a factory that produces millions of cans a day we see how precise calculation of areas is needed to minimise wastage of materials. Visual demonstrations help to introduce the idea of composite shapes, including semi-circles and quadrants - and the examiners' perennial favourite, the running track. Jamie and Katie visit an athletics stadium and demonstrate how to calculate the area inside the running track.</p> <p>The program aims to present the topic in a lively, interesting and entertaining style. Whilst a simple area of a circle calculation is shown, the focus is on applying the process to more complex problems. Splitting composite shapes into simpler calculable shapes is dealt with in detail, using both abstract images and real contexts. Clear graphic and visual explanations are used to develop the concepts covered. The content is chosen to engage the student audience, as well as to support teachers by bringing the outside world into the classroom.</p>
<p>07. Volume of Prisms Duration: 14 Minutes</p>	<p>The definition of a prism is illustrated through a dynamic presentation of the properties of these solids. Common types of prism are introduced by investigating how they form part of the basic toolkit for designers of computer games. A visit to Manchester airport demonstrates how loading freight on to aircraft requires appreciation of volume as a measure of space available. Meanwhile, the manager of the Blue Planet Aquarium needs to work with capacity when calculating the requirements of the sea life that inhabit its massive tanks.</p> <p>The program aims to present the topic in a lively, interesting and entertaining style. We see detailed calculation of volume for a variety of prisms, including those with cross-sections that are composite shapes. Conversion to liquid measure is also included. Clear graphic and visual explanations are used to develop the concepts covered. The content is chosen to engage the student audience, as well as to support teachers by bringing the outside world into the classroom.</p>

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<p>08. The Tangent Ratio Duration: 14 Minutes</p>	<p>The angle of the first drop on a roller coaster, the height of England's tallest sculpture and viewing a boat at sea from a lighthouse are all contexts in which the tangent ratio can be applied to solve real-life problems. Presenters Jamie and Katie show how to model these situations mathematically and demonstrate in detail how to perform calculations in the resulting right-angled triangles.</p> <p>The program aims to present the topic in a lively, interesting and entertaining style. The program shows how to draw the necessary information from a real situation so that a problem can be solved using a simple right-angled triangle and basic trigonometry. Only tangent calculations are included and the working is developed through a step-by-step approach, allowing each stage of the solution to be clearly seen. This approach is supported by clear graphic and visual explanations that help to develop the concepts covered. The content is chosen to engage the student audience, as well as to support teachers by bringing the outside world into the classroom.</p>
<p>09. Loci Duration: 14 Minutes</p>	<p>Mobile phone technology, guide dog training and finding somewhere to live are used to illustrate simple loci. Basic construction techniques are explored alongside these real contexts, and the concept of regions is developed. Presenters Jamie and Katie investigate the main loci tested in examinations and show how compasses can be used to draw these accurately.</p> <p>The program aims to help students to understand how a path of points is built by using dynamic visual images and demonstrations. A mixture of real-life and abstract content is developed simultaneously, alongside detailed instruction on compass constructions. Appropriate maps and scales are used and explained. The topic is presented in a lively, interesting and entertaining style. The program exploits the power of television to produce clear graphic and visual explanations that should enhance the teaching of this topic. The content is chosen to engage the student audience, as well as to support teachers by bringing the outside world into the classroom.</p>
<p>10. Enlargement Duration: 14 Minutes</p>	<p>Television can demonstrate enlargement on a scale rarely seen in the classroom. From a truly massive advertising stunt to a miniaturist who creates micro-sculptures, we see the effects that can be generated using enlargement. A range of unusual scale factors is investigated by examining the dimensions of real-life examples. Alongside these, the techniques are developed through dynamic demonstrations of working on a grid and graphic exploration of the effects of using different centres of enlargement.</p> <p>The program aims to enhance students' understanding of enlargement by taking the topic beyond the boundaries of paper and pencil work. Accurate graphics and clear visual explanations should allow students to see the concepts readily, without the distraction of drawing cumbersome diagrams. Whole number, fractional and decimal scale factors are covered. The topic is presented in a lively, interesting and entertaining style. The content is chosen to engage the student audience, as well as to support teachers by bringing the outside world into the classroom.</p>

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## Starters series

### Building Yard Starters

Duration: 14 Minutes

Presented by maths expert and performer Isaac Anoom in real-life urban settings, these programs are designed to be shown in sections, with useful pause points for discussion, clues and sometimes even answers.

- \* For each topic, Isaac poses a question and then offers a pause point
- \* During the pause point, teachers can hold a freeze-frame on the screen while their students discuss the question
- \* Teachers can then run the program on to get further clues and pause points, or the final explanation.

In this program Isaac covers a range of topics, including:

- \* how to estimate lengths
- \* using nets to work out shortest routes
- \* making sense of ratios
- \* area and perimeter
- \* working out volume
- \* exploring number sequences

### Scrap Yard Starters

Duration: 14 Minutes

Five topics are discussed in this program:

- \* probability
- \* ratio and proportion
- \* rotational symmetry
- \* square numbers
- \* circles

### Shopping Mall Starters

Duration: 14 Minutes

Presented by maths expert and performer Isaac Anoom in real-life urban settings, these programs are designed to be shown in sections, with useful pause points for discussion, clues and sometimes even answers.

- \* For each topic, Isaac poses a question and then offers a pause point
- \* During the pause point, teachers can hold a freeze-frame on the screen while their students discuss the question
- \* Teachers can then run the program on to get further clues and pause points, or the final explanation.

In this program Isaac covers a range of topics, including:

- \* working out the area of an octagon
- \* calculating percentages and VAT
- \* working out the best value for money
- \* practical probability
- \* organising fractions with a card trick
- \* various ways of cutting a cake