Primary Magazine

Issue 33

National Centre for Excellence in the Teaching of Mathematics

Welcome to the 33rd issue of the Primary Magazine. Our little bit of history article focuses on the Tudors, we look at art with a mathematical eye and focus on Fairtrade. Our CPD opportunity explores the use of calculators and our ICT article explores the use of programmable toys in mathematics. *It's in the News!* features the floods of 2010.

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Editor's extras

Have you ever heard of a man named Tom Lehrer? He is an American singer-songwriter, satirist, pianist and mathematician, who was born in 1928. He lectured on mathematics and musical theatre and is well known for the humorous songs he recorded in the 1950s and 60s. These songs included one called The Elements, where he sets the names of the chemical elements to the tune of the 'Major-General's Song' from Gilbert and Sullivan's Pirates of Penzance. In the early 1970s he retired from public performances to devote his time to teaching mathematics and music theatre at the University of California.

Here are a couple of more mathematical YouTube clips of his that you might find amusing:

- That's Mathematics!
- New Math

A new microsite has recently gone live on the portal, The teacher as researcher/teaching as researching. This is a case study of Caroline Ainsworth's professional development journey. Caroline is the mathematics subject leader at Stockland Primary School, near Honiton in Devon. She is the only teacher of mathematics in the school and teaches the subject from Reception through to Year 6. Caroline became interested in the use of Cuisenaire rods as a tool for teaching and learning mathematics. This led her to the work of Caleb Gattegno and Madeleine Goutard, which she began to read extensively and which informed a series of investigations into her own teaching, her children's learning and the nature of mathematics. On the microsite you will find the following materials which are well worth exploring:

- an article written by Caroline about her work and ideas
- a filmed discussion between Pete Griffin (NCETM SW regional coordinator) and Caroline
- samples of Caroline's children's mathematical writing
- a collection of videos filmed by Caroline of children in her school working on mathematics.

This resource is not intended to be an instruction manual. It is simply a story of one teacher's professional development which we hope will inspire and stimulate you to engage in your own research and professional development. If this has inspired you to look further into research you might like to read an article, Teachers reading research, which highlights two pieces of interesting research: 'Leading staff development in primary mathematics' and 'Effective teachers of numeracy'.

We are also pleased to announce that the Primary module has been updated. It is designed for primary teachers who wish to help their children understand the highly connected nature of mathematics and use this to build their mathematical learning. It is well worth exploring and sharing with colleagues.

In the previous issue of the Primary Magazine we were really pleased to announce that our National Priority Project: Making Sense of the Primary Curriculum has gone live on the portal. We have now renamed it Maximising opportunities for mathematical learning across the primary curriculum. The main aim of the project was:

To engage teachers and their pupils in exciting projects involving mathematics in real life and across the curriculum in order to enhance and deepen the mathematics they are taught in the discrete maths lessons, so raising attainment and enjoyment.

Our featured schools this month are Falconbrook Primary School, in Wandsworth, who made links with history, and Liberty Primary School, in Merton, who made links with geography. We hope you enjoy reading about what they did.

Finally, one last reminder of the Mathematical Association (MA) and Association of Teachers of Mathematics (ATM) annual conferences that we mentioned in the last issue. Each has a special primary day which you might be interested in attending.
The MA conference Mathematics: The Big Picture takes place from Thursday 14 to Saturday 16 April and features keynote speeches from Lynne McClure, director of NRICH, Rob Eastaway and Andrew Jeffrey, as well as a wealth of exciting workshops. Their primary day is on Friday 15 April. For more details and booking information visit their website.

The ATM conference Celebrating Gattegno takes place from Monday 18 to Thursday 21. As we all know, Caleb Gattegno made a significant impact on teaching and thinking about education. Within mathematics this included the creation of the ATM, the promotion and use of Cuisenaire Rods, the creation of geoboards, developments of the animated geometry work of Nicolet, and the Gattegno 'tens' chart for number. This conference also has a wealth of workshops and some significant speakers. For more information and booking forms visit their website.

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It's in the News!

2010 was a year of devastating floods. In this issue of *It's in the News!* we look in detail at the two major disasters that hit the headlines, with much property and land ruined and many people killed. These, as you will know, were in Pakistan and Australia. These countries continue to be in the news – the first, because of the problems after the floods, and the second because the floods are still happening, not to mention the recent devastation in Queensland caused by cyclone Yasi. There are links to geography and also some to science. They give opportunities for work on a variety of mathematical concepts including number, measurement and data handling.

Before you use the slides you might find it helpful to look at the following websites for further information:

- NASA (Pakistan floods)
- Heinrich Böll Foundation - video clips (Pakistan floods)
- Herald Sun (Australian floods)
- Google - video clips (Australian floods)
- guardian.co.uk (Australian floods)
- Wikipedia (links to floods in other countries).

As this resource was written a few weeks before publication, it would be worth looking for the most up-to-date information about what is happening now.

This resource provides ideas that you can adapt to fit your classroom and your learners as appropriate. As always, we would be extremely grateful if you could give us some feedback on how you have used it, if it has worked well and how it can be improved.

Download this *It's in the News!* resource - in PowerPoint format.

Download this *It's in the News!* resource - in PDF format.

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Page header - Queensland, Australia floods photograph by Lordphantom74 some rights reserved

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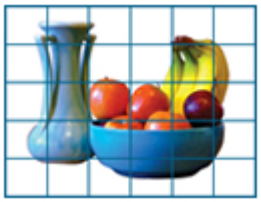

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The Art of Mathematics
Looking at paintings with a mathematical eye

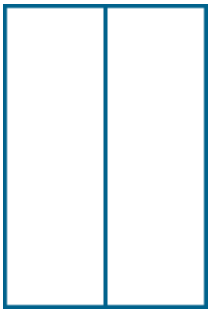
Composition

Painters think hard about how to arrange their paintings. This arrangement is called a composition. The composition draws your eyes to the picture and makes the painting satisfying to look at.

Look at the picture The Baptism of Christ by Piero della Francesca available from the National Gallery.

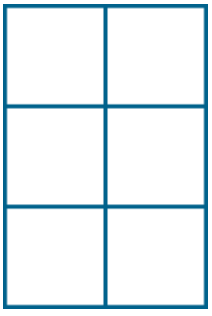
Ask the children what they notice about the composition of the picture. Even young children may be able to say that Christ is in the middle.

On your whiteboard, divide the picture of the baptism in half vertically:



Ask the children what they notice.

Now divide the picture in to three equal parts horizontally:



Now what do they notice?

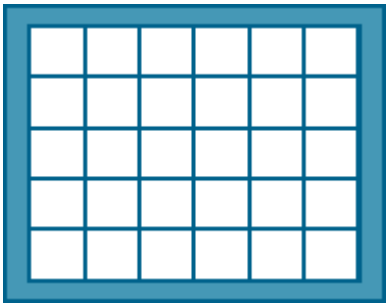
What is on both of the horizontal lines? Why do you think the artist thought this was important?

Discuss with the children why they think the picture has been composed in this way.

Using perspective by drawing to scale

Share with the children some still-life paintings, for example Still life with apples and a pomegranate by Gustave Coubet (1871-2) or Still life with oranges and walnuts by Luis Meléndez (1772). The fruit looks almost good enough to eat!

Artists sometimes use a special screen, similar to the drawing below, to ensure that that their work is accurate and that the items drawn are the correct sizes and proportions to each other as in real life.



You could make artists' screens for the children to use from overhead projector acetates or something similar. Draw a grid with lines two centimetres apart for each screen. Make sufficient screens and mount the acetate in stiff card. You will also need to provide paper with two-centimetre squares (older and more able children could do this themselves).

Ask the children to set up a still life composition using a range of objects. Show them how to place the screen in front of their composition. Ask the children to copy what they see in each two-centimetre square on their paper. Once they are satisfied with their grid copy, they could apply their skills and turn it into a finished work of art on plain paper!

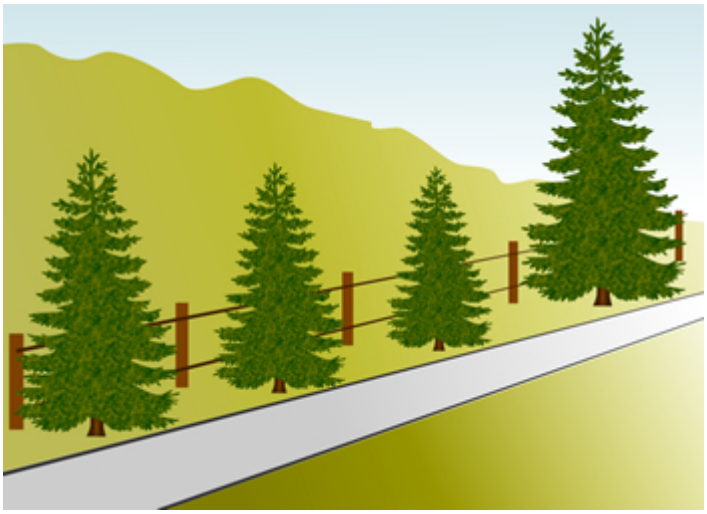
Older children could then work on scale to make the picture larger or smaller.

Tricking the eye

When we look at pictures we are looking at a flat painted surface. But many artists make us believe that we could step inside the picture and walk along the street. They do this by tricking the eye, so that objects in the background are smaller than those in the foreground to make it appear as though they are further away. The technique they use is called 'linear perspective'. In pictures constructed so that all receding parallel lines appear to converge towards each other, eventually meeting at a single point or vanishing point, 'single point' perspective is used.

Take a look at The Avenue at Middelharnis (1689) by Meindert Hobbema. This is just one example of an artist using the single point perspective to give a picture a sense of real life.

Pose the question, where do you think the artist was standing when he painted this picture? Now take time to examine how linear perspective can trick the eye – look at how the artist has painted the trees, houses and people smaller and smaller along the road to make them look further away.



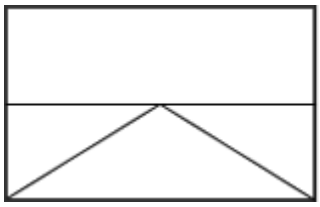
Ask the children to take a look at the trees in the picture.

- what do they notice?
- what is the same and what is different?
- did they notice that they two larger trees were the same size?

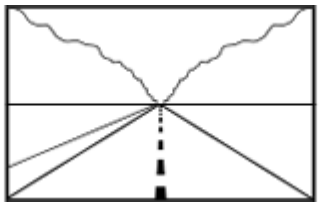
The optical illusion of the trees being different sizes is created when we draw the lines of the road to trick our eyes. Our eyes are used to seeing things get SMALLER as they get further away.

This is how it works…

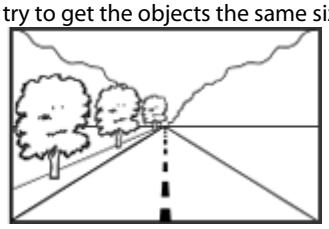
1. Draw horizon, vanishing point and road. Use a ruler.



2. Add centre line to road, footpath and hills



3. Now add houses or trees to the side of the road. First of all try to get the objects the same size...



Ask the children what they notice? Ask the children how they can give the impression that things are further away.

You may now want to compose your own pictures using a combination of these techniques – take a look at the National Gallery of Art for Kids' Still-Life pages.

The Golden Ratio

No self-respecting article about the impact of mathematics on art could fail to mention the Golden Ratio. The Golden Ratio is a special ratio that is approximately equal to 1.618:1. It has been used in art and architecture for centuries. The golden ratio divides a line at a point so that the ratio* of the smaller part of the line to the greater part of the line is the same ratio of the greater part of the line to the whole line. Gifted and talented mathematicians may be interested in finding out more about the golden ratio and art. Take a look at the two articles on the NRICH website which present a history of the famous ratio and an investigation.

You might also like to take a look at the article about Fibonacci, the famous mathematician who invented it, in A little bit of history in Issue 20 of the Primary Magazine.

***** *A way of showing a comparison between two or more separate amounts and compares part to part e.g. on my hand, for every four fingers I have one thumb. The ratio of fingers to thumb is 4:1.*

Use of colour

Pierre-Auguste Renoir (1841–1919) was an impressionist. He was particularly interested in the way that colour changes endlessly with the light. Look at the colour of the water in the picture The Skiff. It is deep blue – why do you think this is? Renoir used just eight colours to capture this colourful scene. He was interested in the way that colours react with each other.

Artists use three primary colours – red, blue and yellow – to make the colours green, orange and purple. The pupils could explore colour-mixing for themselves using paints and different ratios of the primary colours.

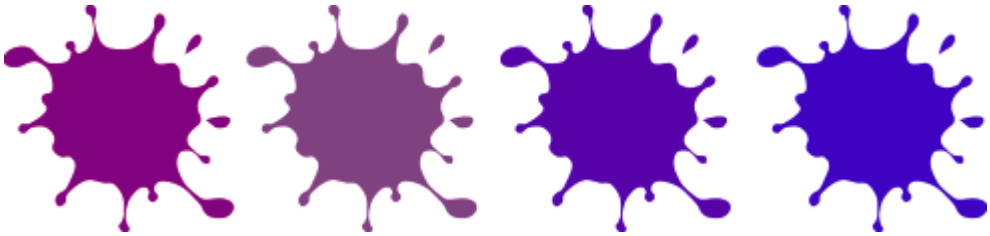
The pupils could mix colours in paint palettes and then record them onto an A3 sheet, showing the two primary colours used and the mixed secondary colour that resulted – most young children should be able to explain that they mixed one part (thimble/spoon/lid/) of one colour in ratio to the other.

For an extension, pupils could explore the variety of secondary colours that can be made by mixing two of the primary colours at a time.

Using the spoon to measure exact quantities of paint, put two parts red and one part blue in a palette to make purple.

- red 2 spoons, blue one spoon
- red 2:1 blue
- red to blue 2:1

This could then be repeated using two spoons blue i.e. red to blue 2:2 and so on using other ratios to make a colour chart.



2:1 2:2 2:3 2:4

Older/higher-attaining children could then record the ratio of each colour with each other.

Other children could then see if they could replicate the exact colour using the same ratio.

Did you know?

Making colours and matching them is so important in art and industry that scientists have developed charts of standard colours to use as references.

Using colour to show the passing of time

Impressionist art is a great way of presenting time. By the very fact that the paintings were done quickly in the open air to capture the changing effects of the light on the colours around them, children should be able to sequence pictures according to the time of day or season. Select four paintings of the same scene, mix them up and present them to the children. Ask the children to sequence them in time order. They should look for clues, especially how bright or dark the paint colours are. Monet's pictures are an excellent source as he painted the same scene at different times of the day or at different times of year. For example, there are many pictures of the Water-Lily Pond. Allow the children to justify their sequence. This will help develop the language of time: before, after, next, earlier, later…

Information from Scale Draw (NRICH).

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Focus on…Fair Trade

The concept of 'fair trade' has been around for over 40 years, though a formal definition does not exist. In 1998, an informal network of four fair trade networks got together, calling themselves FINE:

F Fairtrade Labelling Organizations International (FLO)
I International Fair Trade Association, now the World Fair Trade Organization (WFTO)
N Network of European Worldshops (NEWS!) and
E European Fair Trade Association (EFTA)

FINE members agreed the following definition of fair trade, generally accepted by most:

> Fairtrade is basically an international trading partnership between producers in developing countries and sellers in developed countries such as the UK. Within the partnership, buyers and sellers treat each other with respect and transparency. This results in better rights for marginalised producers and workers and they receive a fair price for what they produce. Better trading conditions promote sustainability and higher social and environmental standards. Fairtrade organisations, backed by consumers, are actively engaged in supporting producers, raising awareness and also in campaigning for changes in the rules and practice of conventional international trade.

Although a growing movement, Fairtrade still only represents a tiny fraction of world trade in physical merchandise, though in some countries up to 50% of all sales in a particular category are Fairtrade. However, the benefits are more widespread than that might imply. Overall, Fairtrade Labelling Organizations International estimated that in 2008 over 7.5 million producers and their families were benefiting from fair trade funded infrastructure, technical assistance and community development projects. Some people are against Fairtrade, seeing it as a type of subsidy or marketing ploy. Others criticise Fairtrade for not adequately challenging the current trading system.

A Fairtrade labelling scheme was started in the Co-operative stores in late 1988. There are now thousands of products that carry the FAIRTRADE Mark, including food products ranging from tea and

coffee to fruits and nuts. Non-food products such as flowers, plants, wine and cotton are increasingly produced under fair trade conditions.

In 2011, Fairtrade Fortnight runs from 28 February to 13 March; watch the Fairtrade Fortnight 2010 award winners on YouTube.

Traidcraft is staging Big Brew, a nationwide initiative to help individuals, churches, schools and workplaces to host a fair trade event during Fairtrade Fortnight. Your Big Brew event could be a coffee morning, or whatever else suits your setting. They offer two different Fairtrade Big Brew packs to help you organise an event in Fairtrade Fortnight. Option 1: Big Brew Food and Resource Pack contains enough for 50 people and costs £9.95, while Option 2: Big Brew Resource Pack is free and contains all the publicity and information resources only, so that you can purchase all the food and drink locally. Other resource packs are available.

World Fair Trade Day was on 8 May in 2010. In 2009, 1 000 events involving 8.2 million people took place in more than 70 different countries. In 2011 World Fair Trade Day will be on 14 May.

Activities

Download a table of sales of Fairtrade certified products in the UK. There are many ways to explore these facts and figures. Children could be asked to answer questions such as:

- which products show the greatest increase in sales?
- which products show the lowest increase in sales?
- in which year did each product have the largest increase in sales?
- in which year did each product have the smallest increase in sales?
- use the internet to find the proportion of sales of each product that are Fairtrade.

The Co-operative has a good reputation for stocking Fairtrade products. Arrange a visit to the local store. Ask the children to search for products which carry the Fairtrade logo. They could record this as tally marks alongside particular food types, or alternatively alongside different types of packages such as tin, packet, bottle, jar etc. Another approach is to find a Fairtrade cube, cuboid, cylinder, tetrahedron and prism or other 3D shape. Photograph the products. Back at school, investigate which type of food or packaging is found most/least often. Is the same type of food always found in the same type of packaging?

You could also choose to explore Fairtrade through a particular product:

1. Chocolate

The first Divine chocolate bar was launched in 1998. Divine Chocolate Ltd is a Fairtrade chocolate producer, part owned by Kuapa Kokoo cocoa farmers' co-operative in Ghana. In 1993, a group of cocoa farmers came together to form a co-operative that would collect and sell its own cocoa for the member farmers' own benefit. As well as sharing in the profits, the farmers have a say in decisions about how the chocolate is produced and sold and increase their knowledge of the fiercely competitive European chocolate market. Kuapa also sells to other fair trade buyers in Europe. Both The Body Shop and Traidcraft buy cocoa butter made from Kuapa's cocoa and include it in their products.

The motto of the Kuapa Kokoo company is 'Pa Pa Paa' which means 'the best of the best of the best'. Comic Relief, in conjunction with Kuapa Kokoo, offer a range of resources from their website. Download

a set of 11 photographs to order the story from bean to bar. There is also a set of matching photo captions, perfect for Key Stage 1. Key stage 2 children could write their own. These photos are all greyscale to cut down on printing costs, but a colour set and DVD can be ordered for £8. The website has much more to offer. Why not settle down with a mug of Fairtrade hot chocolate or a Dubble bar and browse to see what's useful for your class?

Comic Relief, together with Divine chocolate, launched the Dubble Fairtrade Chocolate Bar in 2000. Their Dubble Story of how the Dubble chocolate bar was born is easily accessible to Key Stage 2 children. Follow the story from BEAN2BAR. Children are encouraged to sign up and become Dubble Agents to change the world chunk by chunk! Children have composed chocolate raps, made adverts and more. You don't even have to be an agent to play the Choca Monkey game. There's even a storyboard and lesson plan to download to create your own game.

More about chocolate from Fairtrade on their website.

All the Co-operative's own-brand block chocolate is Fairtrade. Exploring mathematics through chocolate is fun and motivating. Both bars and boxes are useful.

There are several chocolate-based problems on the NRICH website - try Chocolate (or the interactive version Chocolate Bars), Chocaholics, and Christmas Chocolates.

Data handling

- carry out a taste test with Fairtrade chocolate. This could be a square each of milk, white and dark, or three different makes of milk chocolates. Ask the children to order the chocolate from 1 to 3, favourite to least favourite. Which chocolate receives the highest/lowest score? What does this mean?
- carry out a survey of local shops and stores. Which shop offers the highest proportion of Fairtrade chocolate?

Multiplication and division

- how many squares of chocolate could there be in each bar? Write the family of four facts for each bar, e.g. for a 4 by 6 bar, 6 x 4 = 24, 4 x 6 = 24, 24 ÷ 4 = 6, and 24 ÷ 6 = 4.

Fractions

- what fraction of the big shape is the small one? Or conversely, what fraction of the small shape is the big one?

- I have ten bars of chocolate and I share them equally between three people. How much will they each get?
- what percentage of the Smarties in a tube are red, yellow, green, orange, purple or any other colour? This would work well if exploring ratio or proportion.
- three quarters of a box of chocolates are milk chocolate. There are 15 milk chocolates. How many chocolates are in the box altogether?
- more in What Makes a Good Resource, Chocolate Bar Fractions and Primary Magazine Issue 32 ICT in the Classroom, Using Video and Animation.

Measures

There are a number of chocolate-based investigations for example:

- how many bars of chocolate would you need to make your weight in solid chocolate? Estimate first, then consider how you might find out.
- how tall are you if your height is measured in chocolate bars? Estimate first, then consider how you might find out.

2. Coffee

The Co-operative was the first retailer to sell Cafédirect coffee, in 1992. Cafédirect went on to be the UK's first Fairtrade brand, supporting the Aguadas community in Columbia. When coffee prices were at a 30-year low in 2003, the Co-operative switched their own brand range to Fairtrade. Now it is possible to buy Fairtrade coffee almost everywhere, including the smallest of coffee shops. Find out more from the Cafédirect website. Other products you might explore include bananas, cotton, sugar, tea, honey or even gold.

More Information from:

- Fairtrade
- Traidcraft
- Fairtrade Labelling Organizations International
- World Fair Trade Organization (WFTO)
- Network of European Worldshops (NEWS!)
- European Fair Trade Association (EFTA).

A little bit of history
The Tudors

In this article, we are being really cross-curricular and looking at some of the ways that you can link mathematics into a topic of the Tudors. If you are looking at this period of history, try some of the ideas. This will mean you can double up on the maths that you do during the day!

However, due to the large amount of ideas and resources, this feature can only be read directly on the portal, otherwise the interactive nature of the way they are presented will be lost.

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Maths to share – CPD for your school

Calculators

Provide colleagues with a range of resources including pencils, paper, 1-100 grids, number lines, cubes/counters and calculators, and ask them to find solutions to the following questions. Encourage them to use whichever methods or tools they are most comfortable with.

35 + 36

2 + 2 + 2 + 2 + 2 + 2

121 – 71

1 002 – 985

(15 x 3) + (10 x 4)

5 ÷ 3 x 3

10 227 divided by 3

Hold an open discussion relating to the methods used (rather than focusing on the final solutions). Were any of the calculations carried out entirely mentally, without any jottings or workings shown? Which calculations prompted colleagues to use a familiar algorithm? Did anyone use the calculators? How did they use them? Was the calculator used as a first 'port of call' or afterwards for checking? Suggestions might refer to the fact that they know they'll 'get the right answer' with a calculator. Now ask colleagues to answer each of the questions using the calculator. Discuss the skills used. Some of these are explored in more detail below.

Establish how colleagues feel about the use of calculators in the classroom. If necessary, prompt discussion using the following points:

- do they reinforce the importance of the final 'answer' to pupils, and de-value the method used?
- are they useful for checking answers, possibly for pupils to mark their own work?
- can they be helpful in showing early number patterns?
- can calculators motivate pupils and give them increased confidence?
- are they helpful when dealing with decimal numbers, to reinforce place value?
- do they take away the 'number crunching' and allow pupils to concentrate on the 'bigger picture'?

The original National Numeracy Strategy guidance paper, in 1999, 'Calculating with a Calculator' stated:

> "Calculators are powerful tools. Like other tools, children need to learn to use them properly. They are not an appropriate tool for calculations that can be done more quickly and reliably by mental or pencil and paper working… Calculators should not be **used as a calculating aid** until the later stages of Key Stage 2…

…A quite different use of a calculator is **as a resource for learning about a mathematical idea**, just as a dice game or number line might be used."

Along with the renewal of the Primary Framework in 2006 came a new guidance paper, The use of calculators in the teaching and learning of mathematics. This very clearly states that calculators should be used with pupils in Foundation Key Stage as well as Key Stages 1 and 2 and provides example activities for all ages. Specific learning objectives relating to the use of calculators are included for Years 4, 5 and 6. Ask colleagues to draw upon their experiences of using calculators (including the initial activity) to suggest the calculator skills that should be taught by the end of the primary years.

Those suggested in the guidance paper include:

- recognise the operations that the keys on the calculator represent
- clear the display and memory before starting a calculation
- correct a wrong entry by using the 'clear entry' key
- store a value in the calculator's memory and retrieve it during a multi-step calculation
- keep track of a calculation and record the method used
- use of other function keys (square root, square or power keys, fraction notation, brackets)
- recognise the likely size of the answer and check answers
- recognise negative numbers in the display and use the 'sign-change' key
- enter and interpret money and measurement calculations
- calculations that involve time
- calculations that involve more than one step
- recognise and interpret rounding errors
- use the division operation to enter a fraction
- recognise recurring decimals
- decide when a calculator is an appropriate tool to use.

How confident do colleagues feel about using and teaching each of these calculator skills? This might provide a good opportunity for discussing the need for a school calculator progression document. This could outline the key skills to be taught at each phase, similar to the document that many schools have outlining written methods for the four main operations. The calculation strand of the NCETM Self-evaluation Tools provides questions related to the use of calculators in the classroom, and is useful for teachers to confirm any gaps in their subject knowledge and find suitable next steps.

Teachers of very young pupils can begin to familiarise pupils with calculators by including them in role-play areas, for example, shop, garden centre, café, post office. As children begin to learn how to display familiar single digit numbers, they will soon start to explore how two-digit numbers can be entered, stimulating discussion. Keying in larger numbers can strengthen children's understanding of place value, and number patterns can easily be generated on the calculator using the constant function. Ask colleagues to explore how they might use the calculator to easily generate a sequence of multiples of five, starting with zero. Ensure everyone is familiar with the 'constant' function:

- clear the display and memory on the calculator, so that the display shows '0'
- press the '+' and '5' keys, followed by '='
- continue to press '=' and the constant function will continue to add five, generating a number pattern.

Allow time to explore results when using the constant function for subtraction, division and multiplication. Does it work in the same way? With most calculators (Texas/Sharp), colleagues should find:

- keying in '5', '+', '3', '=', '=', '=', '=',… will generate a sequence of numbers, starting with 5 and increasing by 3 each time, i.e. 5, 8, 11, 14, 17, 20, …
- keying in '5', '-', '3', '=', '=', '=', '=', … will generate a sequence of numbers, starting with 5 and decreasing by 3 each time, i.e. 5, 2, -1, -4, -7, -10,…
- keying in '30', '÷', '3', '=', '=', '=', '=', … will generate a sequence of numbers, starting with 30, dividing by 3 each time, i.e. 30, 10, 3.33333333, 1.11111111, 0.37037037, …
- when performing the same procedure with multiplication, many calculators will 'remember' the first number, and so for 5 x 2, the calculator will continue to multiply by 5.

The constant function on a Casio calculator is slightly less intuitive and users will generate a sequence, starting at 5, increasing by 3 each time, by entering '3' '+' '+' '5' '=' '=' '=' … For a sequence starting with 100 and decreasing by 3 each time, one would enter '3' '-' '-' '100' '=' '=' '=' …

Calculators can be used very effectively for reinforcing the value of digits in a number. Ask colleagues to enter '316512' into their calculator display. How can they eliminate both of the '1' digits, using only subtraction, in a single step? How could they reduce 362 to zero, subtracting only multiples of 100, 10 or 1 (subtract 300, then 60, then 2)? Does this activity have potential in a Key Stage 1 or lower Key Stage 2 classroom?

It is useful for teachers to have the opportunity to rehearse their own calculator skills and ensure that they are familiar with the type of calculators available in school. It is important that teachers are aware of the operating system used by the school calculators. Ask them to reconsider the calculation carried out earlier: 5 ÷ 3 x 3. What answer would they expect to get? Many primary school calculators are basic four-function calculators and use an arithmetic operating system. These can only cope with a single operation at a time. Therefore as a user enters 5 ÷ 3, the calculator will display as much of the answer as it can and ignore the remaining digits, truncating the answer, giving an answer of 1.6666666. When the 'x 3' is entered, it will then display 4.9999998. It is important, particularly in upper Key Stage 2, that teachers are aware that these calculators may produce small errors in calculations involving division because they truncate the answer. A scientific calculator uses an algebraic operating system and will 'remember' calculations and the rules of arithmetic. Therefore 5 ÷ 3 x 3 will give the expected answer of 5.

Ask colleagues to use the calculator to find the answers the following questions. Try as much as possible not to write anything down, but to use the various calculator keys to assist. Allow time for discussion and the sharing of strategies.

A room measures 4.6m x 6.1m

A remnant roll of carpet measures 5m x 6.7m

How much carpet would be left over after carpeting the room?

(348 + 368 +193) ÷ (587 – 284)

What is 24% of 487?

When purchasing new calculators for use in school, it is important to consider the operating system and key functions required. More importantly, check that all of the calculators being used in the classroom operate in the same way. Most calculator manufacturers offer examples of activities that can be carried out in the classroom, and suggestions for ways of teaching the use of the various key functions. There are many useful websites and published materials that offer good starting points for integrating calculators into mathematics lessons. Calculators can become a key resource for teaching mathematics, if essential skills are taught well, and their use is planned appropriately.

- Primary Resources offers a range of activities, submitted by practising teachers across the country
- Issue 24 of the Primary Magazine has some fun ideas for activities around calculator codes
- the National Numeracy Strategy produced a booklet, Calculator Activities, with some wonderful starting points for the classroom
- BECTA produced some useful guidance and activity suggestions for using calculators in the classroom
- Ambleside Primary hosts a large interactive calculator suitable for demonstrating key skills to a class
- search on Crickweb for a whole host of bright, useful calculator activities for the KS1 and KS2 classroom.

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National Centre for Excellence in the Teaching of Mathematics

ICT in the Classroom – Programmable toys and more

Problem solving with programmable toys incorporates estimating and measuring with number, length, angles and time, and offers opportunities to make links with other areas of learning, particularly literacy, design and technology and science. It's no surprise that in their report, Digital Technologies – A new beginning, BECTA and the NCETM recommend that one of the features of interactive use of digital technologies should be writing "short computer programs, for example for movements of 'roamers' on the floor". Aspects of mathematics can be explored through robots at all ages and levels of development, in the primary school and beyond. Different types of programmable robot will be needed depending on whether the activity will require the robot turning angles other than 90 degrees, and on the accuracy needed.

Robots and storybooks

What if the three little pigs in the story of the same name were robots, or travelled on a robot, from one house to the next in their story? The 'costume' does not need to be elaborate, as long as it is clear which way the character is facing. A pig could be made with a pink paper spiral for a tail and a pink paper circle for a snout attached to the rear and front of the robot.

Any story involving steps on a journey can be used in the same way, for example *Going on a Bear Hunt*, *The Gruffalo*, *The Very Lazy Ladybird* or *Big Blue Train*. If you are sure that the context will not cause confusion between forward and back, and up and down, the stories of *Jack and the Beanstalk* or *Rapunzel* could also be used. Each step in the journey that the character takes needs to be given a place in the classroom. The easiest way to show this is with a photocopy of the appropriate page from the storybook. Children can programme instructions into the robot and move along with it, using the prompts at each stop in the journey to tell the story. If the exploration with the robot is part of a class theme, then the props used for the journey of the story, and for dressing the roamer, could develop and use skills learnt through design and technology, together with opportunities for exploring shape, estimating and measuring with a purpose.

The mathematical activity can be made more difficult through including the need for turns to get to the next stop on the journey, or needing to programme the whole sequence into the robot, with a wait command of a number of seconds at each stop.

Robots – numbers, measures and time

Make a number track using the programmable robot. Start by marking the front and back positions of the robot on a large sheet of paper, mark the space under the robot '0'. Move the robot forward one step, mark where the front of the robot reaches on the paper and mark '1' in the space under the robot. Continue to create a number track for the robot. If appropriate, the number track can also continue to the left to show negative numbers for moves that take the robot back beyond zero.

Create a time track by programming the robot to travel forwards in a straight line beside a piece of string for the

longest distance possible in the space that you have. Ask the children to mark the point on the string that the robot is passing after 5, 10, 15 seconds.
Time how long the robot takes to do a full turn (360 degrees). Does it take half the time to do a ½ turn? What about a ¼ turn? What other angles, or fractions of turn, could we estimate? Work out how long it would take the robot to get to somewhere in the classroom, school or further afield. Depending on the geography of your setting, it may be possible to find a real purpose for your robot by having it deliver messages between classrooms or the school office.

Robot sports

Robot synchronised swimming can create an exciting spectacle! If you can find a way to video the outcome from above, the resulting resource could be used to explore rotational symmetry and makes a wonderful film for celebrating mathematical work in assembly or to parents. Because the same sequence of instructions must be repeated for each robot there is a real reason for children to write their programme down. The programme can be as simple as a set of arrows, for example: ↑ ↑ → ↓ ← ← written using whole words or sentences, or written in LOGO.

You may want to let children explore their own ways of communicating their sequences before suggesting how to make them clearer or more efficient.

Create a ski slalom for your robot with gates to travel through and time penalties, practising measures, angle and time along the way.

You could try 'robot curling'. Use more than one robot as 'stones' and the children should program their robots to move around a course that involves avoiding the 'stones'. Include strategies to block – older children may start speculating on the lengths of sides on a right-angled triangle as they try to avoid other stones.

For something that appeals to the dancers in your class, try robot figure skating. Agree on a scoring system that recognises intricate or challenging moves such as a 360 degree turn, skating backwards, zigzags or a figure of eight.

Research and CPD

In September 2010 the National Centre published a report on ICT in conjunction with BECTA, Digital Technologies – a new beginning. The report offers a thorough consideration of the issues relating to ICT and mathematics, including:
"One of the features of interactive use of digital technologies in mathematics classrooms is that:

- learners are engaged and actively involved in the exploration and making sense of mathematics (using digital technologies) through meaningful activities that make connections across all areas of mathematics."

Reflect on how this could be achieved with the ICT available in your setting. Consider which contexts would encourage children in your class to see the activities in which they participate in mathematics as 'meaningful'.