Primary Magazine
Issue 29

National Centre for Excellence in the Teaching of Mathematics

Welcome to the 29th issue of the Primary Magazine. Our famous mathematician from the past is John Venn and we look at the art of Vincent van Gogh and focus on prime numbers. Our CPD opportunity aims to develop subject knowledge in probability and our ICT article explores the use of the internet for data collection. *It's in the News!* features the Blitz and the Battle of Britain.

Contents

Editor's extras

We'll start with a reminder of that important date for your diary: 1 December, for the free NCETM national CPD conference, Professional Learning Networks: learning better through learning together, we hope that you will be able to make it!

Here are the details:
Date: 1 December, 2010
Time: 10am – 4pm
Venue: MegaCentre, Sheffield.

Join teachers from across the country to explore the benefits of networking and collaboration to enhance your mathematics teaching and learning. Hear from practitioners who have created networks of all sizes across their department, school or college, local cluster group, HEIs and industry, to discover how collaboration by individuals and organisations can help tackle issues, deliver practical resources and increase pupil attainment.

The day will include:

- exhibitions showcasing NCETM-funded projects that focus on creating networks to share ideas between individuals, departments and institutions, tackle issues in mathematics learning and support professional development
- interactive group sessions to explore the power of working and learning together
- workshops to present examples of collaboration and networks from schools, colleges, subject associations and organisations
- keynote presentations from inspiring individuals who utilise networks.

Some of the teachers involved in primary regional projects will be there to tell us what they have been up to.
To book your place, email events@ncetm.org.uk.

Are you a primary subject leader? If so you might like to take a look the Excellence in Mathematics Leadership (EiML) microsite. Following on from the very successful first wave of the EiML materials, we have now developed a collection of In-Depth Study Modules in collaboration with the Mathematics Associations (AMET, ATM, MA, NAMA and NANAMIC) to provide subject leaders with the opportunity for in-depth professional study. They are intended to offer a detailed and deep insight into what is involved in the role of subject leader.

We have also developed a support package for newly appointed mathematics subject leaders, which is also suitable for aspiring subject leaders or experienced leaders who would like to think afresh about their role. This package includes having access to excellent practitioners from your sector and a follow-up supportive mentor and network.

It builds upon the EiML microsite, which explores some of the key elements and core responsibilities of this demanding role, offers a flexible and stimulating way to review where you are now and allows you to learn from the experiences of other subject leaders. There will be a one-day networking event, Embedding Excellence in Mathematics Leadership, at the City Inn, Birmingham on Saturday 13 November. Keynote speaker Jane Jones HMI will address some of the issues in leadership outlined in Mathematics: understanding the score. Sector-specific workshops will be run by practising expert subject leaders. The

event is free and delegates will be part of a follow-up support network. To register, please complete the online application form, or for further information contact Angela Newton.

If you are a student or have any working in your schools, you might like to explore the Teachers in Training microsite which is full of really useful information and resources.

It was reported in the news recently that there were more students taking A-level mathematics in 2010 than ever before. It might be interesting to track this in future years because those students would have been in Year 2 at the advent of the National Numeracy Strategy which suggests that its implementation has been a success in improving attitudes towards the subject. The news that 80% of our children in Year 6 achieved a level 4 or above this year was also recently published – the highest percentage so far. This is great news when you consider that 54% achieved this in 1997! Despite adverse publicity about mathematics in primary schools, these facts show that we are improving.

It's in the News!

On 7 September we remembered the 70th anniversary of the beginning of the Blitz during WW2 and on 19 September there was a service commemorating the 70th anniversary of the Battle of Britain. World War Two is a topic covered in many schools in England so we thought this would be a good time for *It's in the News!* to cover it. You could incorporate some of the ideas on these slides into your topic work to engage the children in some mathematics-related work. Before you use the slides you might find it helpful to look at the following websites for further information:

- The History Place has photos of Blitz damage in London
- Churchill War Rooms has information about the Blitz and underground shelters
- BBC Schools Primary History
- The RAF site has information about the Battle of Britain and its 70th anniversary.

These slides give opportunities for work on a variety of mathematical concepts including measurement, money, fractions and percentages. They also provide cross-curricular links to history. If you made use of most of the ideas you could have a one- or two-week project and teach all of your maths, literacy and other areas of the curriculum through this theme.

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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The Art of Mathematics
Vincent van Gogh

Since his death, Vincent van Gogh has become one of the most famous painters in the world. Between November 1881 and July 1890 he painted almost 900 paintings, but sold only one of them, The Red Vineyard, just a few months before he died. He worked at such a feverish pace that he had no time to pursue any other source of income. He died at the age of 37.

Born on 30 March 1853, Vincent grew up in Holland. He worked for a firm of art dealers for a while before teaching in England. After short periods as a Methodist minister's assistant, working in a bookshop and studying theology, van Gogh attended the Académie Royale des Beaux-Arts in Brussels. He studied anatomy and perspective in his quest to become an artist. Van Gogh firmly believed that to be a great painter you had to first master drawing, which he clearly did, only then could you add colour. He did not begin his first painting until November 1881, after spending at least a year focusing on his drawing. His legacy includes more than 1 100 drawings and sketches. One of the most recognizable aspects of van Gogh's paintings is his bold use of colour.

In March 1882, he wrote to his brother Theo, "Although I find myself in financial difficulties, I nevertheless have the feeling that there is nothing more solid than a 'handicraft' in the literal sense of working with one's hands. If you became a painter, one of the things that would surprise you is that painting and everything connected with it is quite hard work in physical terms. Leaving aside the mental exertion, the hard thought, it demands considerable physical effort, and that day after day."

Van Gogh's feverish working pace caused him both mental and physical stress. There is much discussion on how much his bouts of mental illness influenced his work. Van Gogh did not begin painting until his late 20s and most of his best-known works were produced during his final two years. When he moved to the south of France, he was captivated by the strong sunlight he found there. His work grew brighter in colour and he developed his unique and highly recognisable style.

It was during one of his bouts of depression that he cut off his ear. He had earlier stopped himself from attacking another artist, Paul Gauguin, with an open razor. He tried to give his ear to one of the prostitutes at the local brothel, but she reported the incident to the police, who went to van Gogh's house where they stopped him from bleeding to death.

On 29 July 1890, at 37 years old, van Gogh shot himself in the chest. He died two days later. His fame grew in the years after his death. Today, he is widely regarded as one of history's greatest painters and an important contributor to the foundations of modern art. Many of his pieces are among the world's most recognisable and expensive works of art.

About a week after his death, van Gogh's brother Theo wrote to his sister Elizabeth about Vincent's legacy as a great artist, "In the last letter which he wrote me and which dates from some four days before his

death, it says, 'I try to do as well as certain painters whom I have greatly loved and admired.' People should realize that he was a great artist, something which often coincides with being a great human being. In the course of time this will surely be acknowledged, and many will regret his early death."

Activities for *Sunflowers*

During August and September 1888, van Gogh painted four pictures of sunflowers. They were to decorate Paul Gauguin's room in the Yellow House that van Gogh rented in Arles in the South of France. Van Gogh wrote to his brother Theo in August 1888, "I am working at it every morning from sunrise on, for the flowers fade so quickly. I am now on the fourth picture of sunflowers. This fourth one is a bunch of 14 flowers... it gives a singular effect."

Show the children Sunflowers at The National Gallery. Are there 14 flowers? Can the children order the flowers for age? Do all van Gogh's paintings of sunflowers have 14 flowers? The National Gallery image allows you to zoom in on parts of the painting. Compare close-up images with a real sunflower to explore how van Gogh achieves the effects he wants.

If you are able to obtain mature sunflowers, estimate then count the number of seeds in each head. The flower head can be 30 to 40 centimetres across, with well over 100 seeds, so sorting the seeds into piles of ten (or into small pots) could be a useful support.

In the document Social and Emotional Aspects of Learning (SEAL): Improving behaviour, improving learning, the Red Resource sheets, pages 14-16 in Relationships include a story about a boy growing a sunflower and a set of pictures which could be ordered.

Use *Ten Seeds* by Ruth Brown (ISBN 0862648491) to explore the life cycle of the sunflower. You could also plant ten sunflower seeds, as in the book, and observe what happens to them. Photograph daily to develop a sunflower timeline. Transfer to a scrap book when it gets unwieldy.
Make a sunflower using a paper plate or a yellow circle of stiff card. Paint the plate yellow. Spread glue thickly on the central circle of the plate and quickly glue sunflower seeds in place. Use scraps of yellow paper and card to add short petals to the outer rim of the plate. When dry, count the sunflower seeds and label the back of the sunflower with that number. You could display the sunflowers with questions such as 'Which sunflower has 15 seeds?' and 'Which sunflower has the most seeds?'
Why not ask the children to paint their own copy of *Sunflowers*? They could practise some ratio and proportion as they mix shades of yellow to match as closely as possible those that van Gogh used. As they mix, encourage them to write down the ratios of different paints they used e.g. one teaspoon of yellow and two of white 1:2. Later they could work them out as proportions e.g. 1/3 yellow, 2/3 white.

The Fibonacci sequence is an example of efficiency in nature. As each row of seeds in a sunflower or pine cone, or petals on a flower grows, it tries to put the maximum number in the smallest space. Fibonacci numbers are the whole numbers which express the golden ratio, which corresponds to the angle which maximises the number of items in the smallest space. The seed head and petals of a sunflower, daisies and pine cones have two sets of spirals, one radiating clockwise and the other anti-clockwise. Find some pictures of sunflowers, daisies or pine cones on the internet. Copy and enlarge them. Ask the children to examine the pictures closely. How many clockwise spirals in each plant? How many anticlockwise spirals in

each plant? Are they Fibonacci numbers? For more information on Fibonacci, go to A little bit of history in Issue 20 of the Primary Magazine.

Other Activities
Look at van Gogh's Chair. Which tessellating shapes can you see? Explore tessellation through the Tile Designer on the Victoria and Albert Museum website. You can design your own tile and tessellate that design in blocks of 2 x 2, 4 x 4 or 6 x 6. The tool also allows you to rotate and reflect the tile to get different effects in the tessellation. It is very simple and intuitive to use. More ideas on how you might use it in the classroom from Issue 51 of the Secondary Magazine.

Two Crabs was painted soon after van Gogh's release from hospital in Arles in January 1889. Despite its name, it is probably the same crab shown both on its back and upright. If the crab started on its back, one way to describe its repositioning could be, flip side to side, translate forward and right. Can the children think of other descriptions? Explore wrapping paper patterns. Can the children find any that could be called 'crab patterns' because one image has been used to create another as in Two Crabs? Describe how each pattern has been made, using rotation, reflection and translation. Revisit the Tile Designer to help with descriptions.

Starry Night was painted in 1889. Ask the children to paint their own starry night using thick paint and their fingers. Alternatively, use pastels on black paper. The same swirling, flowing movements will give the desired effect in both media. 'Less is more' in this kind of activity. Each child could roll a dice (1 to 10 if the paper is big enough) to decide how many stars they can create. Display the paintings in groups with questions such as 'What is the same about this group of paintings?' and 'How is this group different to the other groups?'

Wikimedia Commons has categorised Vincent van Gogh's work as self-portraits, portraits, sunflowers, irises, potatoes and other. Ask the children if they agree with this categorisation, particularly the 'other' category. Could this be broken down further, and if so how? Ask the children to present their final results as a pie chart, block graph or pictogram. Compare the different representations and discuss which is more suitable for a particular purpose.

Vincent van Gogh Gallery offers a chronology of van Gogh's most famous paintings. Ask the children to find out which were van Gogh's best years, that is, the years when he painted more famous paintings. They should choose which type of diagram or graph to use to present their findings clearly. For a more challenging activity, use the Catalog of Paintings and find his more prolific years.

There are several YouTube slideshows of van Gogh's work which might inspire the children as they work.

Further information from these sites:
- National Gallery
- Royal Academy of Arts
- Wikimedia Commons
- Wikipedia.

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Focus on…Prime Numbers

Like the concept of infinity, prime numbers fascinate children and adults alike. For a mathematician, the greatest achievement is to find the highest known prime number. At the time of writing, the highest known prime is $2^{43112609}-1$. To write it out you would use 12 978 189 digits!

Those football fans among you will remember that when David Beckham joined Real Madrid in 2003 there was much debate about Beckham's choice of the number 23 shirt. Marcus du Sautoy suggests Beckham chose number 23 because it is a prime number. If you want to read more of du Sautoy's thoughts about this and other prime numbers have a look at Issue 26 of Plus magazine. You might also find his Music of the Primes interesting.

A number is called 'prime' if its only factors are one and itself. All prime numbers, apart from two, are odd numbers. The first ten prime numbers are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29. Consider for yourself why 1 is not a prime number.

Investigating prime numbers does not have to be the preserve of children in Year 6. Early investigations looking at prime numbers can be started in Key Stage 1 by focusing on prime numbers as numbers that are special. Indeed, Mathematics Attainment Target 2 of the National Curriculum suggests that children in Key Stage 1 should be able to create and describe number patterns, and recognise sequences, including odd and even numbers.

For example, children in Year R and Key Stage One can start by exploring why the numbers 3, 5 and 7 are 'special', Ask them to see how many things they can think of that correspond to number '3', for example. Take a look at Richard Phillips' fascinating website – it will give you some starting points for discussion for the first ten prime numbers. You could give the children three items and see what patterns they could make:

This could then be repeated with five and seven.

There are also some good investigations for Key Stage 1 children with which to start exploring prime numbers on the NRICH website.
For example, these are both Key Stage 1 challenge level 2 activities:

- What's Left?
- Numbers as Shapes.

As an extension of *What's Left?*, why not ask the children to take a 100 square and colour multiples of 2x table, then 3x table etc. What do they notice about the numbers not coloured in?

Or try this one adapted from Mathematical Challenges for Able Pupils Key Stages 1 and 2, published by the National Strategies.

Here are ten cards numbered 0 to 9:

Using all ten cards, rearrange them to make five prime numbers. Can you find any other ways of doing it?

Why not give the children cards with numbers on them so that they can find their partner?

For more challenging investigations for pupils in Key Stage 2, try these statements as starting points for discussion and investigation:

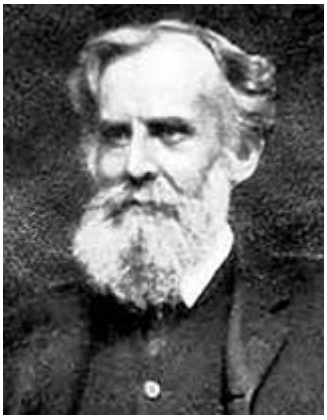
Is it always, sometimes or never true...

- that prime numbers are odd?
- that every prime number is one less or one more than a multiple of six? (a hundred grid with six columns is a useful visual image to support this – the National Strategies' website has a ready-made grid)
- that every even number can be written as the sum of two prime?
- that every prime number is the sum of two square numbers, e.g. $13 = 9 + 4 = 3^2 + 2^2$?

There is an interesting chapter (pp 49 – 65) on prime numbers or 'prima donnas' as he calls them in *The Number Devil: A Mathematical Adventure* by Hans Magnus Enzensberger (2006). This book is a fascinating mathematical fairytale for children in Key Stage 2 that brings mathematical concepts to life.

For your own interest, you may also want to have a look at the article A number that can be divided by one and itself in Issue 27 of the Secondary Magazine.

A little bit of history
Famous Mathematicians – John Venn (1834 – 1923)



John Venn was a British logician and philosopher. He is probably best known, especially in primary schools, as the inventor of the Venn diagram.

John was born in Hull in 1834. His mother, Martha Sykes, died when he was just three. His father was the Rev. Henry Venn and, at the time of John's birth, he was the rector of the parish of Drypool.

His grandfather, also called John, had been the rector of Clapham, south London and was a leader of the Clapham Sect along with William Wilberforce. This was a group of evangelical Christians, based at his church, who campaigned for prison reform and the abolition of slavery and cruel sports. His father also played a prominent role in the evangelical Christian movement being a member of what became known as the Church Missionary Society. He became the secretary of this society, which meant a family move from Hull to Highgate near London.

John was brought up very strictly and it was expected that he would follow the family tradition and go into Christian ministry. He did for a while, he was ordained as a deacon at Ely in 1858 and became a priest in 1859, but this only lasted for a few years.

As a child, he went to Highgate School. He worked hard and did really well in his studies. As a result he earned himself a place at Gonville and Caius College at Cambridge University, which he took up in 1853. After he graduated in 1857 he went into the ministry. In 1862, he gave that up and went back to Cambridge University as a lecturer in moral sciences.

His main area of interest was logic and he published three works on the subject. He wrote *The Logic of Chance* which introduced the frequency theory of probability in 1866, *Symbolic Logic* which introduced the Venn diagram in 1881, and *The Principles of Empirical Logic* in 1889.

In 1883, John was elected to the Royal Society.

As well as being an intellectual, he was also skilled in building machines. He once built a machine for bowling cricket balls. It was so good, that when the Australian Cricket team visited Cambridge in 1909 it was put to use and bowled out one of their top players four times!

John married Susanna Carnegie Edmonstone, the daughter of the Rev Charles Edmonstone in 1867, and they had one son, whom they named John Archibald Venn.

John Venn died in Cambridge in 1923 and was buried in Trumpington Churchyard. There is a stained glass window at Gonville and Cauis College commemorating him and his famous Venn diagram!

Now, more about the Venn diagram...

As previously mentioned, John's main interest was in logic and it was this that caused him to create his diagram. It was designed to show logical relationships between a finite collection of sets. Venn diagrams have been used to teach set theory, probability, logic, statistics, linguistics and computer science.

They are normally made up from overlapping circles. The inside of each circle represents the elements of the set. Anything that doesn't belong in the set is placed outside the circle. Where the circles overlap or intersect you will find elements that belong in two or more sets, so if, for example, one circle represented numbers below 20 and another even numbers, the overlap would contain even numbers below 20. Odd numbers above 20 would be outside the circles.

Venn diagrams are very similar to Euler diagrams, which were invented by Leonhard Euler in the 18th century. Of course, Venn didn't use the term Venn diagrams: he referred to them as Eulerian Circles. It was the philosopher Clarence Irving Lewis in 1918 who was the first to give them their name.

Venn diagrams are great to use in the primary classroom for sorting shapes and numbers. You could try this activity:

> Draw two overlapping circles. Write 35 in one and 4 in the other. Ask the children to tell you what they think the criteria might be. Then write 15 in the first, 32 in the second and 13 outside the circles. Ask the children again what they think the criteria might be – have they changed their minds from their first thought or not? Write 20 in the middle and repeat the question. Next ask the children to give you numbers and as they do so, place them in the appropriate place for the criteria multiple of five and even numbers.

There are a couple of good problems involving Venn diagrams which you might like to give to your class to solve on the NRICH website.

Venn that Tune is a fun website to look at - can you name the songs from the Venn diagrams? This might be a fun activity to develop with your children.

Information from these websites:

- St Andrews University
- Wikipedia.

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Maths to share – CPD for your school

Probability

This Is it possible for me to finish all of my marking before the start of *EastEnders* tonight? Impossible? How likely am I to find a primary teacher who relishes the thought of teaching probability in mathematics? Not very likely? For many primary teachers, probability is one of those 'tricky' areas of mathematics, and one which is seen as best left to 'those in Year 6'. Indeed, the National Curriculum does not explicitly mention probability until Level 5, but as much of the language of probability is rooted in everyday speech and experience, the concept can be introduced with children of all ages. Falk and Levin, in A potential for learning probability in young children, indicate that concepts of probability could be introduced to pupils as young as six. Take the time to work with colleagues to try out some of the key probability ideas and activities explored here, and prove to yourself that probability really can enrich yours and your pupils' experiences of mathematics!

The 'Monty Hall Problem' is probably the most well known of all those concerned with the rules of probability. It is loosely based on a 1970s American television game show *Let's Make a Deal*, and is named after the show's original host, Monty Hall. Ask a colleague to act as the game show contestant, and present them with the problem:

> You are placed in front of three identical doors, numbered 1-3.
> Behind one of the doors sits a brand new, gleaming sports car.
> The other two doors are concealing 'booby' prizes - goats!
>
> You are asked to select a door... you choose door number 1.
> The game show host, who knows where the car prize is hidden,
> reveals a goat behind door number 3.
> He then asks if you would like to change your door of choice before the 'big reveal'.
>
> Do you change your mind, or stick to your original choice?
> Will it make any difference?

Allow some time to discuss the problem and work through the possibilities. Does it matter whether the contestant changes their door choice? Will the chance of winning be any less? Greater? As the contestant cannot be certain which of the two remaining doors is concealing the prize, and initially the doors were equally likely, most people assume that each of the two remaining closed doors has an equal probability and conclude that switching will not make a difference. The common answer is 'stay with my original choice of door'. However, the laws of probability suggest that the player should change their choice of door. Doing so will double the overall probability of winning the car from 1/3 to 2/3! Encourage colleagues to explain their thinking to each other. For those who are completely confused or battling with what seems like common sense, then Marcus Du Sautoy provides a clear, logical explanation of the probability behind the problem in this clip from *Alan and Marcus Go Forth and Multiply*, shown on BBC2. The film *21* starring Kevin Spacey, based on the book *Bringing Down the House,* also explores the mathematics behind the problem.

Despite the fact that many of us use the language of probability every day, often subconsciously, there is potential for a great many misconceptions in our thinking. Teacherlink provides a useful interactive quiz (that can also be downloaded) which aims to test out common misconceptions concerned with

probability. Examples are based on research carried out by Fischbein and Schnarch and are each followed with clear explanations and activity ideas to address the misconceptions. The Data Handling strand of the National Centre Self-evaluation Tools also provides a useful opportunity for teachers to evaluate their current knowledge. Probability-related questions can be found within Key Stages 2 and 3, and in the Adult Learning phases.

Ask colleagues to consider when they, or the pupils, use the language of probability in everyday speech. Examples could include *"It will probably rain tonight"*, *"I bet you can't"*, *"Aw, it's not fair"*, *"There's a good chance the Blues will go down this season"* or *"Mike's really fast, Jack'll never beat him"*. It is useful to use this familiar language, in the correct mathematical sense, at all stages with pupils. Consider where some of these phrases might fit in this suggested progression of activities through probability concepts.

Recognising possible outcomes of random events, e.g:

- ask pupils to choose in which hand they think a marble is hidden when it is randomly swapped over. There are only two possible outcomes, and they have no way of knowing which will be correct
- children will recognise that the only possibilities when tossing a regular coin are 'heads' or 'tails'.

Recognising there is a degree of uncertainty about the outcomes of some events, and that other events are either certain or impossible, e.g:

- ask pupils to run to a blue or red marker corresponding to the colour of a cube pulled out of a bag (containing one red and one blue cube). Add nine more red cubes and continue the activity. Children are very quick to decide that the game is 'unfair'
- show pupils a collection of bags of different sizes and invite them to discuss what is likely or unlikely to be in each bag
- in preparation for a school trip, make three lists as a class: *'What we MUST bring'*, *'What we MUST NOT bring'*, *'What we MIGHT bring'*
- ask pupils to think about their personal skills and make three statements: *'I can definitely…'*, *'I'm not sure if I can…'*, and *'I definitely can't...'*
- link 'always', 'sometimes' and 'never' or 'certain', uncertain', 'impossible' vocabulary when using common classroom resources such as dice or playing cards, e.g. When I roll a regular dice, I will *always* get a number. When I select a card from a regular pack, I will *never* get a 26.

Placing events in order of likelihood and using appropriate words to describe the chance, e.g:

- this will be a refinement of the previous 3 level categorisation and might include terms such as *certain*, *very likely*, *likely*, *unlikely*, *very unlikely* and *impossible*
- have boxes labelled with the different categories and invite pupils to post statements or pictures for later class discussion
- ask pupils for all of the words they could connect with probability, e.g. never, 50:50, no way, sometimes, no chance, could be. Make a class washing line to hang these up in order or likelihood.

Understanding and using the idea of 'evens', e.g:

- allow pupils to keep a tally of outcomes from tossing coins. Discuss the results
- discuss the idea of needing to roll a '6' at the start of many board games. Does this make it harder? Test it out in the classroom. Which number appears most often?

Giving and justifying subjective estimates of probabilities, e.g:

- discuss events that might cause some disagreement amongst the class. Examples might include *'it will rain at the weekend'*, *'there will be enough milk for my coffee at break time'*, *'a dog will walk into the playground'*
- play Probability Match where pupils match up 'event' and 'chance' cards, and convince others of their choice.

Understanding and using the probability scale from 0 to 1, e.g:

- ask pupils to place event cards on a probability scale from 0 to 1. Discuss the notion of 0.5
- consider a statement such as *'I roll a die and…'*. Ask children to place events on a scale from 0 to 1, marked in sixths. Event cards might include *'I get a 7' (0)*, *'I get a square number' (2/6)*, *'I get a number that goes into 12' (5/6)*.

Understand that repeating an experiment may result in different outcomes:

- ask pupils to vote for which way they think a paper cup might land when thrown in the air: upright, upside down, or sideways. Carry out the experiment. What if we only throw the cup once? Twice? How many times should we throw it? Why?

There are a great number of excellent online resources to support teachers both in their own subject knowledge of probability, and with engaging activity ideas for the classroom. Try out some of these, and let us know how you get on.

Mathsonline hosts some excellent flash simulations based on probability concepts. The 'Tossing Coin' simulation can be left to run to produce thousands of trials, producing a bar chart of results as it progresses – a real time-saver in exploring the concept of repeating an experiment! 'Spinning Spinners', 'What's in Santa's Sack' and 'Chase Me' would all be equally valuable in the classroom.

A great deal of discussion could be had from the online simulation of the television programme *Deal or No Deal*. Do pupils really think it makes a difference which boxes are opened? How can they decide whether it is a good idea to take the Banker's offer?

The Mathematics Enhancement Programme, then based at the University of Exeter (now at the University of Plymouth, Exmouth Campus), has produced a useful guide to probability, including key terms, skills and definitions; ideal for teachers. A second booklet explores interesting activities for self-study or for the classroom.

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ICT in the Classroom - Using the internet for real data handling

The internet is a rich resource for investigating and analysing a wide range of real data that can be used for problem solving across the curriculum. There are also databases available to be searched under most themes imaginable.

An easy place to start is with the CensusAtSchool project. The site has real data arranged under curriculum areas covering themes such as Victorian childhood, healthy eating, and environmental issues. The worksheets and teachers notes offer thought provoking questions and lines of enquiry, as well as opportunities to consider the accuracy and usefulness of data collected.

Sports are bursting with statistics, and one set of data that children might find interesting is that of Olympic Games results and world records. Some information on this theme is available through the Centre for Innovation in Mathematics Teaching, where children can answer questions directly from the tables such as 'Who won the Men's Marathon at the 2000 Olympic Games?' or 'What was the time difference between first and second place in the Women's 100 metres?' They could otherwise create graphs to show the numbers of medals won by different countries in different years, considering trends over time.

Rather than rely on datasets already collected, children can access information to make up their own that more precisely answers their own needs. Using a website such as mySupermarket.co.uk, children can compare prices of foods from four different supermarkets to follow an enquiry linked to the budget for a class party, or pricing a recipe for food to make for the Christmas fair.

For a chance to both collect your own data, and then compare it with other datasets go to The Royal Society for the Protection of Birds (RSPB) Big Schools' Birdwatch, which includes a facility online for making many different types of graph and chart with their sample data and participate in a nationwide data collection event. Little Schools' Birdwatch has resources dedicated to inspire three- to five-year-olds, or for more in-depth information try the general Birdwatch pages for statistics about all the birds seen in last year's collection.

How about a holiday or hotel break? Sites such as tripadvisor.co.uk allow customers to rate their experiences of different holidays and hotels. These two summaries are from hotels in Leeds which both get an overall score of 4/5 from the reviews. Can the children argue persuasively which they think is the best hotel based on the statistics? Use this opportunity to discuss what 'average' means and how different averages might be used. Ask the children to present an argument for what average is the most important in choosing a hotel.

The BBC Weather site allows us to compare weather between regions or countries around the world. We can pose the question 'How accurate are the BBC weather forecasts for our town?' and compare the forecasts with data collected at school over a period of time. As winter approaches we might even be

able to use this to introduce negative numbers in the context of temperature, and learn how to plot negative numbers on a graph.

Many organisations have databases available to customers and the public online. The Royal Horticultural Society (RHS) Plant Selector allows us to search through an enormous number of plants. Try working with children to find plants to put into a Carroll diagram. In the diagram below, the blue area represents an area of the school that is ready for planting. Fruit or herbs are to be planted at the front of the bed where they will be more easily harvested, and the left hand side of the bed is against a wall that provides some shade. The diagram could be completed on the screen either using photographs or text from the RHS website.

	Partial shade	No shade
Not edible		
Edible (fruit/herbs)		

The children could make their own mini database for planning a garden or making a plant catalogue, choosing which statistics and information should be included and the order in which the entries will be arranged to help them be found easily.

Other online database ideas

Estate agency sites such as Rightmove can be used for sorting pictures of homes into an on-screen Venn diagram, choosing two categories to compare, such as more than two bedrooms, not priced at more than £200 000, terraced, no garage etc. Perhaps you might develop the idea further by creating the children's own database of real or imagined homes to be used in mathematical role play.

Colchester Zoo has a database of its animals which can be browsed through by animal name, or searched for a particular feature. Try sorting animals by continent of origin, or whether they are carnivores or herbivores. Allow children to discuss and come up with their own ways of presenting the information about the animals that they find interesting.

The British Museum has a database of its collections, where children can search for artefacts relating to a historical theme. Each file includes measurements of the object. Why not make your own class museum? Recreate objects to scale, consolidating measurement skills, and consider different ways of arranging the objects in the museum, for example, along a timeline, by the object's material, or by its use.

Often when the children access information on line they are searching a database. Exploit any opportunities that arise when the searches are not successful. Are the criteria available for the search useful, too many, too few, do the results match the search? How could the database / search engine be better designed? You might even consider using the organisations as an audience for the children's mathematics work by allowing them to contact the organisation with feedback about the websites and information about the enquiry they have undertaken.

CPD and research opportunities

Issue 9 of the NCETM Primary Magazine has ideas for developing learning and teaching in data handling, including suggestions of other ICT resources that can support children's understanding and analysis of data.