Primary & Early Years Magazine 53

National Centre for Excellence in the Teaching of Mathematics

Welcome to Issue 53 of the Primary Magazine. In this issue The Art of Mathematics features the artist David Hockney. A Little Bit of History continues its series on inventions: in this issue we look at scissors. Focus on... explores another mathematics trail, and Maths to Share looks at some research by a Mathematics Specialist Teacher.

Contents

Editor's extras

NCETM Self-evaluation Tools review

The NCETM is updating the online Self-evaluation Tools (SET), which help teachers audit their subject knowledge and pedagogy. The change is necessary to bring the tools into line with the mathematics content in the new National Curriculum. With this in mind, we're hosting an online survey, for present and past users of the SET to give feedback on how they have found using the tools. Everyone completing the survey will be given the chance to enter a draw for £50 worth of Amazon vouchers. We would ask that you complete the survey before **noon on 15 July**.

The National Curriculum

We have recently published a new 'Essentials' page for implementing the National Curriculum. Implementing the new curriculum is a 'one-stop shop' with links to resources on the NCETM portal that will be helpful to subject leaders who are beginning to consider how to support teachers in readiness for the new programme of study. We have also launched a webpage that will keep you up to date with relevant news of the new curriculum as it becomes available.

The NCETM Professional Development Lead Support Programme

We're pleased to confirm new dates this autumn for our programme of national free face-to-face events for Primary CPD leads, the NCETM Professional Development Lead Support Programme (PDLSP).

Those who complete the programme are accredited by the NCETM to provide professional development in the priority areas of arithmetic proficiency in primary schools; to date over 140 participants in the programme have been accredited, with more to come.

The dates and locations for the new Primary cohorts are:

Places	Date	Location	Region
25	20 & 21 Sept - see note below	London, venue tbc	London
	15 & 16 Nov - see note below		
20	28 Sept - see note below	Kent, venue tbc	SE
	23 Nov - see note below		
20	17 & 18 Oct	London, venue tbc	London
	5 & 6 Dec		
20	7 & 8 Nov	Birmingham, venue tbc	WM
	9 & 10 Jan 2014		
20	14 & 15 Nov	Leeds, venue tbc	Y&H
	23 & 24 Jan 2014		

Note: the London Primary cohort (20/21 September and 15/16 November) is particularly aimed at participants on the Mathematics Specialist Teacher (MaST) Programme; the South East cohort PC17 is being run as two one-day events - both Saturdays - 9am - 5pm.

The PDLSP microsite has full details of the programme - including support materials, Frequently Asked Questions, and information about how to book your free place.

Colleagues who have completed the first cohorts have said about the programme:

> *'I really valued the input from experienced colleagues and the diversity of viewpoints was very refreshing.'*
>
> *'One of the main criteria for successful PD is that it stimulates new thinking – it certainly did that for me.'*
>
> *'The course is definitely impacting on my daily work.'*

Videos to support the implementation of the New Curriculum

As part of our support for the implementation of the new National Curriculum, we have produced a suite of videos focussing on calculation and the associated skills and understandings - for example, the concepts of place value and exchange. The videos seek to demonstrate how fluency and conceptual understanding can be developed in tandem. The National Curriculum aim that children should 'reason mathematically' is demonstrated throughout. Each set of videos has an accompanying presentation to stimulate thought and discussion. We hope you enjoy the videos and find them helpful in supporting teacher professional development. We'd be delighted to hear your feedback and learn how you use them, together with any comments you have.

New microsite for subject leaders to support high attainers in mathematics in primary schools

The NCETM has created a microsite, High Attaining Pupils in Primary Schools, for subject leaders, senior leaders and teachers, that will help them to identify and support pupils who are attaining higher than expected standards in mathematics not just in Year 6 but from the time they begin school.

And finally…

You might be interested in watching this short YouTube clip How much stuff do our bodies make in a year? It gives opportunities for different elements of mathematics to explore with your children. The facts are likely to fascinate most of your class!

The Art of Mathematics
David Hockney

David Hockney was born on 9 July 1937 in Bradford, England, to Laura and Kenneth Hockney.

He is a well-known English painter, draughtsman, printmaker, stage designer and photographer. He has several homes, one in Bridlington, Yorkshire, and another in Kensington, London. He also has two homes in California, where he lived on and off for over 30 years, one in Los Angeles and another in Hollywood. He is considered to be an important contributor to the Pop Art movement of the 1960s, and one of the most influential British artists of the twentieth century.

IMG_8182.CR2 (iPad)

He was the fourth of five children. His mother brought her family up as strict Methodists and would not allow smoking or drinking in the home. He used to spend Sunday afternoons at Sunday School drawing cartoons of Jesus – much to his Sunday School teacher's dismay. His father was a conscientious objector in World War I.

David's first school was Wellington Primary School. In 1948, he won a scholarship to the Bradford Grammar School, one of the best schools in the country. His parents were delighted as one of their goals for their children was to have the best education possible. He enjoyed his art classes so much that he decided that he wanted to become an artist. Unfortunately he disliked all the other subjects that he also needed to study. In 1950 he asked to be transferred to the Regional College of Art in Bradford, but his headmaster wanted him to finish his general education first. David wasn't very happy about this and his behaviour at school towards his teachers deteriorated and he didn't really work very hard, spending most of his lessons doodling in notebooks, so his grades were poor. However his art went from strength to strength and he won various prizes and recognition and was asked to draw comics for the school newspaper. In 1953 he finally enrolled in the College of Art and began painting with oils which have been his medium of choice for most of his life. His early artwork was abstract and often involved mirrors. In 1957, he took the National Diploma in Design examination and graduated with honours. Two years later he enrolled in the Painting School of the Royal College of Art in London. It was here he gained national recognition as an artist.

At the Royal College of Art, David featured in the exhibition Young Contemporaries which announced the arrival of British Pop Art. He was due to graduate in 1962 but the Royal College wouldn't let him because he had refused to write an essay required for the final examination. He believed that he should be assessed solely on his art. He drew the sketch The Diploma in protest. Recognising his talent and growing reputation, the Royal College changed its regulations and awarded him his diploma so he was able to graduate. When he was at the Royal College, he was a serious student working hard to develop his style but he also enjoyed a social life and liked to spend time with his friends exploring pubs and coffee bars around London.

He painted works about vegetarianism and the poetry he liked reading. He also began painting about his sexual orientation. He had never felt comfortable about this growing up in Bradford but at the Royal College he was able to talk freely about it and made friends with other gay men.

In 1961 David travelled to New York for the first time. He sold some of his paintings to fund the trip. While he was there he visited all the city's galleries and museums. He spent time at the Pratt Institute to work on paintings and sketches. It was from the sketches he made in New York that he came up with the idea of an updated version of Hogarth's A Rake's Progress (eight paintings that tell the story of Tom Rakewell, a young man who followed a path of vice and self-destruction after inheriting a fortune from his miserly father). He also met and befriended Andy Warhol.

He enjoyed his time in the United States and went back to visit, this time to Los Angeles, which he loved, and he subsequently made Santa Monica his home. He enjoyed the laid-back approach to life that Los Angeles offered and it was around this time that David developed the naturalistic, realistic style he is most known for today.


Art Institute of Chicago

In 1964 he was invited to teach at the University of Iowa. He didn't particularly enjoy the job but was able to complete several paintings while he was there. During this period, David hosted his first American exhibition. He received rave reviews and sold every painting!

In 1965 David was teaching at the University of Colorado in Boulder. He lived in an apartment without windows and painted the Rocky Mountains from memory!

In the 1980s David's interest in photography had grown and he began to make photo collages. He used a Polaroid camera and from the photographs he took, he assembled collages. He was fascinated by the idea of seeing things through a window frame. On one occasion, while he was driving through the southwest of the United States he took thousands of photos. He used these to create various collages, such as You make the picture Zion Canyon, Utah.

In 1983, David began a series of self-portraits. These show that he was quite a vulnerable man and unsure of himself, even though he had achieved major success in his life as an artist.

By embracing different technology and media David has made his art accessible to everyone. He used his art to express the love he has for others and they usually have a deep and personal meaning to him which has, at times, caused him personal suffering.


25 trees and other pictures by David Hockney

For more about the life and work of David Hockney visit the sources of this information: davidhockney.com and Visual Arts.

Now for some mathematical ideas…

You can find many of David Hockney's works of art at hockneypictures.com.

Show the photo collages You Make the Picture Zion Canyon, Utah and Merced River, Yosemite Valley

For each discuss picture what the children can see. Can they make out the mountains in the first and the river in the second? Can they identify any shapes and symmetry?

You could take some photos of the children, print them out and ask the class to cut them diagonally into two triangles. They could explore the triangles in terms of type of triangle, types of angle. You could ask them to estimate the size of the angles and then measure them using a protractor. You could explore how to find the area of the triangles, for example, by halving the areas of the rectangles the triangles are half of, and then find these and their perimeters.

They could then use these to make a whole class collage, maybe with the theme of a landmark.

Show Rainy Night, which David created on his computer using a drawing programme and a tablet computer

Discuss the reflections in the water and the concentric circles made by the rain. You could give the children mirrors and ask them to lay them flat on their tables and place objects or pictures upright against one edge. They then move them towards the mirror and draw the reflections that they can see.

Ask the children to make an abstract picture of concentric circles. They could draw around different sized circles to do this or, if they are able to, use a pair of compasses.

You could explore the ratios of white and blue paint to make up the different shades in the painting. Ask them to experiment – can they make any of the shades David Hockney has made? Encourage them to write the ratio beside their colours. You could then explore how to turn the ratios into proportions.

Ask the children to make their own copy of this painting and to ensure they include mixing paints and painting reflections and concentric circles.

Show Beach Umbrella

Focus on the shadow in this painting. You could explore how to find an approximate time of day. If it is a sunny day, go onto the playground and mark the shadows of a cone or something similar. Ask the children to measure the lengths of the shadows at different times of the day and record these next to the time of measuring.

Look at the angle made between the shadow and the umbrella where they meet on the sand. What type of angle is it? What would be a reasonable estimate of its size? Discuss how to find out and then use a protractor to measure it.

You could ask the children to draw a similar picture with an object and its shadow. When everyone has done one sort them according to angle type (acute, obtuse, right) and then order from smallest angle to largest. You could then ask them to measure the angles as accurately as they can.

Show Large Interior

Ask them to identify the pieces of furniture that they can see in the room. Ask them to count them.

They could identify the different shapes that can be seen. Can they name the quadrilaterals? You could use this as an opportunity to explore the properties of quadrilaterals, including square, rectangle, parallelogram, rhombus, kite and trapezium. They could make an information poster with drawings and descriptions. They could do a sorting activity using a two criteria Carroll diagram.

They could make up their own 'interior' picture. Encourage them to decorate the walls with different 2D shapes.

Show Small Santa Monica and The Bay from the Mountains

Count the mountain tops. What 3D shapes do they resemble? You could ask the children to try and make a cone and a pyramid out of paper or card. They could work in a group and, when they have a few of each, arrange them to look like a mountain scene. Of course, you will need to discuss the properties of these shapes first!

You could print out a copy, make a 6 x 3 or 8 x 4 grid and cut out the 18 or 32 rectangles. Give one to each child and ask them to copy and then paint (trying to match the colours by mixing paints) their section on a piece of A4 paper. Once they have, put all the pieces together to make a huge version of David's painting. You could work out by how much they have scaled up the original copy you had to make the large version.

The ideas here are just to give you a taster of the mathematical activities that could be involved when looking at artists such as David Hockney. We know you can think of plenty of others! If you try out any of these ideas or those of your own, please share them with us! We know you can think of plenty of others! If you try out any of these ideas or those of your own, please share them with us!

Explore further!
If you've enjoyed this article, don't forget you can find all the other *Art of Mathematics* features in the archive, sorted into categories: *Artists*, *Artistic styles*, and *Artistic techniques*.

Focus on…
Mathematics trails

In this issue of *Focus on...* we share a mathematics trail designed by three students in their second year at Kingston University, Matt Woods, Sean Moran and Becky Viner-Waite. Matt, Sean and Becky are history/geography specialists. Matt says:

> *"We are very pleased with our maths trail as we believe it makes maths more accessible and applies it to real life scenarios so children can see why we learn maths. I've always found maths hard to engage with but by choosing a topic or a place like Wembley Stadium, it can be made interesting to children who would prefer to be out playing football rather than in a lesson. It may be stereotypically for boys but a similar maths trail could be made about more or less any outside area, for example, Disneyland or the function of Wembley Stadium could be changed, for example to a concert venue to make it interesting to girls."*

As you can see from Matt's comment, their trail takes us around Wembley Stadium. The ideas here can be reproduced for all football stadiums around the country. So if you are planning a trip to one, use some of their ideas, we are sure they would be delighted. If you do please let us know how you get on.

As suggested in the article about the mathematics trail to Legoland in Issue 52, there is always plenty of mathematics involved in planning a trip to such a place, for example:

- using calendars to plan the date
- working out the cost
- finding a suitable route and working out how long it will take in a coach travelling at an average speed of 50mph
- finding a coach of a suitable capacity
- working out what time to leave school to get there for 9am and what time you will return
- exploring the cost of items in the 'gift shop' and considering the amount of spending money the children might like to take.

Wembley from a stand

Back to the mathematics trail…

The activities in this trail meet many aspects of the Mathematics National Curriculum and can be adapted to suit both Key Stage One and Key Stage Two. These include:

- addition, subtraction, multiplication and division
- calculating areas
- money
- time.

The second slide has some mathematical facts about Wembley which could lead to some word problems involving the four operations. These could include fractions and percentages. There are also opportunities for scaling and measuring if you wish the children to make drawings or models.

The second slide asks the children how to get to Wembley on the London Underground. Many children find these maps fascinating and so it could be explored in different ways, for example, how many different ways are there to get from Waterloo to Wembley? Which would be the shortest route? The children could look on a street map for underground stations and calculate the distances apart on the ground.

The other slides give suggestions of problems to solve which involve such areas of mathematics as number, money and measurement including time. These can be extended and developed further to suit your children.

You could continue with this theme and explore football matches further, developing a variety of problems and investigations for the children to solve.

Problem Solving is a component of the trail, with the activities containing an element of this. The trail also puts mathematics into context and allows children to recognise that it is incorporated into numerous aspects of everyday life.

Have fun exploring the mathematical possibilities of Wembley Stadium!

Explore further!
If you've enjoyed this article, don't forget you can find all previous *Focus on...* features in our archive.

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& Early Years
Magazine 53

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A little bit of history – Scissors

In this issue of the Primary Magazine we are continuing our short series of articles on inventions. We are looking at one of the most used pieces of equipment in the classroom…

Along with Post-it Notes and Blu-Tack, scissors are another invention that we cannot do without, especially in the classroom!

A few facts you may or may not know about scissors…

- they are hand-operated instruments used for cutting different thin materials such as paper and cloth
- they have a pair of metal blades that pivot so that the sharpened edges slide against each other when they are closed
- there are different types of scissors, some of which have specialised uses for example those that cut hair
- scissors are commonly thought to become shears when they are longer than six to eight inches (about 15 to 20 cm)
- these days scissors are specifically designed with plastic or rubber handles for a power or a precision grip
- in lower-quality scissors the cutting edges are not very sharp. It is the shearing action between the two blades that enables you to cut with them
- in high-quality scissors the blades can be extremely sharp and are tension sprung. These scissors tend to be used for things that need precision cutting
- children's scissors usually have blade tips which are blunted or 'rounded' for safety
- there are specially designed foot or mouth operated scissors for people who do not have the use of their hands
- most scissors are made for use with the right hand, but these days there are left-handed scissors for use with the left hand.

When were scissors invented?

It is thought that scissors were invented around 1500 BC. The earliest scissors found are said to be from Mesopotamia and date back 3 000 to 4 000 years. In those days they were made from bronze blades connected by a flexible strip of curved bronze which allowed them to be squeezed together.

It is believed that modern cross-bladed scissors were invented by the Romans in around 100AD. These were made from bronze or iron and pivoted at a point between the tips of the blades and the handles.

As the Romans travelled around Europe so did the scissors! Consequently their usage spread to other countries. Initially they were mostly used by tailors and barbers. After the Roman period, scissors of a better quality and design were made and sold. These were used in countries such as China, Japan and Korea. As the art of calligraphy spread, concave blades were developed to cut paper. These were widely used around the world.

During the Middle Ages and the Renaissance, spring scissors were made by heating a bar of iron or steel, then flattening and shaping its ends into blades. The centre of the bar was then heated and bent to form a spring. It was then cooled and reheated, a process which helped to make it flexible.

William Whiteley & Sons (Sheffield) Ltd is officially recognised as the first manufacturer of scissors. They began trading in 1760. Apparently, Robert Hinchliffe, from London, a self-proclaimed 'fine scissor manufacturer' produced the first pair of modern-day scissors made of steel.

Scissors

During the 19th Century, scissors were handmade with elaborately decorated handles. They were made by hammering steel to form the blades. The rings in the handles were made by punching a hole in the steel and enlarging it with the pointed end of an anvil.

Today scissors are pieces of equipment that are used nearly everywhere and by nearly everyone!

Scissor superstition…

Over the centuries various superstitions about scissors arose. Here are a few of them from uncommonscissors.com:

- you will 'cut off' fortune if you use scissors on New Year's Day
- scissors should be put away during thunderstorms to decrease the likelihood that the house will be struck by lightning
- placing a pair of scissors under the pillow of a woman in labour will 'cut her pain in half'
- breaking both blades of a pair of scissors is a sign of an impending disaster
- giving a pair of scissors as a gift will cause problems in a friendship by cutting the relationship in half
- a pair of scissors nailed above a door in the 'open' position, to resemble a cross, protects a household from witchcraft and evil influences
- dropping a pair of scissors warns that a lover is unfaithful

Information from:

- Uncommon Scissors
- Wikipedia.

Now for some mathematics...

Please remember: scissors are not a toy and should be used carefully under appropriate supervision

Scissors come in varying sizes. You could ask the children to look on the internet to find the different sizes that there are and make a list of those they find. They are sometimes given in Imperial measurements, so this would be a good opportunity to practice converting from in inches to centimetres. Some come in sizes of mixed units, this would be an opportunity to rehearse equivalent

units of measure. Others have fractions in their measurements so you could use these for some revision of fractions.

They could also draw lines of the different lengths and order and compare them.

The children could collect different sized scissors from around the classroom and measure their lengths and widths at various points. They could then draw these measurements as accurate lines to the nearest centimetre or millimetre.

They could scale up these measurements and, on large pieces of paper, measure and draw enormous pairs of scissors. This would be a good way to rehearse ratio.

'My scissor collection'

The children could look for and print out pictures of scissors and use these for sorting activities using Venn and Carroll diagrams. You could ask the children to make up their own criteria which may involve, for example, colour and length. A quick search on Google images will produce lots of examples.

Scissors are asymmetrical sometimes due to the sizes and shapes of the handles but mainly due to the crossing of the blades. They can however be used to create symmetrical patterns. Give the children a piece of string and ask them to place it vertically on their table. They could then collect an even number of scissors that look the same and arrange them on either side of the string to make a symmetrical pattern. You could give them a second piece of string to make a horizontal mirror line. They then alter their pattern so that it is symmetrical in all four quadrants. They could draw their patterns and use these for mathematical discussions.

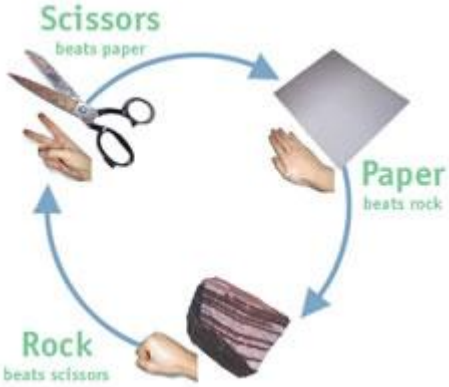
You could ask them to use two pairs of scissors and investigate ways to position these so that together they form a symmetrical shape (using scissors of the same colour):

They could then draw around their new shape and cut it out. They make a background on a piece of A4 paper with a mathematical theme, for example, 2D shape, lines meeting at different angles and stick their scissor shape onto it:

Ask the children to place a pair of scissors on the table so that the handles are facing away from them. They could then practice rotating the scissors from the end of the blades. They could do this in 90° and then 45° turns in both clockwise and anti-clockwise directions. They could then explore other points of rotation, for example one of the handles, the central pivot or a point away from the scissor as in the picture below:

They could then draw around a pair of scissors and cut the image out several times. They could make a pattern to show these rotations using their drawings.

You may have heard of the game 'Rock, paper, scissors' which is a hand game usually played by two people. The players simultaneously form one of three shapes with an outstretched hand. The 'rock' beats scissors, the 'scissors' beat paper and the 'paper' beats rock. If both players show the same shape the game is tie. Ask the children to work out how many possible combinations of shapes can be shown. They could then work out the probability of each shape winning and the probability of a tie. They could represent their probabilities on a probability scale and as a fraction or percentage. They could then try this out, maybe 20 times, and see if their probabilities were correct.



Rock paper scissors

You could ask them to work with a partner and make up an alternative game of 'Rock, paper, scissors' by throwing small 3D shapes. Give pairs a variety of shapes to choose from – after revising their names and properties in terms of number of faces, edges and vertices, the shape of their faces and whether the shapes are prisms or not. They choose the same three shapes each, hide them in a small bag and then pick one to throw on the table. They should make up their own rules, for example cube beats pyramid, pyramid beats cuboid and cuboid beats cube.

If appropriate you might wish to show the children this clip from The Big Bang Theory, where one of the characters says that players will tie 75% to 80% of the time due to the limited number of outcomes. You

could use this statement to explore percentages, for example, if playing 30 games how many will be a tie? They could explore whether this statement is correct for the games they played above.

You could ask the children to play the version suggested on the clip. Do the extra items make a difference to the percentage of ties?

You could ask the children to play the game against the computer on the New York Times website. They could work out the percentage to show the number of times they beat the computer or vice versa.

We hope that this article has inspired you to make a more mathematical use of your classroom scissors!

If there is any area of history that you would like us to make mathematical links to, please let us know.

Explore further!
If you've enjoyed this article, don't forget you can find all previous A little bit of history features in our archive, sorted into categories: *Ancient Number Systems*, *History of our measurements*, *Famous mathematicians*, and *Topical history*.

Maths to share – CPD for your school

In *Maths to share* we look at research undertaken by Mathematics Specialist Teacher, Kathryn Davies. Kathryn has recently gained the status of Mathematics Specialist Teacher (MaST) from Edge Hill University, Ormskirk. She has completed the two-year MaST programme which is designed to help teachers to develop a deep understanding of a range of approaches to the teaching and learning of mathematics across key stages, helping them to become 'champions of mathematics' who will work to change attitudes towards the subject, making it more accessible and relevant to children. The following article discusses the use of Lesson Study as a collaborative school approach which can have a positive impact on mathematical learning throughout the school.

It would be helpful to print out copies of Kathryn's report to give to colleagues. Ask them to read it before the staff meeting and to be prepared to discuss how her work might make a contribution to the way mathematics is taught at your school in the future.

A focus on Kathryn's school's development plan was 'outdoors' and she had the intention of finding out whether working outdoors would have an impact on learning for underachieving boys who found it difficult to settle in the classroom.

Begin the session by discussing the underachieving groups in each class at your school:

- are they predominantly boys or girls or a mixture of both?
- are they present in specific year groups or throughout the school?

Kathryn's research was with Year 2 boys, so as you discuss what she did, ask staff to consider how it could be made relevant to the particular underachievers in their year group.

Ask colleagues to consider these quotes from the DfES and Rhydderech-Evans:

> *'Learning outside the classroom is about raising achievement through an organised, powerful approach to learning in which direct experience is of prime importance. It can lead to children gaining a 'deeper understanding of concepts that are often difficult to teach effectively within the classroom alone'* (DfES, 2006:3).
>
> *The outdoor area in school can 'provide a stimulus for a wide range of mathematical investigations' by presenting 'opportunities for making children aware that mathematics is real'* (Rhydderech-Evans, 1993:5).

- how strongly do colleagues believe that learning outside the classroom can be a powerful approach to learning?
- do they believe that mathematics outside the classroom presents 'opportunities for making children aware that mathematics is real'?
- do they think that the direct experiences children have can lead to a deeper understanding of concepts that are often difficult to teach effectively within the classroom?
- what do colleagues think are the difficult to teach concepts?

You could make a list of the concepts that colleagues consider difficult to teach and then consider how these could be developed using rich investigational tasks outside the classroom.

You could do this as a mind mapping type activity. Give groups of colleagues a large piece of paper and ask them to write one of the difficult to teach concepts in the middle. Ensure all those listed are covered. They then think of outside activities that could be done to help develop the children's understanding. Give them five minutes to discuss and write notes. Then ask the groups to pass their 'mind map' to another group. They read the suggestions and add their own. Keep doing this until everyone has contributed to each concept.

You could collate all these at a later date and distribute to colleagues to use in future planning.

You could discuss the idea of collaborative working as a way of supporting CPD in your school:

- is this something you and your colleagues would consider?
- do any colleagues feel this would be of benefit to them?
- do you have any newly qualified teachers or colleagues on Teach First or graduate programmes that would benefit?

You could discuss the mentoring model of collaborative working considering the comments from Liversidge (an effective mentor is a good role model who can help to develop confidence in the mentee by valuing their thoughts and encouraging them to try their ideas) and Hughes (a mentor is not about providing answers but enabling the trainee to generate their own solutions).

Kathryn saw the mentoring model as being too hierarchical. Is this view shared by your colleagues?

Consider the lesson study model. Fernandez says that it is an approach that can bring together 'groups of teachers to discuss lessons they have first jointly planned in great detail and then observed'.

- would colleagues be prepared to be involved in this model?

Kathryn highlights several positive aspects of this model. One such aspect was the opportunity for teachers to study the behaviours of the children in different working environments and learn the best way to maximise progress. This is often something that class teachers don't have the opportunity to do.

- what do colleagues think about this?

Kathryn found that, although it was not the primary aim of the project, her colleagues gained teaching ideas and various strategies that they had not previously used.

Discuss the statement from Fernandez (2002:400):

> *'when teachers have the opportunity to observe in each other's classrooms, much incidental learning will actually happen …however, the power of lesson study lies in bringing teachers together to make their lesson study learning purposeful and directed.'*

- would colleagues value an opportunity to learn teaching ideas and strategies from watching each other teach?
- would any feel threatened by this?
- how could you arrange for this approach to CPD in your school?
- what would be the barriers?

Kathryn mentions that her head teacher was very supportive and covered classes to enable their project to take place. Despite this, barriers were encountered, particularly planning non-contact time for discussion and reflections.

- how could barriers such as these be overcome in your school?

Kathryn found that for the target group of boys, working outdoors was very effective and the group made progress. She finished her report by saying:

> *'Lesson study was an appropriate and effective collaborative approach to establish whether working in an outdoor environment has an impact on mathematical learning for this group of boys and the members of the team are all keen to continue to use the outdoor area to teach a variety of maths objectives.'*

At the end of your meeting, if colleagues are in favour of a carrying out a small project to use the outdoor area as a way of developing mathematics learning across the school and using lesson study to explore this, make some plans. Over the next term monitor its success and feedback to colleagues at a future meeting.

If you do, please let us know, we would love to hear about it!

Explore further!
If you've enjoyed this article, don't forget you can find all previous *Maths to share* features in our archive, sorted into categories, including *Calculation*, *Exploring reports and research*, and *Pedagogy*.