Primary
& Early Years
Magazine 56

National Centre
for Excellence in the
Teaching of Mathematics

Welcome to Issue 56 of the Primary Magazine. In this issue, The Art of Mathematics features the artist Dame Laura Knight. A Little Bit of History continues its series on inventions: in this issue we look at pencil sharpeners. Focus On... explores another mathematics trail, and Maths to Share looks at the Singapore 'bar model'.

Contents

Editor's extras

The National Curriculum

Last term, we 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 website that will be helpful to subject leaders who are beginning to consider how to support teachers in readiness for the new programme of study.

As part of this support we have produced a suite of 16 videos focusing on calculation and the associated skills and understanding (for example, the concepts of place value and exchange). The videos seek to demonstrate how fluency and conceptual understanding can be developed in tandem. One of the aims of the new National Curriculum, that children should 'reason mathematically', is demonstrated throughout. Each set of videos has an accompanying presentation to stimulate thought and discussion about teaching and learning. We hope you enjoy the videos and find them helpful in supporting teacher professional development. We'd be delighted to receive your feedback, and to learn how you use them (either by commenting below or emailing us at info@ncetm.org.uk). In the near future this suite will include videos focusing on fractions, algebra and division. So keep a look out for these!

The NCETM Professional Development Lead Support Programme (PDLSP)

We're pleased to confirm more new dates 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
20	14 & 15 Nov	Novotel, Leeds city centre	Y&H
	23 & 24 Jan 2014		
20	17 Jan 2014	Altrincham Grammar School for Girls, Cheshire	NW
	21 Mar 2014		
20	5 & 6 Mar 2014	London, venue tbc	London
	28 & 29 Apr 2014		

Note: Cheshire, Altrincham Grammar School for Girls is being run as two one-day events, times to be confirmed. London Primary Cohort (5/6 March and 28/29 April) are particularly aimed at Primary SLEs.

The PDLSP microsite has full details of the programme - including support materials, 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.'*

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

The new National Curriculum explains that 'pupils who grasp concepts rapidly should be challenged through being offered rich and sophisticated problems before any acceleration through new content.' Our new microsite, High Attaining Pupils in Primary Schools, aims to support schools in evaluating and supporting their provision for high attaining pupils in mathematics in primary school. It will help subject leaders, senior leaders and teachers 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.

DfE Key Stage 2 tests consultation

The Department for Education (DfE) is holding a consultation on its proposals to change the way Key Stage 2 tests in maths and English are reflected in a national accountability system, and how a separate measure of each pupil's progress is designed. Views can be submitted in a number of ways before **11 October**. More information is here.

And finally…

You might be interested in watching this video from TED on monster prime numbers. Australian radio host, comedian and lifelong mathematics geek, Adam Spencer, shares his passion for these numbers that can be millions of digits long, and take an army of mathematicians and machines to hunt down!

The Art of Mathematics
Dame Laura Knight

Dame Laura Knight, DBE, RA, was an English Impressionist painter known for painting the world of London's theatre, ballet and circus as well as a war artist during the Second World War. She is considered to be the foremost female artist of her generation.

Laura Johnson was born on 4 August 1877 in Long Eaton, Derbyshire to Charles and Charlotte Johnson. She was the youngest of three daughters. Her father died in 1883, when she was still young, and as a result Laura grew up in a family that struggled financially. Her mother was an art teacher and, after her father's death, she had to give private lessons to help provide the money needed to care for her family. She also taught Laura to draw and paint when she was a child.

In1890 Laura spent a short time studying in schools in France with the intention that she would eventually study art at a Parisian atelier (workshop or studio especially for artists or designers). However, this didn't work out and she returned to England after a few months. At the age of 13, she joined the Nottingham School of Art, and was probably one of the youngest students ever to be enrolled there.

In 1892 Laura's mother was diagnosed with cancer, she died three years later. During this period Laura won more awards for her art than any other woman in Britain and she was awarded the Princess of Wales Scholarship.

It was at school that Laura met and became friends with her future husband Harold Knight, also an artist. They married in 1903. They first lived in Staithes, Yorkshire and then Laren in the Netherlands. In both places they were members of the local artists' colony, where they lived and interacted with other artists. It is thought that they moved to Cornwall in 1907, where they became central figures in the Newlyn artists' colony. In Cornwall Laura's work developed a more impressionist style than it had previously.

After the First World War, the Knights moved to London. It was here that Laura began painting the famous ballet dancers of the time. Working backstage at the ballet improved her drawing because her drawings had to be quick and accurate. If her drawings were inaccurate the ballet instructor would blame the dancer not Laura!

Horse-drawn plough, land girl

During this period in her life she met the British circus owner Bertram Mills and the juggler, magician and also circus owner the Great Carmo. As a result of these meetings she began drawing and painting her famous circus scenes.

In 1929, she was made a Dame Commander of the Order of the British Empire, and in 1936 she became the first woman since 1769 elected to the Royal Academy.

Laura and her husband enjoyed visiting Malvern in Worcestershire where they found inspiration for their work. There is a blue plaque at the Mount Pleasant Hotel in Great Malvern, commemorating the time they spent in the area.

During the Second World War, Laura was an official war artist, painting pictures depicting such things as factory workshops, land girls, military people and vehicles. This meant

that she sometimes travelled abroad. She was one of the three British women war artists to do this. In 1946 she became the official artist at the Nuremberg Trials of the Nazi war criminals. After this she returned to painting ballet dancers, first with the Royal Shakespeare Company in Stratford on Avon and then the Old Vic Theatre in London.

Her husband died in 1961. After his death, Laura continued painting until she was in her 90s but the number of her works declined. Altogether during her lifetime she produced over 250 works. She began her life in poverty but became financially successful with a wide variety of friends ranging from gypsies, circus folk and farm and factory workers to famous authors, actors, judges and aristocrats.

She died on 7 July 1970 at the ripe old age of 92!

Information sourced from:

- Dame Laura Knight: The Official Website
- Wikipedia.

Show Ballet

You could use this painting to work on angles, position and direction. For example, the children could investigate the positions of the ballet dancers' arms and the angles that they make. If you can, print out copies of the picture to give to the children and ask them to estimate and then measure, using a protractor, the angles of the arms at the elbows and shoulders. You could discuss the direction in which the dancers' arms are pointing, in relation to the position they are facing and in relation to the person viewing the painting.

You could ask the children to stand in different poses, make angles with their arms and legs and name them. They could then draw ballet dancers which show a variety of angles. They could then estimate and measure these.

You could ask them to move their arms in different directions making use of vocabulary such as right, left, clockwise, anti-clockwise. You could also ask them to move their arms in turns of different sizes of angles, e.g. 90°, 45°.

You could rehearse counting in twos to find the number of arms/feet on the dancers in the painting. This could lead to problem solving such as: if I can see 36 feet, how many dancers are there? If there are nine dancers how many arms are there?

You could give the children boxes or pieces of card and sticky tape and ask them to make a model of a stage in a theatre. This could involve using the internet to find the sizes of stages, for example, 24ft 32ins wide by 16ft deep. They could convert the measurements to metres; scale them down to a model size of their choice. They could then make figures out of, for example, pipe cleaners, to put on their stage. They could explore body ratios in order to make their figures realistic. You could take a look at slide three from *It's in the News!* World's Tallest and Shortest Men for more information about this.

Show Circus Matinee

You could use this painting to practise counting. The children could count the people and horses. Ask the children to work out the total number of ears there are on the horses by counting in twos, using their multiplication facts or doubling. You could ask them to work out how many legs there are in total (horses and people), discussing how they could do this efficiently.

Ask the children what shape they think the circus tent is. Agree that it is difficult to be sure but it appears to be circular. The children could make a model of a circular circus tent. This could be simply done by making a cylinder out of card and then a cone for the top. They could decorate the outside with circus acts such as clowns. For a more complicated tent you could give the children art straws and ask them to build a cylindrical structure with these. They could attach material for the sides. They could make a frame for the roof by making a card circle to stick onto the art straws. They could then use art straws and material or roll paper into a conical shape for the top. Details for making a circle can be found in The Art of Mathematics in Issue 50.

You could use this timeline to explore the history of the circus. If possible, give the children a copy of the information. They could then pick out the information that they find interesting, draw their own number line and plot the dates relating to the information onto it. They could then work out the differences between pairs of dates.

Show Epsom Downs

You could ask the children to tell you what they think is happening in the picture. Epsom Downs is the home of the Derby (horse racing) and during this event there is usually a funfair. You could ask the children what their favourite ride at a funfair is and make a tally to show the information. The children could then show the information on a pictogram, bar graph or pie chart. You could then ask them to make up a problem that might require this information.

You could make up a Design-technology activity that involves the class making a model funfair. This would involve lots of mathematics: for example, measuring, scaling and money (e.g. entrance or ride prices).

Do the children know where Epsom is? You could find the town on a map of the UK. The children could then find out how far away their school is from Epsom by measuring the distance and converting to miles or kilometres using the scale. They could explore the possible routes to travel there and compare the distances.

You could ask the children to research the Derby and, for example, find out for how many years the event has taken place. They could make a table to show the winners of the race and the year in which they won. There are other races that take place during the Derby weekend, can they find out what these are and make up a time table of events?

You could ask the children to estimate the number of people in the painting and discuss why it is impossible to be exact. You could count the people that can be clearly seen and base an overall estimate on that.

You could count the cars, discussing ways in which this can be done more efficiently than counting in ones, for example, subitising for the four in the bottom right of the picture, adding the two on the road and then counting on the others.

Show Ruby Loftus Screwing a Breech Ring

The Breech Ring is part of a mechanism that closes and seals a gun barrel's powder chamber after the projectile and powder charge are loaded. Can the children identify it in the painting?

You could ask the children to identify the 2D and 3D shapes that they can see. This would be a good opportunity to recap the properties of these and other shapes. You could give them some plasticine and ask them to make a sphere, then turn it into a cube, a cuboid, a cylinder and finally a cone. Of course, for each shape they make, discuss what they have done to create their new shape, the properties it has and where they might see it in real life. Explain that if they take the apex from the cone and create a face, they have a truncated cone. Can they identify the truncated cone in the painting?

truncated cone

What efficient ways can they think of to count the people in the painting?

You could carry out a similar activity as suggested for 'Circus Matinee' for this timeline of events in World War 2.

You could also do some work on rationing which could involve converting imperial measurements to metric. The children could weigh the amounts on a rationing card to get a feel for how little people in those times could buy.

You might like to do some of the activities suggested in *It's in the News!* from Issue 29, which focuses on The Battle of Britain and the Blitz.

Show The Grand Parade; Charivari

You could use this painting for another estimating and counting activity. How many people and animals can the children see? What are they doing in the painting? What is the ratio of clowns to horse riders, acrobats to other acts, horses to sea lions? They could also find the proportions and percentages of each.

Ask the children if they have ever been to a circus. If they have, they could describe the acts that they saw. You could make a list of these for example, acrobats, jugglers and clowns. You could make a tally to show how many children have seen each one. The children could then make pictograms, bar graphs or pie charts to show the information.

The ideas here are just to give you a taster of the mathematical activities that could be involved when looking at artists such as Dame Laura Knight. 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*.

Image Credits

Page header: Dame Laura Knight courtesy of Wikimedia Commons, in the public domain
Horse-drawn plough, land girl courtesy of Wikimedia Commons, in the public

Focus on…
Mathematics trails

In this issue of *Focus On...* we share our last mathematics trail in the series designed by students at Kingston University: Frances, Laura, Charlotte and Charlotte.

If you have created mathematics trails or anything else that you think our readers would be interested in reading about in *Focus on...* please let us know (either by emailing us at info@ncetm.org.uk or by leaving a comment below), and we will be in touch!

The trail takes us around the Weapons Room at Hampton Court Palace. The students' ideas can be adapted for any stately home that has weapons on display.

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

- Estimating
- Counting
- Fractions and Percentages
- Shape
- Symmetry

The fourth slide gives some helpful suggestions for activities that you can undertake before a visit to a place such as this.

The slides are self-explanatory and adaptations can easily be made. Hampton Court Palace has many other areas worth exploring as do other similar homes around the country. You might like to devise some mathematical activities for these – and tell us about them! You could, for example, design mathematical activities for the gardens. Hampton Court has a maze. Our summer special, Issue 54, focussed on mathematics clubs. In that issue there is a section on mazes which you might like to explore.

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

Have fun exploring the mathematical possibilities of the Weapons Room at Hampton Court - and why not consider adapting these ideas for the next trip that you have planned with your class?

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

Image credits
Page header by Eugene Regis, some rights reserved

A little bit of history – pencil sharpeners

In this issue we continue our series on the history of frequently used pieces of classroom equipment. Following our article on the history of pencils in Issue 55, we thought it would be appropriate to look at the history of the pencil sharpener.

Despite the fact that pencils have been around in various forms since the 16th century, it was over 300 years before someone came up with something people could use to sharpen them. Before pencil sharpeners, a pencil was sharpened using a knife (whittling). This was often a bit of a chore and rather a hit and miss affair that didn't always give the desired shape or even a sharp pencil tip. Then in 1828 the first pencil sharpener was invented. It didn't resemble the pencil sharpeners we have today. The sharpener had small metal files set at 90° in a block of wood. These files scraped and ground the edges of the pencil's tip. The inventor was a Frenchman named Bernard Lassimore. Unfortunately it wasn't much faster than whittling and so it didn't catch on.

Twenty-six years later another Frenchman, Therry des Estwaux, improved on the original design and came up with the first sharpener that worked by twisting the pencil inside a conical shaped device.

In 1851, an American, Walter K Foster, patented the first American sharpener which was an improved version of the one invented by Therry des Estwaux. The advantage of this version was that it could easily be mass produced. Numerous variations of the conical shaped sharpener developed after this as there were frequent demands for improvements in design. Inventors and companies took up the challenge of supplying offices, schools and eventually homes with efficient machines to sharpen pencils. This began as a result of the mass production of wood-cased lead pencils in the late 1870s. Some of these were handheld, others could be stood on a flat surface with a winding device, but all these variations had one flaw. They were quite bulky and when using them, the user had to hold the sharpener steady and turn the pencil or hold the pencil still and turn the sharpener. These methods often resulted in a broken lead.

The Eagle's new pencil sharpener

In 1896 the AB Dick Planetary Pencil Pointer arrived. It used files on discs which revolved as they went around the pencil's tip. The user had to insert the pencil into what was known as the 'chuck' which was mounted in a sliding carriage. They would then slide the carriage along a horizontal wooden shaft. The pencil rubbed on the files and rotated, the result was a sharpened pencil!

Not long after this came the electric pencil sharpener. It was developed in the early 1900s but didn't become commercially viable until the 1940s. These sharpeners had a huge advantage over all previous types because the user could simply insert the pencil and moments later take it out and it was sharp – like magic!

Pencil sharpeners now come in a wide variety of colours and shapes, including those powered by battery, mains electricity and hand. Some sharpeners have a case around them to collect the shavings

which can then be emptied. Most have blades inside the sharpener which sharpen the wood of the pencil and therefore the tip and the shavings come out of a slot along the edge of the blade.

Today some specialised types of pencils, such as the flat ones used by carpenters, are still often sharpened with a knife.

Did you know…

The Reverend Paul Johnson, a World War Two veteran started collecting pencil sharpeners after his wife gave him some as a gift in the late 1980s. He kept his collection in a small shed outside his home in south east Ohio, US. Altogether he had 3 400 and the oldest was 105 years old! He died in 2011 and shortly after his death tourism officials in Logan, Ohio, put them on display in its welcome centre

Information sourced from:

- Office Museum
- Swingline (blog)
- Wikipedia.

Now for some mathematics!

Pencil sharpeners

You could make a collection of all the sharpeners in your classroom. This could lead to activities such as counting efficiently and making arrays. You could ask the children to suggest ways to sort them, for example colour, size and the material that they are made from. Use a Carroll or Venn diagram to answer questions, the questions could include how many blue sharpeners do we have with two holes? Or something similar involving sorting two criteria. They could estimate, measure and compare the diameters of the pencil holes and order these in ascending or descending order.

You could ask the children to research the different pencil sharpeners available on the internet, for example, on Google. How many have they seen in use at school or at home? Do they have one that is similar to any that they can see? What 3D and 2D shapes can they see in the different sharpeners? This would be a good opportunity to rehearse properties of shape. From a selection of 12 sharpeners (real or from the pictures), you could ask questions that involve ratio and proportion, such as, what is the ratio of cylindrical shapes to cuboid, what proportion are neither?

They could choose around 10 sharpeners of different prices and plot these prices on a number line. They could then find the differences between pairs of prices using a counting on strategy. They could find the total cost of buying several of them. You could give them an amount of money to spend on two or more sharpeners. They could then work out how much they will have left after buying them.

You could print out copies of a selection of pencil sharpeners. If the children have two copies, they could cut the sharpeners out and make a symmetrical pattern with one line of symmetry. If they have four copies, they could make a symmetrical pattern in the four quadrants.

The children could also sort the pictures according to criteria that they make up, for example, shape.

They could draw around their own pencil sharpener and then rotate it for 45º or 90º to make a pattern that shows rotational symmetry. What shape was their original drawing? What shape or shapes can they see in their rotation? Can they tessellate their sharpener? If so, they can make a design in the style of MC Escher.

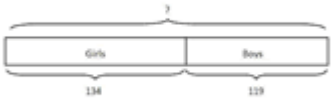

'Pencil sharpener 3'

If you have some spare lead and coloured pencils the children could sharpen them and collect the shavings. They could then draw some shapes and decorate them, using the shavings, to make a collage which should have a hint of colour.

You could ask the children to time each other as they sharpen pencils using a stopwatch. Who is the fastest? They could make a table to show the results.

We hope that this article has inspired you to make a more mathematical use of your classroom pencil sharpeners! 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 this issue of *Maths to share* we look at a technique that is used in Singapore to help children bridge the gap between concrete mathematical experiences and abstract representations. In Singapore, children are encouraged to use visual models such as 'bar models', 'ten frames', arrays and place value charts. We are going to focus on the 'bar model' which is specifically used to help children make sense of word problems. The approach is meant to reveal the structure of the mathematics in the problem. It is not a tool for performing a calculation. In Singapore, children begin to solve multi-step word problems from the equivalent of our Year 4 using this technique. This is applied to solve increasingly more difficult problems. Some schools in England are now beginning to apply this approach and are finding it really helpful. If you have experience of using the 'bar model', we would love to know if it has made a difference to your children's ability to make sense of and solve multi-step word problems.

It would be helpful if you had colour rods or small cubes available during your meeting so that colleagues can fully explore this method both practically and visually.

Begin your meeting by setting this problem:

'Ben spent $\frac{2}{5}$ of his money on a CD. The CD cost £10. How much money did he have at first?'

- would this problem cause difficulties for the children in your school? Why/why not?
- if this appeared on a KS2 SATs paper how many Year 6 children would confidently attempt it?

Next ask colleagues to solve the problem for themselves. Invite volunteers to share how they found their solution. Discuss the mathematics needed to achieve a solution.

Ask colleagues to copy you as you demonstrate how to find the solution using the 'bar model' practically with colour rods…

Line up five identical colour rods or cubes to represent five fifths

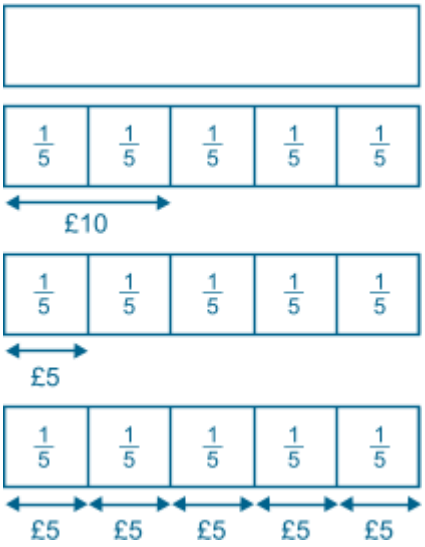
Move the rods or cubes that represent $\frac{2}{5}$ to one side.

If these represent £10, how much does one cube represent?

Agree £5.

There are five cubes altogether, so the total amount of money Ben started with was £25.

Next demonstrate this on a whiteboard or flipchart:



Total amount of money Ben had before he bought the CD is £25.

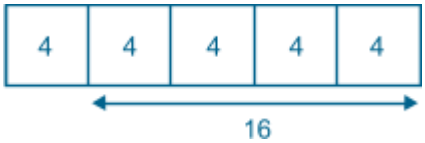
- what do colleagues think of this practical and then visual approach?
- do they think that it helps to 'open up' a problem?

Set one or two problems for them to solve, first practically using rods or cubes and then by drawing the 'bar model' as you did.

You could use these examples:

1. Peter has four books. Harry has five times as many books as Peter. How many more books does Harry have?

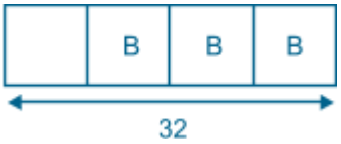
Peter's books 

Harry's books 

Harry has 16 more books.

2. There are 32 children in a class.

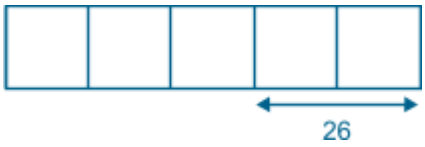
There are 3 times as many boys as girls. How many girls?

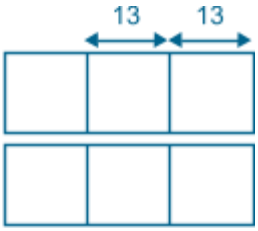


Each square is 8, so there are 8 girls and 24 boys.

3. Sam had 5 times as many marbles as Tom. If Sam gives 26 marbles to Tom, the two friends will have exactly the same amount. How many marbles do they have altogether?

Tom's marbles 

Sam's marbles 



Each part is 13, so 78 marbles altogether

4. A computer game was reduced in a sale by 20% and it now costs £48. What was the original price?

Each part is £12, so the original price was £60.

Hopefully, your colleagues will be quite excited about how this technique helps to make sense of problems!

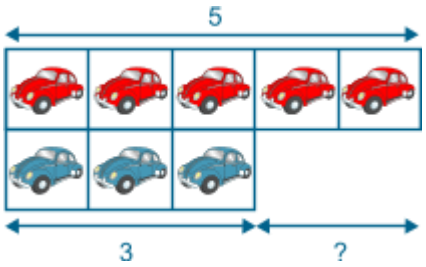
It may be worth spending some time discussing how this technique can be introduced in Reception and KS1 so that the children will become familiar with it and competent in using it when they are in KS2.

Here are some suggestions to get you started:

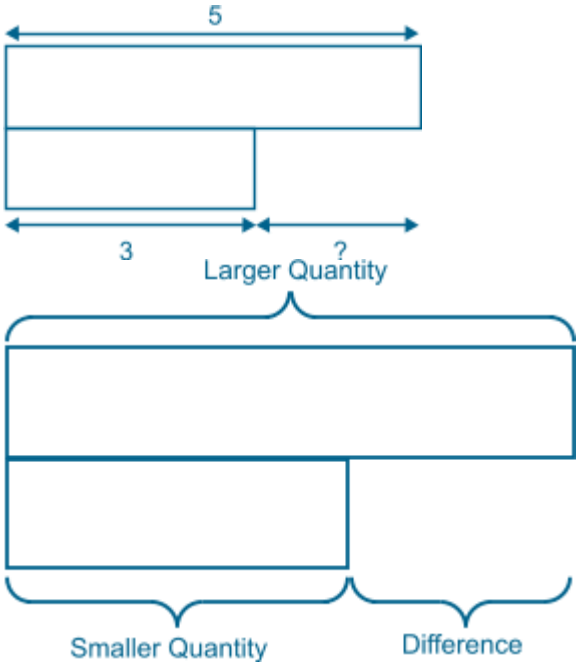
In Reception and KS1, simple calculations can be explored practically and when the children are ready they could also be represented pictorially. For example:

Using sweets, set this problem: Sally had 3 sweets. Armani gave her 2 more. How many does she have now?

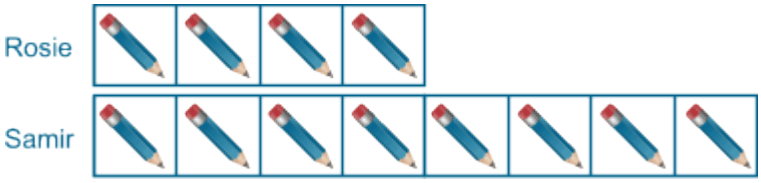
Using red and blue cars set this problem: Rasheed had 5 red cars and 3 blue. How many more red cars does he have?



This becomes a generalisation where a whole will represent 5 and not distinct squares:



Rosie had 4 pencils. Samir had twice as many. How many pencils did Samir have?



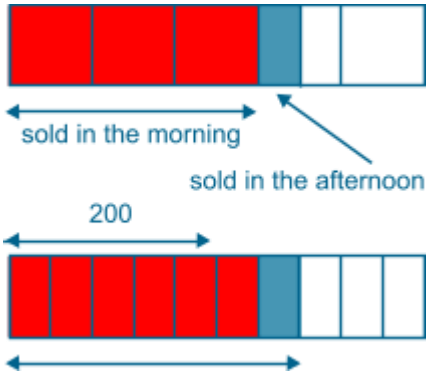
Make a list of the ideas you and your colleagues think of to distribute after the meeting.

Finish the meeting with this problem:

'Sophie made some cakes for the school fair. She sold $^{3}/_{5}$ of them in the morning and $^{1}/_{4}$ of what was left in the afternoon. If she sold 200 more cakes in the morning than in the afternoon, how many cakes did she make?'

There are five more morning parts than afternoon parts, so each part is 40 (200 ÷ 5). She made 400 cakes.

Clue:



And finally…

Ask colleagues to try this technique out with their classes. They could discuss how their children responded at a future meeting.

We hope that you have found this article helpful. If you decide to use it for staff professional development, please let us know (either by posting a comment below or emailing us at info@ncetm.org.uk) - we'd love to hear what you did.

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*.