Primary
& Early Years
Magazine 44

National Centre
for Excellence in the
Teaching of Mathematics

Welcome to Issue 44 of the Primary Magazine. In this issue we feature the artist Heath Robinson, and we explore the mathematical possibilities of The Great Fire of London. Focus on... gives ideas for using a function machine, and Maths to share looks at fraction strips and cubes to enhance children's understanding of fractions.

Contents

Editor's extras

In *Editor's extras* we have details of a recently published document by Lynne Churchman, Number and Calculation Getting the best results, which you may wish to download and use with teachers in your school. We wish to remind you about one of the professional development opportunities funded by the NCETM, and we also give you a few fascinating number facts.

The Art of Mathematics

This issue explores the art of Heath Robinson, the 'gadget king'. He was an English cartoonist and illustrator best known for his drawings of his complicated and outlandish inventions. If you have an artist that you would like us to feature, please let us know.

Focus on…

We focus on having fun with function machines. 34 years ago Steve Pratchett designed a function machine. In this issue we share his design and also the suggestions he gives for its use, both mathematically and across the curriculum.

A little bit of history

In this issue we look at the mathematical opportunities within the topic of The Great Fire of London. The fire happened on 2 September 1666 and was one of the most famous incidents in Stuart England. If you have any history topics that you would like us to make mathematical links to, please let us know.

Maths to share – CPD for your school

Following the fraction research looked at in the last issue we look at some research undertaken by a Mathematics Specialist Teacher who explored how fraction strips and cubes helped children in developing their understanding of fractions. You will need to print out copies of this research for colleagues to read prior to your meeting.

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Editor's extras

Number and Calculation Getting the best results

You might be interested in downloading the booklet published by Oxford University Press (OUP) Number and Calculation Getting the best results, written by Lynn Churchman. Lynn was a teacher, teacher trainer and Mathematics Advisor before moving into the national roles of Specialist Subject HMI for mathematics with Ofsted and Manager of the mathematics team at QCA. She is now Schools Improvement Director of National Mathematics Partnership, a company dedicated to working with schools on raising achievement in mathematics and primary school improvement through mathematics.

In this booklet Lynn draws on her vast experience to provide an overview of Ofsted's reports Good Practice in Primary Mathematics: Evidence from 20 Successful Schools (2011) and Mathematics: Made to Measure (2012). It has been written to help you reflect on your school's approach to teaching number and calculation with a focus on problem-solving and reasoning, calculation policies and the debate around written methods. The action points and key question panels to will help you assess the teaching of calculation and the development of children's capacity to solve problems in your school. As it is the beginning of the new school year, why not take a look at this with you staff and help it inform your mathematics development plan?!

The NCETM Professional Lead Development Support Programme

There are still some places available on the programme of national free face-to-face events for CPD leads in teaching schools and improvement agents.

We want to remind you that, by completing this programme, you will be:

- accredited by the NCETM to provide professional development in priority areas (arithmetical proficiency in primary schools/ algebraic proficiency in secondary schools and colleges)
- supported to obtain the NCETM CPD Standard - a nationally established, widely recognised and quality assured badge of excellence in CPD provision.

More number patterns…

In the previous issue of the Primary Magazine, we gave you some mathematics puzzles and fascinating number patterns. Here are a few more.

Can you work out how these patterns work?

Try this puzzle - and let us know your answers!

A two-digit number, read from left to right is 4.5 times as large as the same number read from right to left. What is the number?

One for the children:

Some ducks are marching across a path. There's a duck in front of two ducks, there's a duck behind two ducks and there's a duck in the middle of two ducks. What is the least number of ducks that there could have been?

Have a look at this meme: can you work out why this happens?

And finally…

'Dad, can you help me find the lowest common denominator in this problem please?'
'Don't tell me they haven't found it yet, I remember looking for it when I was a boy!'

Teacher: how much is half of 8?
Child: up and down or across?
Teacher: What do you mean?
Child: Well, up and down it's 3 or across the middle it's 0.

The Art of Mathematics
Heath Robinson (31 May 1872 – 13 September 1944)

Heath Robinson was born William Heath Robinson and was widely known as 'the gadget king'. He was an English cartoonist and illustrator best known for his drawings of his complicated and outlandish inventions. He was born in an area of London known as Stroud Green into a family of artists. His father and brothers, Thomas Heath and Charles were all illustrators.

He studied at Islington Art School from 1887 to 1890, and then moved to the art schools of the Royal Academy. He wanted to become a landscape painter but realised that he wouldn't earn enough money to support himself, so he initially became a book illustrator. His early work included illustrating books, such as Danish Fairy Tales and Legends by Hans Christian Andersen, Twelfth Night, A Midsummer Night's Dream, and Charles Kingsley's The Water Babies.

He later wrote and illustrated three of his own children's books: *The Adventures of Uncle Lubin*, *Bill the Minder*, and *Peter Quip in Search of a Friend*. His first book is regarded as the start of his career in the pictorial invention of crazy machines.

During the First World War he drew large numbers of cartoons of very unlikely secret weapons used by soldiers. These were published as collections with the titles 'Some Frightful War Pictures', 'Hunlikely', 'The Saintly Hun' and 'Flypapers'.

He also produced humorous drawings for magazines like Tatler and newspapers, such as The Sketch. In 1934 he published a collection of his favourites in a book called 'Absurdities'. These included the 'wart chair' which was a simple apparatus for removing warts from the top of a person's head and the 'multimovement tabby silencer' which automatically threw water at noisy cats.

Essentially he was caricaturing the age of the machine and the self-importance of some of the people caught up in that age. His 'inventions' were usually powered by steam boilers or kettles, heated over candles, and kept running by bald men in monocles or glasses! There would be complicated pulley systems threaded with knotted string. His cartoons were so popular in the early 1900s that, in the UK, the term Heath Robinson contraption was often used to describe unnecessarily complex and implausible contraptions. In the US the term was used to describe ingenious temporary fixes to anything that had gone wrong using whatever is available such as string or tape. This is possibly linked to Britain's shortages during WW2 and the need to 'make do and mend'. People still use the term today although it is not so common.

One of his most famous series of illustrations was those for Norman Hunter's book *Professor Branestawm*, which tells the story of a brilliant, eccentric and forgetful professor. This provided a great backdrop for Robinson's drawings.

He married Josephine Latey, daughter of newspaper editor John Latey, in 1903. They moved to Pinner, Middlesex in 1908. This house now has a commemoration blue plaque. It has been restored and is the home of the Heath Robinson Collection.

In September 1944 he went into hospital for an exploratory operation and died a few days later.

Mathematical opportunities in the work of Heath Robinson

It can be quite tricky to find original works on the internet, so we have used copies of prints - click on the title to show the picture. You can find these and plenty of others to explore on Google's image search and ILN prints.

Show the children First Lessons in Walking and ask them to describe what they can see.

Give pairs of children a small copy of the picture. They cut out the baby and compare its height with those of the parents. They should find they are about the same height. Discuss why the adults appear to be the same height as the baby, when clearly the baby must be much smaller.

This could lead into a discussion on perspective and how the object appears smaller the further away it is from the observer. Conclude that the parents are further away from the baby and to the observer they will appear comparatively small.

Ask the children to estimate how far the baby is away from its parents in centimetres or metres. You could follow these suggestions so that the children can find out how close their estimates are.

- give these average heights:
  - one-year old: 70cm
  - man: 178cm
  - woman: 164cm
- ask the children to scale these heights down, maybe by dividing by 10 or halving and halving again (rounding to the nearest whole number if appropriate). They could then draw stick people at these new heights
- they could make models out of plasticine or modelling clay that will be the same height as their drawings. They set them on the table with the baby far enough away from the adults so that, when they look at eye level to the table, their models appear to be a similar height
- they then measure the distance between the baby and the adults, scale that distance back up and find out how far apart they might be in 'real life'.

Show the children A Complete Washout and explain that it is about 'the trials of spring-cleaning as endured on the ark' (Noah's). Ask them to estimate how many animals they can see altogether and count to check. How many pairs can they identify?

How could they sort the animals into a Carroll diagram? Ask them to suggest headings, e.g. wings/no wings, standing/not standing. They could draw their own Carroll diagram, write in the headings and count those that fit the criteria, making a tally in the appropriate section as they do, and then repeat for those that don't fit the criteria.

What shapes can they see? Look at the rectangular panes in one of the windows and liken them to an array (3x2 or 2x3). How many panes in all four windows? Can they draw a single array to represent these?

Next ask them to explore how many rectangles can be found in one of the windows. You might need to ask them to draw their own window on squared paper for this. Can they find 16? For example, in the first row of three, there are three small rectangles, two 2x1 and one 3x1, making a total of six.

Show The Pancake Making Machine. Ask the children to describe how the man is making his pancakes. You could discuss the idea of pulleys and what role they take in this machine.

Explore the shapes and angles that can be seen. Ask them to show you any acute, obtuse and if appropriate reflex angles. You could give the children copies of the picture and ask them to estimate and then measure the size of various angles.

Can they see diagonal, parallel and perpendicular lines?

Look closely at the wheel in the top left corner of the picture. What fraction has it been divided into? You could ask the children to draw four of their own circles, keep one whole, divide a second into half, the third into quarters and the final one into eighths. They could cut these pieces out and explore ordering and comparing the pieces and then equivalences.

Show How to Dispense with Servants in the Drawing Room and The Spare Room, and discuss what is happening in each one. What are the inventions? How do they work?

You could use the two illustrations to explore shape, angles and lines as suggested for the pancake machine.

You could then ask the children to design their own eccentric machine! They need to think of its potential use. They could sketch out their ideas, then draw plans and then make a model of it. This could involve considering the best shapes to use, the lines and angles that will be needed to join the shapes together. During the model making, of course, they will need to measure accurately using a ruler!

If you have followed up any of the suggestions in this article or in other Art of Mathematics articles please let us know. We can feature your class's results in future magazines.

Information sources:

- BBC History
- Wikipedia.

Image Credits

Primary
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Focus on…
Having fun with function machines

This is the last in this series of articles adapted from the work of Steve Pratchett. We would like to thank Steve for generously allowing the magazine to edit and share his projects with everyone.

In this article we look at something he designed and made to use with primary school children 34 years ago. Some of you might have used it! It is a function machine. Sound familiar? How things come full circle!

After reading this, you might be inspired to make your own, get that old example out of a storage cupboard somewhere or use the idea in one of the ways suggested below – or in one of your own. Please let us know if you create an original idea!

This teaching and learning aid was made before the invention of Velcro! If you decide to make one of your own then self-adhesive Velcro is a much simpler and more effective option for attaching the input, output and function cards. As you will also see below it has the added advantage of providing an effective way of attaching 3D objects as well as number or pictorial cards.

You can add your own stamp to the idea, e.g. making the machine 3D, changing its design, adding a machine noise, e.g. bell, buzzer, 'Dr Who sound'. Alternatively, the children can vocalise a series machine noises and even actions to accompany each function. If you don't like the concept of a machine, it could be some other magic number manipulator, e.g. a witch who throws the numbers (input) in a cauldron and casts a spell (function) and the number transforms (output).

- this teaching aid machine can be used across a wide variety of number computations, e.g. addition, subtraction, multiplication, division/fractions, rounding up, multiple computations - double 3 and add 2, and with a wide age range of children from the Early Years to Year 6
- a variation on this machine could be a 3D box large enough for a child to sit inside to perform the function. Children enter an input through an opening and the child processes it inside according to the machine's function and ejects the output
- whatever the variation of function machine, it is important that it is used as interactively as possible so that children can participate fully in all the operations. Teachers should not keep all the fun bits to themselves!
- further elaborations could include an element of "dressing up" e.g. a function machine operator equivalent of the Thomas the Tank Engine's Fat Controller.

Ideas for its use

1 Finding the output

The teacher presents the input number and the function and the children have to identify the resulting output number, e.g.

Input	Function	Output
3	Double (x2)	?

2 Finding the input

The teacher presents the function and the output and the children have to deduce the original input number, e.g:

Input	Function	Output
?	Double (x2)	16

3 Finding the function

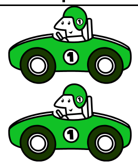
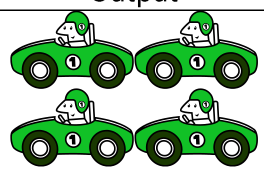
The teacher presents the input and output numbers and the children have to deduce what function the machine has performed, e.g:

Input	Function	Output
2	?	10

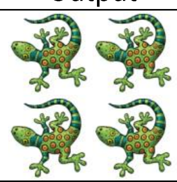
4 Using number cards, pictorial cards or concrete objects?

Velcro allows you to use any of these. Remember using notation is the most abstract for young children. Hence, part of progression is the move from sets of real objects through pictorial representations of sets of objects to the symbolic representation of sets of objects with numbers. There is also a need for young children to match objects/pictures/symbols. The function machine can be used with numbers, pictures or objects or any combination of the three, e.g:

Using objects

Input	Function	Output
	Double (x2)	

Using picture cards

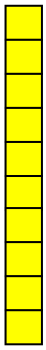
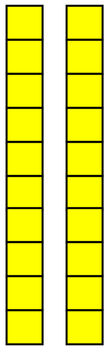
Input	Function	Output
	Double (x2)	

Using notation

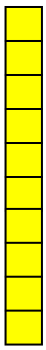
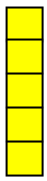
Input	Function	Output
2	Double (x2)	4

5 Using larger numbers

It is possible to use the function machine with larger numbers on the cards. However, it is also possible to illustrate the computation with concrete apparatus. Interlocking cubes, backed with Velcro, are ideal for this as they can be joined together as sets of ten or broken apart for halving/ division, etc.

Input	Function	Output
	Double (x2)	

One stick of (set of) ten doubled is two sticks of (sets of) ten, which is 20

Input	Function	Output
	Halve (÷2)	

Break a stick of interlocking cubes in half.

You can also use tens and units by putting Velcro on the back of some individual cubes (units) and some sticks of ten (tens).

6 Are the children doing algebra?

Yes they are! Even with KS1 you are laying the foundation of algebra as you are giving children a number sentence in which there is an unknown, e.g:

Input	Function	Output
?	Double (x2)	6

This can be expressed in an algebraic equation (in this example find y):

$$y \times 2 = 6$$

$$y = 6 \div 2 \text{ or } y = {}^{6}/_{2}$$

$$y = 3$$

7 Contexts in which the function machine can be used

- you can use the machine as part of an interactive mathematics mental oral starter, where children come out and place number cards, pictorial cards, function or concrete objects onto the machine display board to complete number sentences
- you can use the function machine as part of the teaching to introduce the main mathematics activity
- you can use the function machine as a 'filler', e.g. 5 minutes left at the end of a lesson or before going home, something to solve during register, etc
- the function machine can be used as a group teaching and learning resource, e.g. with a pair of children or a group of four. Children can play one-against-one or two-against-two setting a number sentence on the machine and the others completing it
- children can adopt the 'role of teacher' and set a problem on the machine for the rest of the class or group to solve
- you can adapt the machine to other areas of the curriculum, e.g. in Literacy, the machine's function could be creating opposites. Input the word dark - what is the output word? (light) In art, the machine's function could be to mix colours. Input two colours cards red and yellow - what is the output colour? (orange)
- MFL: you could have a combination of functions for the machine, e.g. the machine doubles a number and also turns it into French:

Input	Function	Output
5	Double (x2) and translate into French	10
Five		Dix

When you start to explore the function machine's flexibility, possibilities and applications, it then becomes apparent that it is worth investing time in designing and making one. It is not a ‘one-trick pony’, which only gets used once. If you are going to invest a lot of time in making a teaching and learning resource, then you want maximum usage and value-added learning during a year and future years with the classes of children you teach. It’s a cost benefit analysis where you have to weigh up where best to invest your limited preparation time.

A little bit of history – The Great Fire of London

A potted history of the Great Fire

The Great Fire of London was one of the most famous incidents in Stuart England: it was the second tragedy to hit the city in the space of twelve months after the Great Plague of 1665.

The Great Fire of London began at night on 2 September 1666 when most people were asleep. It took place in the baker's shop in Pudding Lane owned by Thomas Farynor, the personal baker for King Charles II. Apparently his maid failed to put out the ovens at the end of the night. The heat created by the ovens caused sparks to ignite. They fell onto the straw and bundles of sticks that were used to heat the oven. The straw started to burn, the sticks caught fire and so did the shop. In her panic, the maid tried to climb out of the building but failed. She was one of the few victims of the fire.

The fire blazed for four days. Many citizens fought hard to save their families, homes and animals.

Others left the city and gathered on nearby heaths such as Hampstead where they were safe and had a good view of the destruction of the fire.

Samuel Pepys, well-known for his diaries and a Member of Parliament at the time, saw this enormous blaze after being awoken by his maid. His diary writings have helped people understand just how much it changed the city.

According to Samuel Pepys, a servant first saw the flames after midnight and was able to alert everyone. This probably saved thousands of lives.

The houses and shops in London were mostly built out of wood and pitch and they were packed tightly against each other in narrow rows and streets so the Great Fire quickly spread quickly. It fed on the timbers and nearby haystacks of a local hostelry, the Star Inn. After this, St Margaret's Church caught fire and the blaze then rolled into Thames Street, which had warehouses containing tallow, hemp, coal and other flammable materials.

It had been a hot summer with little rain so everything was very dry. At the time there was a brisk east wind which caused the sparks and hot embers to leap from roof to roof.

London citizens tried to form fire-fighting brigades, collecting water in small buckets from the River Thames, but they were able to do little against such a fierce, natural enemy. In less than ten hours, the fire had moved onto the London Bridge and would have destroyed Southwark on the other side, if not for a gap in the crossing that had been created by a fire 33 years earlier.

Apparently, if the Lord Mayor of the time had ordered the homes and buildings ahead of the fire to be destroyed this would have created a firebreak that might have stopped the fire earlier. Perhaps unwisely, he was too worried about how much money it would take to rebuild them!

The King, who had been previously been criticised for leaving London during the plague in 1665, stayed in London during the Great Fire and finally issued a command to use gunpowder to destroy all buildings in its path but by this time, the fire was uncontrollable.

It was the King's brother the Duke of York (the future King James II) who finally issued an order for the paper warehouses to be destroyed ahead of the fire. This was done in time to save Westminster.

Fortunately the wind that had helped spread the fire, turned back on itself and drove the flames into what had already been burned. The fire had nothing to ignite and so died out.

Surprisingly, most of the people survived, possibly only five died, but the wooden buildings could not be saved. Almost 80% of the city was destroyed in just a few days including 430 acres of land, 13 000 homes and 84 churches. One of these churches was the old St Paul's Cathedral. The heat created by the fire was so great that its lead roof melted and flowed like a river down the streets. It is said that many pigeons lost their lives. They refused to leave their nests, their wing feathers got burned and they plummeted into the fire.

The Queen's House survived the Great Fire only because it was surrounded by the stone tower walls..


The Monument

The Great Fire did bring some benefits, the streets were widened, the buildings were made stronger and more fireproof and many of the rats carrying the Great Plague were eliminated. The Fleet, a 'tributary' that flowed into the Thames, was an open sewer associated with disease and poverty. The fire effectively boiled the Fleet and sterilised it. Slums were simply burned away.

The task of re-planning London was given to Sir Christopher Wren. When it was rebuilt, it was done with bricks, mortar, and stones instead of wood so that this kind of fire would not happen again.

The Monument to the Great Fire of London was completed in 1677, and remains in place today so that no one will ever forget what happened.

A little bit of mathematics...related to the great Fire of London

To set the scene, create a timeline of historical events and plot the Great Fire onto this: Issue 43 has a selection of events you could use for this.

The fire started on a Sunday, the children could create a calendar page for September 1666 highlighting the dates and days of the fire.

You could explore the numbers involved in the items destroyed: 430, 13 000, 84. Explorations could include place value, odd and even numbers and how these can be identified, multiples of 2, 5 and 10. Older children could find factors.

What do the children think 80% means? Many young children will be aware of the percentage sign, so it is worth trying this out. You could link to fractions and visually demonstrate how much of a whole amount eight tenths is.

You could make a model of the fire. Make houses out of boxes, or better still ask the children to make their own cubes and cuboids out of card. Use this to discuss the properties of these shapes including the shapes of their faces, their symmetry and right angles. Once they have made their houses make tissue paper flames and weave them amongst the houses.

You could ask the children to imagine they are Thomas Faryner and to tell his story. This could lead into a discussion on bread. How would it have been made in those days? How is it made today? How has the role of a baker changed?

You could:

- explore the cost of buying bread today.
- look on supermarket websites to find prices and compare them.
- have a data handling session looking at the different makes of bread available and the different types, of which there are many. The children could survey the types of bread that they eat at home. They could then create pictograms, block graphs or bar charts to represent this data.


Supermarket bread

You could collect the packaging from a variety of breads. The children could then identify all the numbers that they can see, for example those related to best before dates, weight, percentages. Can the children find out what a baker's dozen is and where the term came from?

You could have a baking session. The children could make bread rolls. This is an ideal opportunity for the practical measuring of, for example, temperature, capacity, weight, time. For length, they could make boxes to put their rolls in. Together you could calculate the cost of making one roll and then different multiples. This would be good for rehearsing mental calculation skills. What would they charge for each one if they were to sell them to make a profit? You could talk in terms of a 50% or 100% profit.

If appropriate you could plan a visit to the Musuem of London to see the Great Fire displays in the War, Plague & Fire gallery. This could involve:

- locating the Museum of London on a map
- planning the route from school
- finding the distance by measuring with string and converting according to the scale (with a calculator if appropriate)
- work out how long it will take to get there and therefore what time they would need to leave school
- discuss transport options
- you could find the cost of the trip and work out how much that would be per child.

You could involve the children in some role play. They could dress up as firemen and explore the capacity of a bucket:

- how many litres will it hold?
- using different containers explore how many of each is needed to fill the bucket?
- how many buckets are needed to fill a larger container/tub?
- how many buckets filled with water do they think would be needed to put out a fire?

We hope this article has inspired you to take a mathematical look at one of history's memorable events.

Information sources:

- historylearningsite.co.uk
- The Kids Window.

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The Monument by Ben Sutherland some rights reserved
Supermarket bread by yisris some rights reserved

Maths to share – CPD for your school

Fraction strips and cubes

In Issue 43, we explored the research by Siegler et al, who made the link between understanding fractions and future mathematical achievement. In this issue, we look at some more research, this time carried out by Mathematics Specialist Teacher Olivia Moat from Eaves Primary School. Olivia studied the MaST programme at Edge Hill University. Her tutor was Vicki Grinyer.

In her article Olivia discusses the use of fraction strips and cubes to support and enhance the teaching and learning of fractions with a group of Year 6 pupils. The group involved included seven children, four boys and three girls, who had been identified as at risk of not reaching Level 4 at the end of Key Stage Two.

You will need to print out Olivia's article and give copies to colleagues to read prior to your meeting. It would be helpful to ask colleagues to bring examples of successful fraction activities that they work on with their children to share during the meeting.

You will also need cubes and strips of paper that are the same width and length.

Ask colleagues to reflect on what Olivia says in this part of the Understanding Fractions section on pages 1 and 2:

> Fractions can be a difficult concept to grasp, as the normal number rules that apply to so many areas of mathematics no longer apply. Lamon (2005) suggests that pupils may suddenly find that meanings and models and symbols that worked when adding, subtracting, multiplying and dividing whole numbers are not as useful.
>
> Bezuk and Kramer (1989) argue that it is unsurprising that children find fractions so difficult considering the complexity of the concepts involved. For example, $\frac{1}{4}$ is not greater than $\frac{1}{2}$, yet four is greater than two. Furthermore, Cramer and Wyberg (2009: 226) discuss how children can find the fact that fractions consist of two numbers, yet only represent one amount, a difficult concept to master.
>
> Another troublesome concept to understand is that different fractions, containing different numbers, can also be equivalent.
>
> Fractions can be divided into five sub-constructs (part/whole, measure, operator, quotient, ratio), which only reinforces and demonstrates the complexities of fractions, and highlights further why children often find it a challenge. Charalambous & Pitta-Pantazi (2007: 295) explain that:
>
>> '...the part-whole subconstruct of rational numbers, along with the process of partitioning is considered a fundament for developing understanding of the four subordinate constructs of fractions'.

If the part/whole subconstruct of fractions feeds into all other subconstructs, and is not firmly understood by pupils, then their understanding of the other facets of fractions will be less secure.

Fractions can be difficult for children because they are hard to visualise. When visualising $\frac{3}{5}$ for example, children will often have little experience of this number to refer to. Bezuk & Kramer (1989) insist that using manipulatives is crucial in developing students' understanding of fraction ideas as it helps make the fractions 'real' and not just an abstract number.

Ask colleagues to think of children they have taught that have struggled to understand fractions and identify the specific issues that they had. You could make and display a list of these and refer to them when using the fraction strips and cubes. Colleagues could then consider whether these resources might address any of the issues on the list.

Ask colleagues to consider:

- how much do they understand about each of the subconstructs of fractions themselves (part/whole, measure, operator, quotient, ratio)? It might be a good idea to ask them to work with a partner and try to think of a definition for each one.
- how confident are they in teaching fractions?
- how many of their children struggle to order unit fractions? Why do they think this is?
- how many of their children struggle with equivalent fractions? Why do they think this is?
- how closely do colleagues relate fractions to division?
- do they ever refer to the fractions made in Years 1 and 2 when sharing, say 20 between 4 by telling the children each portion is one quarter?
- what manipulatives do they use, if any, to help the children in their understanding?

Remind them of the research, Fractions: difficult but crucial in mathematics learning, discussed in Maths to share in Issue 36. If colleagues have not read this it might be worth giving them the opportunity to do so. It suggests that one way to teach fractions is through division.

You could ask colleagues in KS1 to experiment with this idea next time they work on sharing. Once they have, invite them to feedback what happened at a future meeting.

Spend some time exploring the activities colleagues have brought to the meeting. Ask them to share how they use these and how and why they believe they help develop the children's understanding.

Refer to the Using Cubes section of Olivia's article. Give piles of cubes to colleagues and ask them to find different fractions, e.g. $\frac{3}{4}$ of 16. Next ask them to use the cubes to explore improper fractions such as $\frac{5}{2}$.

Ask them to consider the usefulness of using these manipulatives in Year 6. Again, suggest that colleagues try using these when working on finding fractions of numbers and improper fractions in Years 5 and 6.

Spend some time looking at fraction strips. Use the idea from Fraction Strips (from What Makes a Good Resource). Give colleagues strips of paper and ask them to fold one into half, another into quarters and a third into eighths. They then use this to compare, order and find equivalences, e.g. which is the larger fraction, $\frac{1}{4}$ or $\frac{1}{8}$? Why? Encourage them to consider that the larger the denominator the greater the number of parts a whole is split into. If I had £24 and offered you $\frac{1}{4}$ or $\frac{1}{8}$, which would you take? Why? How many eighths are the same as a half/quarter?

Then ask them to compare, order and find equivalences using fraction strips that have already been divided up.

- Which do colleagues think are the most effective and why?
- In which ways could colleagues use both?

As a group look at the improvement table in Olivia's article. As she says, there had been a great increase in the children's understanding.

Ask colleagues to reflect on what they have been doing and discussing during this meeting and to make some decisions on how they will adapt their current practice to maximise their children's understanding of fractions.

Suggest that they explore the fraction section of the Self-evaluation Tools to assess their confidence in teaching these.

We hope Olivia's article has given you and your colleagues useful ideas for teaching fractions.

Remember you can also evaluate your own confidence in teaching fractions using the NCETM Self-evaluation Tools.

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