Primary
& Early Years
Magazine 61

National Centre
for Excellence in the
Teaching of Mathematics

Welcome to Issue 61 of the Primary Magazine. In this issue, The Art of Mathematics features the French artist Edgar Degas. In A Little Bit of History, the final article in our series on classroom equipment looks at paper. Focus On... features Film in Education's London Primary School Film Festival, and Maths to Share looks at division.

Contents

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Editor's extras

The National Curriculum

- **The NCETM Resource and Planning Tool**
  We have recently started publishing sections of a new area on our site, dedicated to helping teachers plan lesions in line with the new curriculum. At this stage, this new resource and planning tool includes material for teachers in Years 1, 2, 5 and 6. Other year groups will follow soon. This complements the new curriculum Essentials page, published last term, which 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 programmes of study. Both of these are linked to from our central new curriculum page that will keep you up to date with relevant news of the new curriculum as it becomes available.
- **Video material to support the implementation of the National Curriculum**
  As part of this support we have added a further 44 videos to our existing suite of 16 videos showing teaching in primary (and some secondary) classrooms, focusing on calculation, fractions, algebra and division, and the associated skills and understanding. 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. The initial suite of 16 videos is also available on a new DVD, which gathers together, in one convenient place, all relevant video material currently on the website, together with a complementary PowerPoint presentation, containing notes to stimulate thought and discussion among teachers in CPD situations. Find out more, and details of how to order your copy, here.

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 March	Nottingham	EM
	9 May		
20	7 & 8 April	Birmingham	WM
	5 & 6 June		

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."*

Maths Hubs update

Arrangements for establishing around 30 new mathematics education strategic hubs (Maths Hubs) across England are progressing. An announcement on how each of the coordinating schools will be selected is expected towards the middle of March. The aim of the initiative is that every school and college in England, from early years to the post-16 sector, will be able to access locally-tailored and high quality support in all areas of maths teaching and maths learning.

Online material for subject leaders to support high attainers in mathematics in primary schools

Have you seen the section of our website which aims to support schools in evaluating and supporting their provision for high attaining pupils in mathematics in primary school? High Attaining Pupils in Primary Schools 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.

The Rolls-Royce Science Prize 2014

You might be interested to hear that the Rolls Royce Science Prize, which has existed for a few years, is now proactively on the look-out for schools that stress the importance of mathematics within science teaching. Find out more - including details of how to apply, and what you might win.

And finally...

In the previous issue we told you about the world record for the most babies born to one woman - 69!! Did you find the different combinations of children she could she have had in 30 years? Well, the answer is sixteen pairs of twins, seven sets of triplets, and four sets of quadruplets!

The Art of Mathematics
Edgar Degas

Edgar Degas was born Hilaire-Germain-Edgar De Gas on 19 July 1834 in Paris, France. He was a French artist famous for his paintings, sculptures, prints, and drawings. He is especially well-known for his paintings of dancers. Did you know that more than half of his works depict ballet dancers?

Edgar was the eldest of five children. His mother was Célestine Musson De Gas and his father Augustin De Gas. His father was a banker and the family was quite wealthy. When Edgar was a young man he began to call himself Degas as he felt 'De Gas' was a rather pretentious spelling of the family name.

At the age of eleven, Edgar began his schooling in the Lycée Louis-le-Grand. He graduated in 1853 with a baccalaureate in literature. His interest in painting developed at a young age. By the time he was eighteen he had turned a room in his home into an artist's studio and had begun copying paintings for the Louvre. Unfortunately his father did not support Edgar in his desire to become an artist, he expected Edgar to go to law school. Edgar registered with the Faculty of Law at the University of Paris in November 1853 to satisfy his father's wishes. However he really wasn't interested in this career path and made little effort with his studies. Two years after enrolling, Edgar was offered a place at the Ecole des Beaux-Arts. He abandoned studying law in favour of studying art and he was far more successful at this school than he had been at the University of Paris!

In July 1856, Edgar travelled to Italy, where he stayed for three years. He drew and painted copies of the works of the artists of the Renaissance, such as Michelangelo and Raphael. It was during this time that he studied and became accomplished in the techniques of high, academic, and classical art.

Edgar returned to Paris in 1859 and continued his education in art by copying paintings at the Louvre. He remained a copyist for the Louvre until well into his middle age.

Cotton Exchange in New Orleans

Edgar exhibited one of his paintings at the prestigious Salon in 1865 for the first time. This was a historical painting, which was the type of work he first produced. This received little interest. He exhibited annually at the Salon for the next five years. He gave up on historical paintings and produced more contemporary paintings particularly of women at work, milliners, laundresses and horses. He developed an interest in

horses when visiting a childhood friend in Normandy in the early 1860s. His first successful horse painting exhibited at the Salon was The Fallen Jockey, which depicted a scene from a Steeplechase. This change in his art was influenced by the work of Edouard Manet who he met in 1864 while copying in the Louvre. At the Salon his paintings won both praise and criticism. In 1868 he exhibited his first major work which introduced the subject with which he has become best known, dancers.

Edgar enlisted in the National Guard in 1870 at the outbreak of the Franco-Prussian War. His work defending Paris left him with little time for painting. It was during rifle training that he found out that his eyesight was defective and from then on eye problems were a constant worry to him. After the war in 1872 Edgar went to visit his brother and other relatives in New Orleans, Louisiana, USA. He began painting family members and scenes from around New Orleans. One of his works depicting a scene at The Cotton Exchange gained attention back in France and was his only work to be purchased by a museum during his lifetime.

Edgar returned to Paris in 1873. His father died the following year and in the settling of his estate it was discovered that Edgar's brother was in huge debt. To preserve the family name, Edgar was forced to sell his house and a collection of art work that he had inherited. He now found himself suddenly dependent on sales of his artwork for income.

Edgar had become disenchanted with the Salon in the late 1860s and joined forces with a group of Impressionist painters. Together they rejected the rigid rules, judgements and elitism of the Salon. They began organising independent exhibitions. The first was in 1874. They held eight in total, the last in 1886. Edgar took a leading role in organising these and showed his work in all but one of them. Conflicts developed between himself and the others in the group. These escalated for various reasons over the years, many conflicts arose because Edgar was very critical of the Impressionist movement and wasn't a true Impressionist painter. As a result of these conflicts the group disbanded in 1886. Whether he considered himself an Impressionist or not, this style describes his work better than any other style and he is known as an Impressionist painter today

Edgar's financial situation improved through sales of his own work. He was able to help out his family and indulge in his passion for collecting works by artists he admired, for example, Manet, Cézanne and van Gogh.

Full ballet rehearsal on the stage

As the years passed, Edgar became more and more isolated, he lost many of his friends which was a deep regret to him in his later years. He is known to have worked in pastel to the end of 1907, and is believed to have continued sculpting until 1910. Most of his pastels and sculptures were discovered after his death.

Apparently he stopped working in 1912. He never married and spent the last years of his life, nearly blind, restlessly wandering the streets of Paris before dying in 1917. Edgar's last years were sad and lonely.

He was recognised as an important artist by the end of his life and is today now considered one of the founders of impressionism despite his work crossing many stylistic boundaries.

Information sourced from:

- Edgar Degas, The Complete Works
- Wikipedia.

Now for some mathematics!

Show A Carriage at the Races

You could give pairs of children copies of the painting and ask them to count the numbers of people and horses. They could make a tally, crossing out those they count on the picture. How did they count them, one by one or in groups? Who counted in the most efficient way?

You could ask them to tell you the 3D and 2D shapes that they can see. What shape do they think makes the main part of the man's top hat? What shape makes the brim of the hat? The children could explore cylinders and circles and make a top hat that would fit them. Of course they would need to find the diameter of their heads in order to create the circumference of the circular face of a cylinder to make a hat that would fit them! If they work on the approximation that the circumference is roughly three times the diameter of a circle, they should manage to make one that fits. How will they make the brim? This could be a good investigation to carry out and an opportunity for mathematical reasoning.

The children could explore circles as suggested in the Art of Mathematics in previous issues of the Primary Magazine such as Issue 50 when we featured Michelangelo. When they draw their circles, the children add the same number of radii as the number of spokes on the wheels of the carriage. Can they work out how many there must be from the part wheel they can see in the picture? Can they calculate, using what they know about the angles in a circle, the size of the angles where the radii extend from the centre of the circle? The children could measure these with protractors to find out if their calculation was correct. This could lead to drawing other circles with different numbers of radii and calculating their angles.

You could explore ratio and proportion by mixing paints to give the colour of the sky. What ratios of white to blue paint are needed to give the different shades of blue they can see? What are these as proportions?

Show A Grecian Dance

You could use this painting to work on body ratios. Give the children a copy of the painting and ask them to measure different parts of the dancers' bodies. Apparently, an average person's foot is the same length as the ulna (the bone linking the inside elbow and wrist). Seven of these are the same as a person's height. Are Degas' dancers in the right proportion? You could ask questions, such as, if the ulna of one of the ballet dancers is 20cm, how tall is she? There are four femur (thigh bone) lengths in a person's height, so what is the length of the ballet dancer's femur?

You could then ask children to work with a partner to explore other body ratios. For example:

- are the children seven of their feet tall?
- how many circumferences of their thumb is the same length as their foot?
- how many circumferences of their head are the same as their height?
- what is the ratio of the circumference of their thumb to their head?

You could take a look at slide three from *It's in the News!* World's Tallest and Shortest Men for information on this.

Ballerinas in the Studio

Ask the children to draw stickmen ballet dancers which are in proportion using the body ratios they have already looked at. This could involve accurate measuring in centimetres and millimetres. This could also involve measuring angles. They could first practise estimating and measuring the angle of the ballet dancers' arms where they bend at their elbows and draw these on their pictures. They could also explore other positions of arms, legs and heads which give different angles to those in the painting.

Show A Roman Beggar-woman

This is a great painting to use to carry out some paint mixing. There are many shades of brown to explore. Ask the children to work with a partner to find out the ratios of blue, yellow and red paint needed to make each shade. Once they have done this, they use their paints to make a copy of the woman.

You could also use the painting to explore 2D shapes and perpendicular and parallel lines. The children could create head scarf patterns using shapes that tessellate. You could use their ideas to explore rotation and translation.

At the Starting Line – jockeys in training

Show A Woman seated beside a Vase of Flowers

Ask the children to consider the mathematics involved in the previous three paintings and to come up with some ideas for this one, for example, estimating and counting the flowers and discussing why it is difficult to be exact, angles, circles, ratio through colour mixing. You could then ask them to choose one of their ideas and develop an investigation for the class to carry out.

Show The Ballet Rehearsal on Stage

How many ballet dancers can the children see? You could discuss ways to group them to make the counting easier.

This painting lends itself to some of the ideas given in Issue 56, when we featured Dame Laura Knight as our artist. Why not try some of these, and a few others, for this Degas painting:

- you could explore angles, for example, the children could investigate the positions of the ballet dancers' arms and the angles that they make. Can they see any 180º angles? What about 45º? 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 and the feet where they bend at the ankle
- you could explore position and direction by discussing the direction the dancers' arms are pointing, in relation to the position they are facing and in relation to the person viewing the painting. You could link this to the size of turn their arms will have made to get to where they are from a relaxed position by their sides
- 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 measure these
- you could ask them to move their arms in different directions making use of vocabulary such as right, left, clockwise and anticlockwise. You could also ask them to move their arms in turns of different sizes of angles, e.g. 180º, 90º, 45º
- 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. They could scale down the dimensions they find to a reasonable model size. They could then make figures out of, for example, pipe cleaners, to put on their stage.

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

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Focus on…
Film in Education's London Primary School Silent Film Festival

We have mentioned the Film in Education's silent film event in a previous issue of the Primary Magazine. We thought that you might like to hear more about it from Film in Education themselves! It is a very exciting opportunity and if any of you get involved it would be great to hear what you did, how it went and the impact it had on the learners in your schools.

Film in Education's 'London Primary School Silent Film Festival 2014' is well underway and there are a few slots still available if your school would like to be involved!

Our film workshops can be adapted to any subject, whether this is exploring the History of Pythagoras' Theorem, the work of Plato, or anything else film worthy! Be part of this year's festival, and give your students the opportunity to explore maths through drama, film and creative writing. Children work with a professional film crew to write and shoot their own short film based on curriculum subjects and each film is entered into the festival in July 2014. There is also an awards ceremony to celebrate the children's achievements.

Our festival is not only an opportunity to mark the successes of the year. As it is held in a prestigious and historical London venue, it also gives children the opportunity of engaging with London on a social level. Our previous festivals at Theatre Royal, Stratford East have involved many children who had previously never visited a theatre. This in itself is particularly significant, as the theatre is such an extremely important institution in both our cultural and social history.

We work closely with schools to create films that will inspire and engage children of all ages and give them the opportunity to learn about film making first hand, supported by industry professionals. The process is a fantastic evaluative opportunity, providing evidence of the students' learning. The films are a great educational resource, and can be used by teachers for years to come as a class introduction to the topic covered. Children will explore filmmaking as an approach to storytelling, communication and documentation. They are encouraged to use memory, observation and imagination to express their ideas, knowledge, thoughts and feelings; giving them a real sense of achievement and self-worth. We carefully use our expertise to adapt to various abilities and ages in every workshop.

This project works with any primary school class, in any sized school, as we creatively use and adapt their specific facilities and environment in order to tell their desired story. A typical workshop lasts two days, but can be personalised to the project's specific needs. DAY ONE involves an introduction to the Silent Film genre, through analysing filming and acting techniques, looking at examples of Silent Film and understanding how it differs to films today. Lively discussion is encouraged, centred around a specific topic, and a concept of the film is decided upon by the class. The children create shot lists, scripts and storyboards, and begin to see their project come to life. They also consider costume, props and set. DAY TWO usually takes place a week later, and there is always lots of excitement in the air. Guided every step of the way by the Film in Education team, the children are encouraged to take ownership of the project, both in front of and behind the camera. They set up shots, direct actors, consider continuity, any special effects, and act!

Above all we create high quality films which can be used as a learning aid and provide a positive environment for learning in which pupils are interested and engaged.

For more information, or to book your workshop, email info@filmineducation.com.

We hope that you found the series interesting. If you have anything you would like to share with us, please let us know.

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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A little bit of history – paper

This is the last in our series of articles on the history of pieces of commonly used classroom equipment. In this issue we feature possibly the most common of all - paper. The word paper comes from the name of the plant papyrus, which grows along the Nile River in Egypt and was the very first form of paper recorded. However, true paper is made of pulped fibres from plants like wood, cotton or flax and not papyrus at all!

We encounter paper in one form or another every day of our lives. Take a moment to consider when and why you last held some paper: was it in the form of a book, a newspaper, a diary, a register, was it when you were writing a note, making jottings, printing information from the internet or using a £5 note or some loo paper? This is a good discussion to have with the children. They might be amazed at how much we take the humble piece of paper for granted!

But first, a little about the history of paper…

It is widely thought that the origins of paper go back over 5000 years to the Nile River valley in Egypt. It was there that a marsh grass known as Papyrus grew prolifically. The Egyptians used this plant to make a material that they could write on. They did this by cutting thin strips from the plant's stem, softening them in the Nile water and layering them at right angles to each other to form a kind of mat. This was then pounded into a thin sheet and left in the sun to dry. The result was ideal to write on and lightweight so also portable. This became the writing medium of choice for the Egyptians, then the Greeks and Romans. They used it for record keeping, spiritual texts and works of art.

Similar processes were developed in other countries, for example, in Central America during the 2nd Century AD the Mayans did a similar thing for bookmaking, in the Pacific Islands paper was made by beating a fine bark over logs to make clothes.

Book of the Dead of Taiuherit

All these were more like mats than paper because they had a laminated feel about them. The paper we use today came from China. In around 105 AD a Chinese eunuch called T'sai Lun experimented with a process that involved softening the fibre of plants so that each filament was completely separated from the others. These were then mixed with water in a large vat. Then a screen was submerged in the vat and lifted up, catching the fibres on its surface. These were then dried and the result was a thin yet flexible and strong layer of intertwined fibre which today we call paper.

The Chinese kept this invention to themselves for a couple of centuries, then the secret began to spread in the 3rd century AD, first to Vietnam and then to Tibet. In the 4th century it was introduced to Korea and in the 6th to Japan. Gradually, the art of papermaking spread to Nepal and India. It made its way to the west in 751AD when the Tang Dynasty was at war with the Islamic world. In one of the battles that ensued Islamic warriors captured some Chinese, several of whom were papermakers. The warriors took them to Samarkand which soon became a centre for paper production. This then spread to Baghdad,

Damascus and Cairo. Finally when the Moors from North Africa invaded Spain and Portugal they brought papermaking with them and that was how it started in Europe in the 12th century.

Before Chinese papermaking arrived in Europe, the Europeans had used papyrus until the 9th century and then moved onto parchment which was made from animal skin. This was very expensive and the idea of paper being used as a practical everyday item was not a consideration. By the 15th century things had changed dramatically, printing technology had rapidly increased and this created an ever increasing demand for paper. At first European paper was made from recycled cotton and linen and a huge trade had developed around the trading of old rags. It is rumoured that the black plague entered England from Europe on these old rags! Soon this source was insufficient and some strange attempts were made to find replacements for the rags, for example, fibres from straw, cabbage, wasp nests and finally wood. Today, softwoods such as spruce have become the most suitable source of pulp for the mass production of paper.

Paper Weaving

In Europe and America, the mass-production of paper has become a thriving industry supplying huge volumes of paper for the production of newspapers, books, magazines, paper bags, paper plates and cups, toilet paper, money and a huge variety of other purposes - including clothing, chimney's and even coffins! Paper is now such a natural part of our daily lives that we can sometimes forget just how much we rely on this essential, renewable and evolving resource!

You might be interested in exploring some of the myths and realities from Paper Online.

Information sourced from:

- About.com
- HQ PaperMaker
- Paper Online.

Now for some mathematics - just a few ideas to whet your appetite...

Ask the children to work with a partner and together write down as many different ways paper can be used in our daily lives. Did they come up with any of these: books, photographs, newspapers, magazines, directories, paintings, letters, labels, Post-it Notes, restaurant bills, train and bus tickets, birthday cards, boxes for cereals, biscuits, chocolates and ready meals, notes in our monetary system,

cheques, postage stamps, coffee filters, tea bags, juice cartons, child's drawings, school textbooks, toilet paper, kitchen towel, nappies? The list could go on and on!

Ask the children to write eight of their suggestions on separate pieces of paper. They then work with another pair to sort their ideas into groups of similar uses, for example, paper used at school, paper for food related items, paper used in the home, paper for reading. They could then create a table to show their suggestions. For example, if they have book, magazine, newspaper, one of the categories to place in their table could be paper for reading and the number three would go in the column next to it.

As a class you could discuss the most common uses for paper as far as the children are concerned. Make a list on the board and a tally to show how many children have used these over a day or two day period. You could represent the information as a pictogram or bar chart. You could turn the results from the tally into a pie chart by approximating each type as a fraction of the total.

You might like to download a summary of the history of papermaking. The children could plot dates on a history number line, work out which years the different centuries cover, plot specific dates onto it and find differences between them.

You could ask the children to explore the sizes of sheets of paper that we can buy in packets, for example A2, A3, A4, A5. They could find their lengths and widths and work out and compare each size's perimeter and area. They could explore how many sheets of paper come in a ream. They could find the costs per ream from different suppliers. You could ask questions such as: If the school orders 24 reams of paper, how many individual sheets of paper would be delivered? If it was divided equally amongst all the classes in school, how many sheets would each class receive? How much would it cost to buy this amount from different suppliers?

You could carry out some shape explorations. The children could make an equilateral triangle and then turn it into a square. Who can do this with the fewest folds? The children could explore nets of 3D shapes. They could make packaging for different objects in the classroom.

You could have great fun exploring Sierpiński's fractals from Issue 25.

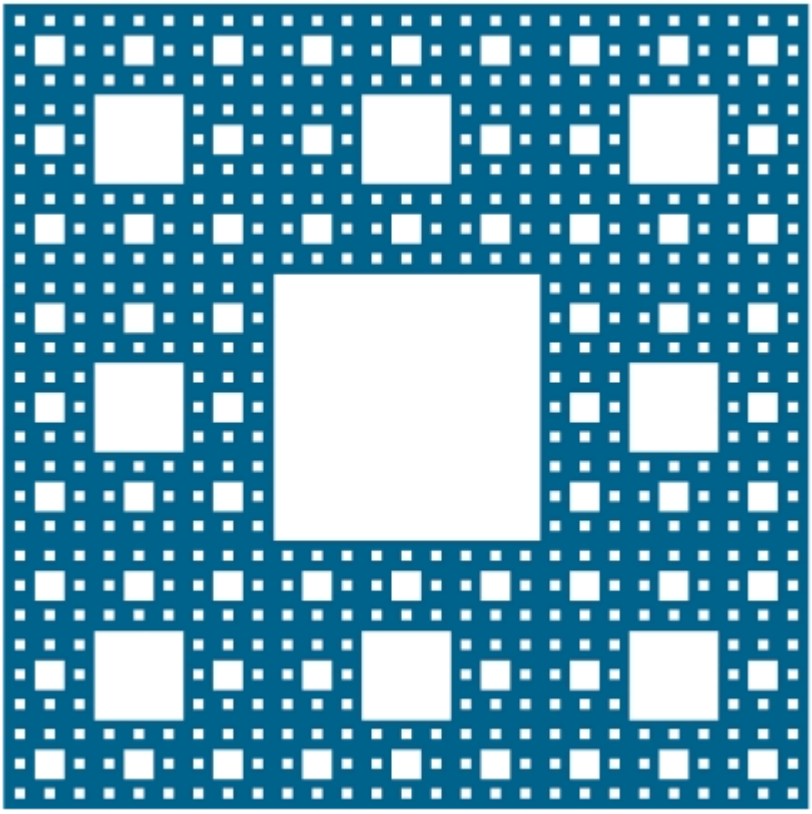
Firstly, his Triangle:

As you will notice, he used an equilateral triangle, but you can have a go with any type. You need to:

1. draw your triangle
2. make three copies of it, but at half its height and base
3. place the three copies on the original so that each touches the other two at a corner
4. repeat step two as many times as you want!

You could use this idea to explore area, fractions and percentages: for example, what fraction of the large triangle is this smaller triangle? One thing's for sure: it could make a really interesting and colourful display for your classroom.

Sierpiński's carpet is done in a similar way but using squares – you could try with a variety of quadrilaterals and see what happens. Sierpiński begins with one square. He then reduces its length and width by a third and positions eight copies around the edges of the original. He repeats this several times making 64, 512, 4 096 and finally 32 768 squares! You could challenge the children to work out the pattern of these numbers and find how many squares there will be in the next 'carpet':



To see clearly how it grows, have a look at shodor.org.

You could embark on some class paper making! The instructions from The Paper Project are simple and easy to carry out in the classroom. They involve some measurement and ratio which you could expand on in more detail to make the most of the mathematical opportunities in this. Once the children have made their paper they could cut it to A5 size and make up a mathematical puzzle to write on it!

There are lots of websites with instructions for paper planes and gliders. How to do Anything in the World has some simple instructions.

Once the children have made their gliders, you could have competitions to find, for example, the glider that flies the furthest, the glider that stays in the air for the longest. Ask the children to give you ideas for the types of competition that they would like to hold.

You might be interested in exploring these websites which have some great ideas for mathematics and paper:

- Khan Academy has some interesting ideas for paper symmetrical snowflakes. They are worth trying out with the children

- Origami Club has lots of animals (and other things) to make that involve measuring and using different sizes of paper. You could include estimating, measuring and ordering heights of some of the animals that the children make
- CutOutFoldUp has several interesting mathematical things to make with paper.

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

This is the final part of our series of four explorations of ways in which you can help your children to develop their conceptual understanding of the four operations. In Issue 58 we looked at addition, in Issue 59 we looked at subtraction, in Issue 60 we looked at multiplication, and in this issue we explore division. For more about this operation see Issue 27, which explores the basics of this concept. In this issue we will focus on the development of the formal written method. In the past the formal written method was commonly referred to as the 'bus stop' method: this is a term to discourage colleagues from using when teaching it!

In Year 3, the National Curriculum requires teachers to teach children to:

- write and calculate mathematical statements for multiplication and division using the multiplication tables that they know, including for two-digit numbers times one-digit numbers, using mental and progressing to formal written methods

In Year 4 the requirements focus on division using mental calculation:

- recall multiplication and division facts for multiplication tables up to 12×12
- use place value, known and derived facts to multiply and divide mentally, including: multiplying by 0 and 1; dividing by 1; multiplying together 3 numbers
- recognise and use factor pairs and commutativity in mental calculations

In the notes and guidance it suggests that pupils practise to become fluent in the formal written method of short multiplication and short division with exact answers.

In Year 5 the requirements include the use of mental calculation and formal written methods as and when appropriate:

- multiply and divide numbers mentally, drawing upon known facts
- divide numbers up to four digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context

In Year 6 the requirements state that teachers should teach children to divide numbers up to 4 digits by a two-digit whole number using the formal written method of long division, or where appropriate the formal written method for short division and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context.

As discussed in Issue 57, so long as the formal methods are taught, it is up to colleagues in individual schools to decide when these are taught. This might be something you, as a staff, wish to consider during your meeting.

For the meeting you will need copies of the multiplication and division sections of the National Curriculum and equipment such as straws and base ten equipment.

If you have them, place value counters would be helpful or simply sets of three different coloured counters to represent hundreds, tens and ones.

Begin your staff meeting by writing these calculations on the board:

- 123 ÷ 3
- 165 ÷ 10
- 325 ÷ 25
- 408 ÷ 17
- 623 ÷ 24

Give colleagues a few minutes to discuss ways to solve each calculation. Take feedback, discussing the different strategies they have used.

There are several ways to answer these calculations, including some efficient mental calculation strategies. It might be worth highlighting the more obvious methods, such as:

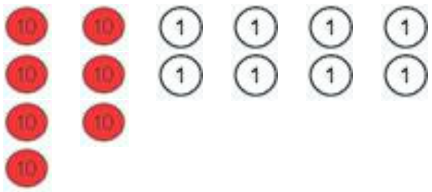
- 123 ÷ 3: partitioning 123 into 120 and 3, use knowledge that 4 x 3 = 12 to know that 40 x 3 = 120
- 165 ÷ 10: make each digit ten times smaller
- 325 ÷ 25: use knowledge that 25 x 4 = 100 to work out that there are 13 groups of 25 in 325
- 683 ÷ 9: using knowledge of tables' facts means that you can partition 683 into 630 and 53. 630 ÷ 9 = 70 and 53 ÷ 9 = 5 remainder 8, so 683 ÷ 9 = 75 remainder 8
- 408 ÷ 17: use knowledge that 17 x 10 is 170, so 17 x 20 = 340, 17 x 2 is 34, so 17 x 4 = 68. Therefore 408 ÷ 17 = 24

Ideally, we would all want our children to develop the ability to look at a calculation and decide which method is the appropriate one to use for dividing numbers. Sometimes it might be that a mental calculation strategy is the most efficient, sometimes it might be the formal method. Remind colleagues that this means teaching mental calculation strategies remains important. In the requirements and the notes and guidance the children are encouraged to use mental calculation strategies where appropriate. We need to make sure that our children are given plenty of opportunities to do this all the way through KS2. Grouping (or chunking) is a useful mental calculation strategy that encourages children to make use of multiplication facts and to use these to derive new facts. So for appropriate calculations this strategy should be encouraged. Grouping has had some bad press over the last year or so because it was seen to be used for every division calculation that the children carried out and was often an inefficient method leading to unnecessary errors. So, if you are a school that focuses on this method, encourage colleagues to consider when it should be used and when the formal method is more appropriate.

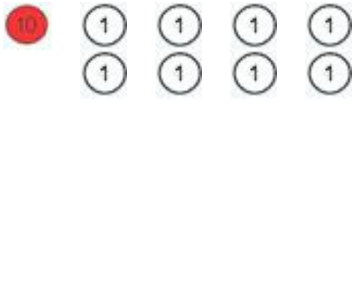
It is important that the children make use of multiplication and corresponding division facts to help them answer division calculations. The National Curriculum states that children need to know all facts to 12 x 12 by the end of Year 4. Do colleagues have any tried and tested methods that have helped their children to learn these facts? It might be worth making a note of them for other colleagues to use.

As with the other operations, it is probably wise to begin teaching the formal method with a simple calculation, such as, 78 ÷ 6. Begin by exploring this using base 10 equipment and place value counters, and model the approach in a similar way to this…

Ask colleagues to make 78 using the equipment that you have available:



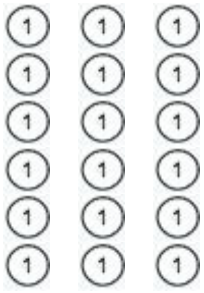
Unlike grouping, which makes use of the multiplicative concept of place value, this method highlights its positional side. Ask colleagues to consider the number of tens they have and to put them in groups of six. Agree that they can make one group of six tens and that there will be one ten left:



One group of six tens

The remaining one ten cannot be grouped into six and so needs to be exchanged for ten ones:

The 18 ones can now be grouped in sixes:



The written calculation looks like this:

$$\begin{array}{r|ll} & 4 & 3 \\ \hline 6 & \not{7}^{1} & 8 \end{array}$$

Ask colleagues to compare what they have done practically with the written version. Ask them to consider what is the same and what is different about them. Practise a few more calculations similar to these and then progress on to 3-digit by a single digit division and then 4-digit by 2-digit division. Aim to practice with calculations that cannot be done more efficiently using a mental calculation strategy.

As colleagues work through these practically, encourage them to record the steps they make in a written calculation.

You could include divisions that have remainders and lead a discussion on the contexts in which they

would be left as whole number remainders, fractions or rounded up or down. Currently remainders are often expressed as decimals in Year 6. It's worth noting that decimals are mentioned in the notes and guidance.

Finish your meeting by leading a discussion on when the children in your school should be taught to use the formal written method for division. Compare colleagues' thoughts with the expectations from the National Curriculum. As a group make a decision to write into your school calculation policy.

We hope that you have found this article helpful. If you decide to use it for staff professional development, please let us know - we'd love to hear what you did.

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