Primary Magazine

Issue 8

National Centre for Excellence in the Teaching of Mathematics

Welcome to the eighth issue of the Primary Magazine.
In this issue we introduce a new series of articles where we explore the mathematics of art through the work of various famous artists and cultures around the world.
Our Up2d8 Maths focuses on the opportunities for measures, particularly temperature, following the extreme weather the UK was suffering during the last few winter months.

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From the editor

Should the government scrap primary school SATs? Are they helpful or simply a headache? Do you spend weeks before them preparing the children in Year 6 by giving them practice tests? Are any of your children anxious about taking them?

Last year saw great inefficiency in the marking and reporting of results, with many schools sending papers back to be remarked and others not having the results back before the children began their KS3 education. KS3 SATs have now been abolished – should the same happen to KS2?

In fact, the papers themselves are good national indicators of the levels that children achieve and provide a reliable assessment of National Curriculum attainment. However, using them to produce league tables can be counterproductive.

Click here to read some opinions. Why not have your say by adding your comments to the Primary Forum?

Assessing Pupil Progress (APP) pilots are underway in most if not all local authorities around the country. Is your school involved in one? If so, we would love to know how it is going – the successes and difficulties for example. Please let us know by adding your comments to the Primary Forum; alternatively you might like to add your comments here.

You may be interested to read some research that shows that children's attitudes to mathematics become entrenched by the age of nine, according to research by the mathematics tutoring website *The Whizz*. A spokeswoman for the website said: "The older the child, the less their feelings towards maths, and towards their own ability, are prone to change."
In their findings, over 90 percent of children aged between six and eight, either liked or loved mathematics. However, this did not last: between the ages of nine and 12, fewer than 70 percent liked or loved mathematics, and almost 15 percent disliked it.
To read more of this report and the relevant research click here.

You might be interested to know that The Mathematical Association (MA) and the Association of Teachers of Mathematics (ATM) both have their annual conferences planned for April. You can click on the organisation names for details and also to book should you wish to attend. They both look very exciting! The MA conference 'Mathematics yesterday, today and in the future' has a special primary day; the ATM conference 'Mathemateg Unknotted' is for all teachers of mathematics.

Up2d8 maths

The 'Arctic Snap' provides great opportunities for work involving data handling and measures, particularly temperature. There is also a focus on the thinking skills of enquiry and reasoning with opportunities for discussion and links to science. The suggestions presented on the spreads are ideas which are not year group specific, so will need to be read through and adapted before use.

Click here to download the Up2d8 maths resource - in PowerPoint format.

Click here to download the Up2d8 maths resource - in PDF format.

The Art of Mathematics

M C Escher

A short biography

Maurits Cornelis Escher was born on 17 June 1898 in Leeuwarden, in the Netherlands. His father noticed that his son enjoyed art and drawing so he sent him to study at the School of Architecture and Decorative Arts in Haarlem. However, Escher left to develop his interest in graphic arts when he was 21. He spent a number of years travelling in Europe, while his interest in graphics grew. In 1921 he got married and lived in Rome, Italy. At the time, his works depicted landscapes using impossible perspectives.

During the 1930s, Escher moved to Switzerland. Then, in 1936, he visited the Alhambra in Granada, Spain. The Moorish tilings he saw there fascinated him, and he began to explore plane symmetry. Between 1936 and 1942, Escher produced 43 coloured drawings with a wide variety of symmetry types. He adopted a highly mathematical approach, using a notation which he invented himself.

His fame slowly spread. During the 1950s his work was displayed in science museums rather than art galleries and several articles were written about him.

Towards the end of his life, Escher produced his best known puzzling prints. These were intellectually playful. In later life, Esher cut himself off from friends and family, retaining just a few friends. He died on 27 March 1972 in Laren, the Netherlands after a long illness.

Click here to go to the official M C Escher website.

Escher unicorn

Give the children plenty of time to study this image.

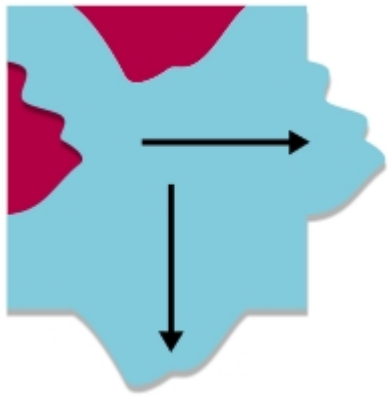
Which part of the unicorn tessellates with itself? Which parts tessellate with its reflection?
Are there any lines where you could easily cut the image into strips? Can you describe how the image from one side of the line is changed to that on the other side? Children should be able to spot a combined reflection and translation. Escher often uses this in his work. Is the translation a movement up or down? If the children find this hard to see, then print out the image, cut along the tail/back legs line and slide one strip until the children are convinced. Slide both up and down from the original position.
Which tessellating 2D shape is the unicorn based on? If you ask the children to imagine the wings slide down to tuck under his belly, they should be able to see that the basic shape is a square.

Escher tiles

You can use the fact that this, and many of Escher's tessellations, are based on a square or rectangle to make your own.

Give each child a square or rectangle of card. Ask them to cut out a piece from one side of the square, then slide it over to the opposite side and attach with a bit of sticky tape. The fact that the cut piece and added piece are identical means that they will tessellate. Repeat for the other pair of sides. Make sure you

have several spare squares to allow the children to experiment with until they are happy with the shape they make.



It is best not to be too ambitious – no unicorns!

Once the children are happy with their shape, give them a piece of A3 paper or similar. Start from one corner or the middle, it makes no difference. Draw around the shape once, then slide it to the top, bottom, left, right of that drawing and repeat until the page is filled. Choose two colours and colour alternate shapes in one of the colours. Use the second colour for the rest. Alternatively, draw around the shape on coloured paper and only pick one colour. Again, colour alternate shapes. The effect is amazing!

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Focus on Spring

Are you ready to 'spring' into action?

Winter is slowly creeping away and spring is just around the corner. According to the astronomical definition, spring begins on the 'vernal equinox' in the Northern Hemisphere – 21 March. It signals the beginning of a long period of continuous sunlight at the North Pole. But what does it mean for us living here in the UK?

For many of us, spring conjures up images of new flowers, trees blossoming, birds building their nests, baby animals and spending time outside in the sunshine. March also brings St David's Day on the 1st in celebration of David, patron saint of Wales, St Piran's Day on the 5th, in celebration of Piran, patron saint of Cornwall, St Patrick's Day on the 17th in celebration of Patrick, patron saint of Ireland, and this year, Mothering Sunday falls on the 22nd. In the UK, Mothering Sunday is celebrated on the fourth Sunday in Lent, the period of forty days (excluding Sundays) preceding Easter.

All of this provides a wealth of information, just crying out to be used as a context for exciting mathematical activities in the classroom! Why not try using some of the facts below to start mathematical conversations in your classroom… let us know how you get on!

- The word 'March' comes from the roman Martius. This was originally the first month of the year and was named after 'Mars', the God of War. March was also the beginning of our calendar year too. We changed to the new style or Gregorian calendar in 1752. It is only since then that we have started our year on 1 January.

- St Patrick brought public attention to the shamrock, after using a three-leafed specimen to explain the concept of the Holy Trinity. According to legend, the additional leaf found on a four-leaf clover, brings good luck. It is estimated that there are approximately 10 000 three-leaf clovers for every one with four leaves. The New York Times reported about a man who had found 160 000 of them to date!

- 'Easter Island', in the south-eastern Pacific Ocean, is a special territory of Chile. The first European discovery of the island was on Easter Sunday in 1722 by Dutch navigator, Jacob Roggeveen.

- Each year, nearly 90 million chocolate bunnies are made in preparation for Easter.
- When it comes to eating the chocolate bunnies, as many as 76% of people prefer to eat the ears first.
- In 1928, an act was passed in Parliament to fix Easter Day as the first Sunday after the second Saturday in April. It has never come into force though. In Britain, Easter is taken to be the first Sunday after the full moon that follows the (northern hemisphere) spring equinox (easy once you know how!).

- The Guinness Book of Records holder for the largest Easter egg ever made, is the Belgian chocolate producer Guylian, who made a chocolate egg with at least 50 000 bars on behalf of the city of St Niklaas. The egg measured 8.32 metres high. Twenty-six craftsmen worked for a total of 525 hours to build the egg. They needed 1950 kg of chocolate!

For these, and many other facts relating to spring and Easter:

A whole host of activities, fact pages, games, puzzles, recipes and traditions relating to the Christian festival of Easter can be found on the Indobase website and on the eparenting website.

The Met Office website is a wonderful source of child-friendly information relating to the seasons and weather.

Antonio Luque's website has an incredibly clever programme that can be used to calculate the date of Easter in ANY given year!

And finally…


¡Felices Pascuas!
(Spanish)


Glad Påsk
(Swedish)


Joyeuses pâques
(French)


Frohe Ostern
(German)


Buona Pasqua
(Italian)


Happy Easter
(English)

Click here for 'Happy Easter' in 75 languages!

Starter of the month

EYFS

- Sort familiar objects to identify their similarities and differences
- Use developing mathematical ideas and methods to solve practical problems

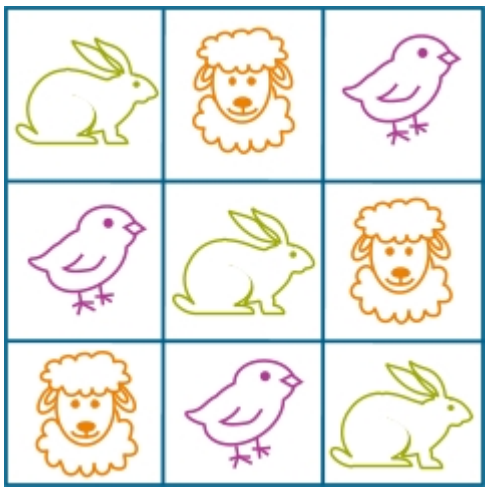
Give each child a picture of a decorated egg. Ask them to tell their partner something special about it. Comments might include relate to colour, size, patterns etc. Ask one of the children to describe their 'special egg' to the class/group. Does anyone else's egg have the same 'special quality'?

Show the children a set of six black and white eggs. Model how to choose an egg and then describe its features for the class to guess. Ask the children to do the same and describe their chosen egg to their partner. Can their partner guess which one?

Explain that you have chosen an egg and will now give clues to help them discover which one. (See clues with egg sheet (1) below). Encourage the children to ask useful questions, such as 'How many shapes does the egg have altogether?' or 'Does the egg have any circles?'.

KS1

- Present solutions to puzzles and problems in an organised way; explain decisions, methods and results in pictorial, spoken or written form, using mathematical language and number sentences.



Show the children a simple, completed 'SUDOKU' (this can be downloaded as part of the activity worksheet below) and ask them to explain what they can see.

Once they have determined how many different symbols there are, ask some further questions, eg How many of each symbol are there? Is there anything special about each row or column? Why could I not put a 'lamb' here? (point to centre square) How many 'chicks' can you see? Are there more 'chicks' than 'rabbits'? Ensure children understand that each row and column may only contain one of each symbol.

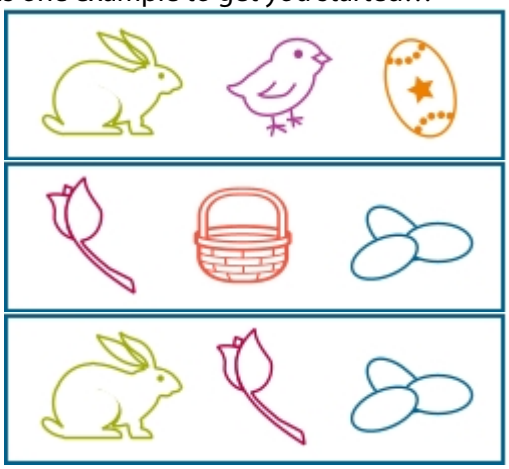
Now show them a partially completed SUDOKU. Ask them to discuss with a partner where they might start. Why? Are there any squares that they cannot fill in straight away? Why not?

See if the whole class can work together to solve the 'SUPER SUDOKU'. This might be easier with cut-out symbols that can be moved around the grid as necessary. Click here for a sheet of large symbols ready to print out and use. Click here for the solution.

KS2

Represent a puzzle or problem by identifying and recording the information needed to solve it; find possible solutions and confirm them in the context of the problem.

Show the pupils a collection of symbols commonly seen at Easter time. Examples might include eggs, baskets, chicks, rabbits etc. Explain that you have chosen three of the symbols and placed them in an order of your choice. You will give them pieces of information which they must use to determine which symbols you have chosen, and the order in which they lie. The children will need to think logically, determine which, if any of the information is redundant, and test their theories as they proceed.
Here is one example to get you started…



Two of the pictures are correct and both are in the correct positions

One of the pictures here is correct, and it is in the correct position

Two of the pictures here are correct, and they are both in the correct positions.

The solution:

Encourage the children to choose their own set of three symbols, and write clues similar to those above. They can try to solve each other's problems…can they 'beat the teacher'?

For more problem-solving activities using the theme of Easter (including some similar to that explained here, but with four symbols!)…click here.

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A little bit of history – Our number system

The symbols used for numbers varied around the world until the 15th Century. It was in this century that the first printing machine with movable type was invented by Johannes Gutenberg. Click here for details of him and his invention, the Gutenberg printing press.

It was then, when printing really took off allowing for the first time ever the possibility of the mass production of printed books, that number symbols began to be standardised and the use of the numerals 0 to 9 became almost universal. Of course, not every country used this new system, but most did and continue to do so today.

These symbols were based around the Brahmi number system. Brahmi was the writing system of ancient India. Buddhist inscriptions found from around 300BC became our 1, 4 and 6 and a century later their use of other symbols became 2, 7 and 9. The use of 0 was first recorded in the 9th century, but it is believed that this originated in the 6th Century in India.

1	2	3	4	5	6	7	8	9
—	=	≡	+	h	ψ	?	⤿	?

Brahmi numerals of the 1st Century

This Indian number system (or Arabic as it is sometimes known) was probably introduced to the rest of the world by traders and merchants centuries earlier than the 15th but it wasn't in common use.

We have the Italian mathematician Fibonacci to thank for first promoting its use in Europe in the 13th Century. He studied as a child in North Africa, where his father was a diplomat, and it was here that he first encountered Indian numbers. In his handwritten book *Liber abaci* he wrote:

> *When my father, who had been appointed by his country as public notary in the customs at Bugia acting for the Pisan merchants going there, was in charge, he summoned me to him while I was still a child, and having an eye to usefulness and future convenience, desired me to stay there and receive instruction in the school of accounting. There, when I had been introduced to the art of the Indians' nine symbols through remarkable teaching, knowledge of the art very soon pleased me above all else and I came to understand it, for whatever was studied by the art in Egypt, Syria, Greece, Sicily and Provence, in all its various forms.*

Click here for his biography.

It was from this Indian number system that we learned about place value. Hindu mathematicians from the 300s and 200s BC used a base 10 system having symbols for each number from one to nine and a name for each power of 10, for example 'sata' was their word for hundred and 'dasan' was ten. They would write these names when writing the numerals, so 264 would be written as 2 sata 6 dasan 4. In around 600AD they invented a symbol called 'sunya' which meant empty so that they didn't need to write the place names, for example 2 sata 4 was replaced by 204.

A Department for Children, Schools and Families initiative to enhance professional development across mathematics teaching

The numerals were arranged with their lowest value digit to the right, with higher ones added to the left. This was because they read from right to left. We have taken on this despite the fact that we read the other way around!

The Indians were not the first to develop a system of place value. The Babylonians had a place-value system centuries before them but theirs was in base 60. The Indians were the first to develop a base 10 system.

Evidence of the earliest uses of the Indian or Arabic number system in England can be found on the tower of Heathfield Church, Sussex, where there is the date inscription 1445 and on a wooden lych-gate at Bray Church, Berkshire, where there is the date inscription of 1448. By the middle of the 16th Century these numbers were in common use in most of Europe. Many people liked this number system because they could easily use them to write out calculations. Some people preferred to use Roman numerals because they solved calculations on an abacus and didn't need to write them.

After printing became more widespread, many mathematics textbooks were published most of which showed calculations using the Indian numerals and this brought the system into widespread use.

Mathematicians think the invention of this system is one of the world's greatest inventions because of its concept of place value and the use of zero. These two aspects make it easy to represent large numbers and carry out calculations that would be difficult to do using any of the other ancient numerical systems. To understand why this would be, see *A little bit of history* in archived issues of the Primary Magazine for some of the different and more complex number systems:

- Chinese numbers
- Roman numbers
- Greek numbers
- Egyptian numbers
- Babylonian numbers
- Mayan numbers
- Inca numbers

Did you know…?

...that we get the word algorithm, meaning calculation method, from the man who invented it? His name, when translated from the Latin, was Algoritmi

...that modern-day Arab telephone keypads often have two forms of Hindu-Arabic numerals: Eastern Arabic and Western Arabic/European

The information for this article was found on these sites:

St Andrew's University
Wikipedia
Lim Wei An and Neo Kangwei

Maths to share – CPD for your school

Addressing teachers' subject knowledge - shape

Ask colleagues to read the article The Development of Spatial and Geometric Thinking: The Importance of Instruction, by Jenni Way.

At the meeting
Ensure that teachers are aware that this is an opportunity to develop their subject knowledge and address misconceptions – no judgements will be made. You may need to provide appropriate shape-based resources for the following introductory activity which may take up to 20 minutes.

Using the Always, Sometimes, Never cards, ask colleagues to consider each statement in turn and decide whether the statement is **always true**, **sometimes true** or **never true**. All members of the group must explain their thinking and all members of the group must agree the decision.

Discuss the solutions in detail and address any misconceptions.

This is a good opportunity to encourage colleagues to self-evaluate their subject knowledge further in this area using the NCETM Self-evaluation Tool.

Discussion of the paper
You will need to allow about 20 minutes for this part of the session. To introduce the main aspects of the paper, give each teacher a copy of the Tangram Template.

Ask colleagues to cut out the pieces of the tangram and give them the opportunity to explore what they can do with the pieces. Encourage them to work together and discuss what they have done with the shapes. This is the first activity stage according to van Hiele's levels of geometric thought.

Now, in the role of teacher ask the following questions:

- Which pieces can be made from three other pieces?
-
- How many different ways can the largest triangle (1) be made using the other pieces?

- Choose two shapes. How many different shapes can you make with them? Draw them all and give them names.
- Use three shapes to make a new shape.

This is a stage 2 activity according to van Hiele.

Again, in the role of teacher ask the following:

- Which shapes have a right angle? Match them up in a pile. (What size are the other angles?)
- How many lines of symmetry does each shape have?
- What is the same about all the triangles?
- Which shapes have parallel sides?
- Which shapes have sides the same length within themselves? Which shapes have sides the same length as other shapes? Half/double the length?

This is a stage 3 activity according to van Hiele.

Continue in the role of the teacher and ask:

- How many ways can you make a square from some or all of the pieces?
- What pictures can you make using all the pieces. What can you tell me about the area of these shapes?

This is a stage 4 activity according to van Hiele.

- Ask colleagues to hypothesise the activity that would consititute a stage 5 activity.

After taking part in this activity ask colleagues:

- What would be the advantages of teaching using this approach/activity? (assessment for learning opportunities and opportunities for discussion)
- Does the activity promote learning?
- What could the learning objective be for this type of activity?
- Could you see the progression from one activity stage to another? (van Hiele stages from 1 – 5)
- Can you identify any specific stages progression?

Ask colleagues to consider their own pedagogical knowledge of shape by considering the question:

- Does my teaching develop progression in the understanding of shape through interaction, exploration and discussion?

Next steps

When next you are teaching shape –

- Try out the tangram activity with your class at the appropriate stage of development
- Plan a similar activity that involves manipulation, construction, and discussion, eg how squares can be assembled to make a cube, or investigating Euler's Law
- Evaluate the lesson and share with colleagues.
- Use the activities from Primary National Strategy Shape and Space Activities booklet
- Have a look at Learning maths outside the classroom – ideas about shapes on the NCETM website and plan an activity of a similar nature.

Use the following links to find out more about this enthralling subject:

- Teacher Enquiry Bulletin: How can we use interactive whiteboards effectively for mathematics learning?
- Teacher Enquiry Bulletin: How can we enhance students' thinking in mathematics?

- Conflict discussion as a teaching (and learning) strategy - Julie Ryan and Julian Williams, University of Manchester
- NCETM CPD - KS3/4 departmental workshop on shape.