Primary Magazine

Issue 27

National Centre for Excellence in the Teaching of Mathematics

Welcome to the 27th issue of the Primary Magazine and welcome to the new school year! Our famous historian is Bernhard Riemann, we look at Aboriginal art and our CPD opportunity aims to develop subject knowledge in division. *It's in the News!* features something cheerful for a change – the Notting Hill Carnival.

Contents

Editor's extras

Thought the World Cup was over? Well nearly, we have some numbers that you might like to play around with. We also have case studies from of a couple of our regional projects, including an interesting one to do with setting, and an article by a *Numbers Count* trainer.

It's in the News!

In this issue we look at carnivals, in particular the Notting Hill Carnival which takes place over the August bank holiday. The slides provide opportunities for work with such mathematical concepts as measurement, money and data handling, as well as cross-curricular links with geography, D&T and music.

The Art of Mathematics

This issue explores Australian Aboriginal art from dot paintings to turtles and tortoises to didgeridoos. Have some fun getting to know the history of this type of art and trying the mathematical art ideas suggested!

Focus on…

Eighty-four years ago in August, Gertrude Ederle, American daughter of a German immigrant, decided it was the perfect day to swim across the English Channel: so we think it is a perfect month to focus on swimming!

A little bit of history

In this issue we look at a potted history of Bernhard Riemann, a German mathematician who studied under Gauss, and was asked by him to prepare a *habilitationsschrift*, the highest academic qualification a person can achieve, on the foundations of geometry.

Maths to share – CPD for your school

We continue our series on mathematics subject knowledge by exploring division. Before the session you might like to consider your own knowledge in the calculations section of Mathematics Content Knowledge in the Self-evaluation Tools.

ICT in the classroom

We look at engaging children in collaborative problem solving using the interactive whiteboard (IWB). As you will see, the IWB can provide rich opportunities for reasoning, communicating and supporting each other's learning.

Editor's extras

We found these number facts related to the World Cup that you might like to incorporate into a starter or group activity – provided that you are not completely fed up with the whole event!

- £500 000 bonus to each Spanish player on winning the World Cup
- £250 000 for each Dutch player if they won
- £20.5 million FIFA prize for the winning team
- £5.9 million FIFA payout for each team knocked out in the second round – such as England
- 3.2 million fans attending the 64 matches, second only to the 1994 tournament in the US
- 20 Adidas 'Jabulani' match balls for each game until the final
- 30 personalised 'Jubalani' balls for the final
- 1 million foreigners entered SA since the beginning of June
- 27 years 4 months is the average age of the players
- 28 years 7 months is the average age of the England squad
- 3 goals scored by England
- 4 goals scored by Miroslav Klose for Germany
- 586 appearances by tournament mascot, the cartoon leopard Zakumi
- 84 490 is capacity of Soccer City in Johannesburg
- 780 performers involved in the closing ceremony
- 700 million YouTube hits for Shakira's World Cup anthem *Waka Waka*
- 113 – 127 is the average decibel range of a vuvuzela.

That's it – until 2014, promise!!

NRICH have been carrying out some research among the students studying mathematics at Cambridge University. One of the questions they asked was about the most influential person in their lives as far as their love of mathematics was concerned. A staggering 60% out of the 1 000 asked said their primary school teacher. Wow, what a responsibility we have!

In Issue 24 we told you about two transition projects, one from Hilary in Ealing, and the other from Liz in the East Riding of Yorkshire, so we thought you might be interested to read the Welsh Office inspection report: Improving numeracy in Key Stage 2 and Key Stage 3, which discusses their findings on several matters, including transition. The purpose of their report was to evaluate the effectiveness of initiatives to improve standards of numeracy and to identify examples of best practice in key areas. These areas include basic skills numeracy support programmes, the use of numeracy in subjects across the curriculum and the effectiveness of provision for pupils' movement from Key Stage 2 to Key Stage 3.

Talking of projects, we have news of two regional projects that have been completed and are now on the portal for you to read. The first is one from Tina, the mathematics subject leader at a school in Kingston. They decided to explore the attitudes and attainment of children working in mixed ability groupings instead of the setting arrangements that they have had at the school for years. It's fascinating reading, as a result of the project, which had a very positive impact, they have decided to stop setting in years 3, 4 and 5 and to alter arrangements in year 6, whereby they have a core and an extension group.
The second completed regional project will be available soon on the What makes a good resource microsite. A group of teachers from Wandsworth and Greenwich came together for some workshops to discuss and write case studies for a selection of resources that they have tried and tested in the classroom and that

have worked very effectively to help children in a variety of areas of mathematics. These resources are designed for you to read, reflect upon, adapt and try out with your class.
We would be very grateful for any feedback on or questions about these two projects.

Go geometry have some useful information and interesting and quite challenging activities on their website. You might like to check it out, maybe for those children in your class who need an extra challenge.

Following on from the article by Numbers Count teacher Katie, in Issue 23, we have an article from Andy Tynemouth, an Every Child Counts National Trainer who works for Edge Hill University. He stresses the importance of diagnostic assessment in the role of a Numbers Count teacher. Should this impact on the role of a classroom teacher? How much diagnostic assessment do you carry out on your children, particularly those who are under achieving? Please let us know, with handy tips if possible, in the Primary Forum.

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National Centre for Excellence in the Teaching of Mathematics

It's in the News!

We leave disasters behind and look at carnivals, with a particular focus on the Notting Hill Carnival which takes place over the August bank holiday weekend, and also the world's biggest carnival in Rio de Janeiro, Brazil. You may find it helpful to look at the suggested websites for some background information:

- thenottinghillcarnival.com
- mynottinghill.co.uk
- Wikipedia.

The slides provide opportunities for work with such mathematical concepts as measurement, data handling and money. They also provide cross-curricular links to geography, D&T and music. There are a wealth of mathematics opportunities here. If you made use of most of the ideas you could have a carnival fortnight and teach all of your mathematics, literacy and other areas of the curriculum through this theme!

This resource provides ideas that you can adapt to fit your classroom and your learners as appropriate. As always, we would be extremely grateful if you could give us some feedback on how you have used it, if it has worked well and how it can be improved.

Download this *It's in the News!* resource - in PowerPoint format.

Download this *It's in the News!* resource - in PDF format.

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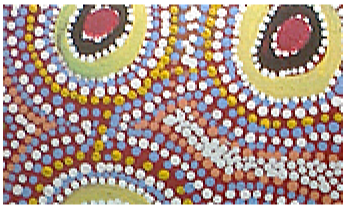


National Centre for Excellence in the Teaching of Mathematics

The Art of Mathematics
Aboriginal Art

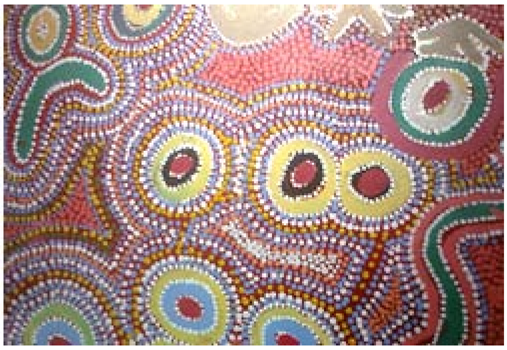
Aboriginal Art is art made by the Indigenous Australians. 'Aboriginal' means 'from the beginning', acknowledging that the people are descendants of the very first inhabitants of Australia. The term is used to describe both modern works and those predating European colonisation. Aboriginal art takes many forms, from rock, bark and body painting to carving, weaving, stone art and music.

Most Aboriginal art is related to Dreamtime. This is the mythological period of time, during which the natural world - and indeed the entire universe - were shaped by the actions of mythical beings. This mythology is deeply intertwined with Aboriginal religious beliefs, Australia's landscape and its native animals. Dreamtime covers the period before and during creation, up to when humans began. The mythical beings were half human, half mythical creatures. Some of the creatures took the form of 'totemic' animals, others took human form. None were perfect, having all the good and bad characteristics of people today. These mythical beings came in many shapes and forms. They found themselves in the featureless landscape and the waveless ocean. When they reached the land they began their work of creation, not only making all things but naming them too. A giant serpent which had been sleeping underground pushed upward and writhed across the void, creating the landscape as she passed. The mythical beings created everything there is, including the laws, customs and languages. Once they had established the social order and its laws they simply crept away.

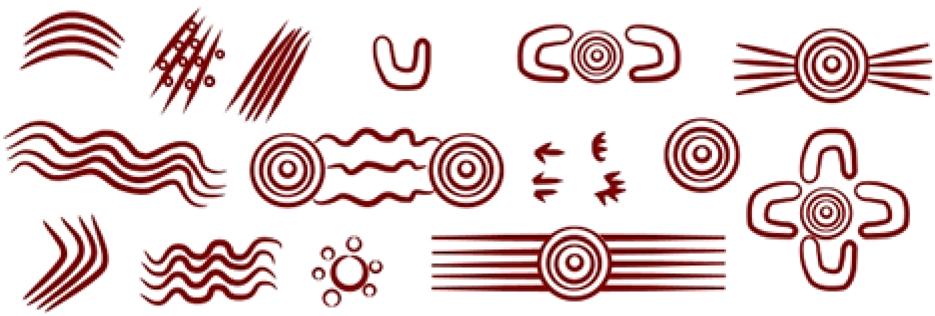
The Australian Aboriginal culture is one of the most ancient in the world. It has a rich tradition of storytelling. Dreamtime stories have been passed down, either orally or through pictures, for thousands of years. Each tribe has its own stories to explain the creation of life and how something came to be the way it is. Passing on the stories was often gender restricted – either male to male or female to female. No one could relate or paint someone else's dreaming or creation story without their permission.

Aboriginal dot paintings

Aboriginal paintings are very distinctive and often reflect the characters and scenes in myths and legends. The work is characterised by hundreds of dots surrounding shapes with a symbolic meaning. The symbols are used to create a simple storyline. Other traditional symbols in paintings included fish, turtles, crocodiles, snakes, kangaroos and other animals as well as weapons and tools. The dotted motifs and sometimes abstract modern equivalents have become the trademark of contemporary Aboriginal art. These paintings are simple in technique yet full of detail and story. There can be thousands of dots and many symbols all in one painting.



Aboriginal art has always used very few colours since they were usually made from what was available locally. Ochres are among the earliest pigments used by mankind, derived from naturally tinted clay containing mineral oxides. These were obtained from ochre pits and then traded between clans.



Download the traditional symbols from Aboriginal Art Online and invite the children to use the symbols to create a simple story. This could be an invented story or a key event in their life, such as the birth of a sibling. If there is no symbol for what the children want to say, they can make up their own, but in keeping with the style of the known symbols. Surround the symbols with a series of dots using a limited range of colours such as red, brown, orange, yellow and occasionally green. Alternatively, younger children could fill a basic outline of an Australian animal with dots, and then surround it using different coloured dots. Make the dots by dipping a cotton bud or the end of a paintbrush in the paint and then dab the painting where a dot is required. Younger children could use a finger. Alternatively, create a picture using the small dot tool in a drawing programme. If the dots are too large, they blend together and the structure is lost.

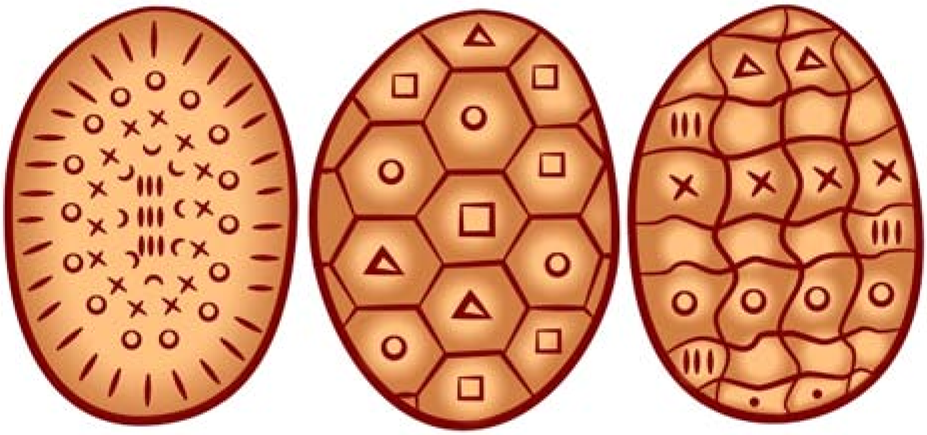
Look at some examples of children's work at ART-RAGEOUS! and at the Barking and Dagenham Aboriginal Art Project.

Estimate the number of dots used to make an Aboriginal dot painting. This could be the child's own painting or a print. After recording the estimates, use strips of card to make a 1cm x 1cm (1 square centimetre) window. Place the window in three or four different parts of the picture and count the visible dots. Calculate the average number of dots seen in each window. This is the average number of dots per 1 cm^2. Measure the size of the whole picture and calculate how many dots have been used to create the picture. Discuss whether this is an accurate figure or an estimate.

Turtles and tortoises

Look at pictures of the turtles and tortoises. What shape are their shells? What patterns can the children see in each of them? If you have postcards or downloads available showing aboriginal paintings of turtles, invite the children to compare these interpretations with the photographs. What is the same? What is different? How has the artist chosen to show the shapes and patterns on the shells? The patterns in the paintings tend to be more decorative than realistic.

Roll out a ball of red (terracotta) clay to make an oval. Place some hexagonal paper on top of the oval and use a needle to prick the hexagons through onto the clay. Be careful not to press too hard. Join the dots to mark out a set of hexagons or use as a dotted outline. Add a design in each hexagon. Either make a pattern or try to make every hexagon different. Children could use different base shapes such as pentagons or octagons. They could also consider symmetry, rotation and translation!



When complete, make a walnut-sized ball of clay and place under the middle of the shell. Gently press the edges of the oval sides down around the ball, so the entire piece becomes dome-shaped. Either air dry or bake in a kiln. Paint using traditional Aboriginal colours. Result – a model turtle!

Didgeridoo

The best known of all Aboriginal musical instruments is the didgeridoo. It is a primitive yet enduring instrument which has been in use for over 40 000 years. A real didgeridoo is over a metre long and made from a hollow wooden branch with a beeswax mouthpiece. The branch would have been hollowed out by termites. However, it is easy to make your own using PVC plumbing pipe or cardboard tubes. Get rid of any rough edges on PVC pipes by sanding them down. The length of the didgeridoo needs to be manageable. For an adult, around 150 cm is about right. This is around 15 cm shorter than the average height of an adult. Children could make their own, 10 cm shorter than their own height. Work in pairs to measure each other's height, and then draw up a chart. If using cardboard tubes you might need to join two together. Use paint (you'll need acrylic paint on PVC piping) or markers to decorate your didgeridoo with aboriginal patterns or symbols. Add feathers, leather string or other found materials. Challenge groups of children to measure some didgeridoos and use the height chart to work out who made it. Explore whether the length of the didgeridoo makes a difference to the sound it makes.

To play the didgeridoo, stand or sit with the instrument straight out in front of you, with one end resting on the ground. Place your mouth inside the tube and blow with loose, vibrating lips. Make occasional animal sounds too. Use a stick to beat out a rhythm on the didgeridoo as you play. See and hear how it's done on YouTube.

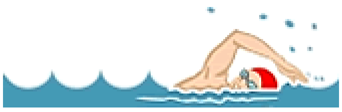
Further information from:

- Aboriginal Art Online
- Aboriginal Art and Culture Centre
- Ausemade
- Jackie's resources for learning and teaching: Aboriginal Dreaming Stories
- YouTube: Dreamtime Australia
- YouTube: Australian Aboriginal dot art.

Focus on…the first woman to swim the Channel

Imagine it is a bright August morning on the northern French coast. How will you spend the day? Lounging in the garden…strolling through the French countryside…heading to the beach? Eighty-four years ago in August, Gertrude Ederle, American daughter of a German immigrant, decided it was the perfect day to swim across the English Channel. So, on 6 August 1926, she became the first woman ever to successfully swim the 34 kilometre (21 mile) stretch, and break all previous records.

In this edition of the magazine, we focus on this incredible feat, and hope to inspire you with some exciting mathematics for the classroom. Use some of the interesting facts or activities listed, then let us know what you get up to.



Did you know…?
Swimming the Channel:

- the first person to 'officially' swim across the English Channel was British man Matthew Webb, who swam from Dover to Calais on 25 August 1875 in 21 hours and 45 minutes.
- Gertrude Ederle took just 14 hours and 39 minutes, a record which she held for 24 years
- her successful swim did attract some controversy, with claims from the British press that the two tug boats that travelled alongside her (one with her trainer, father and sister, the other full of reporters) shielded her from the bad weather and so made her swim 'easier'!
- Ederle was coated with a mixture of olive oil, lanolin, and Vaseline; in the hope that the grease would help keep her warm in the water and lubricate her skin as she swam
- the water temperature of the English Channel is between 59°F and 64.5°F (15°C to 18°C) – depending on the time of year.
- on 4 July 2006, comedian David Walliams successfully swam the English Channel in 10 hours and 34 minutes, to raise money for Sport Relief.
- only 10% of those attempting the full Channel swim actually succeed.

The Channel itself:

- the English Channel is one of the world's busiest shipping lanes, with around 600 tankers and 120 ferries crossing it every day
- the Channel Tunnel links Folkestone in Kent with Coquelles near Calais in Northern France. It measures 31.35 miles long
- the tunnel was started in 1988 and was officially opened in 1994. It actually consists of three tunnels: two rail tunnels and a third (smaller) service tunnel
- at the 1994 completion actual costs were, in 1985 prices, £4 650 million: an 80% cost overrun
- at the peak of construction, 15 000 people were employed, at a cost of over three million pounds per day
- seven million cubic metres of spoil, enough to fill Wembley Stadium 13 times, was excavated during the tunnel's construction – and used to create a new piece of land attached to the British Isles called Samphire Hoe
- the shuttle trains are 800 metres long, equivalent to the length of seven football pitches.

Short activities

Use the facts above to work out the average swim speeds of Matthew Webb, Gertrude Ederle and David Walliams (assuming they each took Ederle's route). A strong swimmer can swim two to three km in an hour. Would these three be considered 'strong' swimmers?

If I can swim a length of my local 25 metre swimming pool in 32 seconds, how long would it take me, assuming a constant swimming speed, to swim four lengths? 200 metres? A kilometre? Thirty-four kilometres?

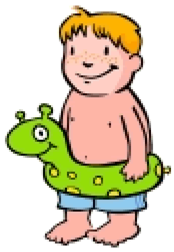
Mark out a 'swimming pool outline' either on the hall floor or playground. How fast do pupils think they could 'swim' (run, with swimming arms!) the length of the 'pool'? Use stopwatch timers to allow them to find out and compare. What happens when they 'swim' two lengths or five lengths? Does it take exactly twice/five times as long? Why not?

Discuss with pupils what they do in 14 and a half hours (Ederle's approximate swim time). Compare it to the length of time they are asleep at night, or the fact that it is approximately two days' worth of school!

Using local maps (or use Google Maps) find places 21 miles away from school. Can they imagine swimming there?

Longer activities

Encourage pupils to follow a line of enquiry by providing them with an open statement such as 'Boys can swim further than girls'. To what extent do they agree? Disagree? Even very young pupils are likely to have fairly strong views on this! In groups, ask them to plan how they could find out if the statement is true and allow them the time to carry out their ideas. Have they considered how to collect their data, and whether they need to ask all those interested, or just a sample? How will they present their data? For what purpose? Refer back to Maths to Share in Issue 10 of the Primary Magazine, which looks at some of the issues that might arise when handling data in the classroom.



Open statements or questions could be differentiated according to age or ability, or by the level of support given to pupils. Other suggestions might include:

- who has swum the furthest over the summer holidays?
- over half of the children in our school can swim.
- people with large palms can swim faster than those with small palms.

The NRICH site hosts a useful problem for introducing or exploring negative numbers, using a swimming pool context. The Swimming Pool problem is aimed at Key Stages 1 and 2, and provides hints and teachers' notes, as well as solutions.

Try these typical 'matrix' logic problems to encourage pupils to consider how they can work systematically, and use tables and charts to support their thinking.

The solution:

	1st	2nd	3rd	4th	5th	6th
Alice	X	X	X	X	X	√
Aaron	X	X	√	X	X	X
Adam	√	X	X	X	X	X
Abby	X	X	X	√	X	X
Austin	X	X	X	X	√	X
Allen	X	√	X	X	X	X

From The Race.

Now try this one:

Louise and three other women decide to go swimming. They each wear a different swimsuit (one wears a silver one!). From the clues, can you determine the first and last name (one is Burns) of each woman and the colour swimsuit she wore?

1. The four women – Louise, Ms Cloud, Ms Moses and the woman who wore the blue swimsuit, all belong to the same swimming club.

2. The woman who wore the gold swimsuit isn't Caroline.

3. Ms Cloud isn't the woman who wore red.

4. Mrs Pebble, who didn't wear gold, works with Cherri's brother.

5. Red was not the colour of choice for Louise.

6. Caroline, whose surname isn't Moses, didn't wear blue to the pool.

7. Paula always wears the current season's swimwear design.

Wikipedia gives details of various types of logic puzzles, including 'logic grid puzzles'

There are many opportunities for exploring mathematics in a swimming context. Try focusing on swimming speed (measurement of distance and time), surface area of hand palms (area of irregular shape), kicking angle of legs, rhythm of the stroke (sequence, counting), breathing… let us know what else you think of!

Many websites give further details about Gertrude Ederle's incredible life: Wikipedia and Your Dictionary are particularly good examples. Details of other record-breaking Channel swimmers (ie oldest...youngest...fastest) can be found at channelswimming.com.

Are you interested in attempting the Channel swim yourself? channelswimming.com has some useful information and guidance.

Answer to swimwear matrix problem:

First name	Last name	Swimwear colour
Louise	Burns	Gold
Caroline	Cloud	Silver
Cherri	Moses	Red
Paula	Pebble	Blue

A little bit of history
Famous Mathematicians – Bernhard Riemann

Bernhard Riemann (1826 – 1866)

Bernhard Riemann was born in Breselenz, a village near Dannenberg in the region of Hanover, Germany, on 17 September 1826. His father, Friedrich Bernhard Riemann, was a poor Lutheran pastor in Breselenz, who fought in the Napoleonic Wars. His mother died when he was a child. Bernhard was the second of six children. He frequently suffered from nervous breakdowns, was very shy and had a fear of public speaking.

In 1840 Riemann went to live with his grandmother in Hanover, where he went to school at what is now the Lyceum Academy. When his grandmother died two years later he was moved to the Johanneum Lüneburg to continue his studies.

At this school he studied the Bible, but his main interest was in mathematics. At one point he tried to prove the accuracy of the Book of Genesis mathematically. His teachers were amazed by his ability to solve complicated mathematical problems, often faster and more competently than they could!

In 1846, when he was 19, he started studying philology and theology in order to becomae a priest and to help with the family finances. He didn't make it, instead his father managed to save enough money to send him to university to study mathematics. He went to the University of Göttingen, where he attended some of the lectures of Carl Friedrich Gauss. In 1847, he went to Berlin for two years to study. Here he met some eminent mathematicians such as Jacobi and Eisenstein. After this, he returned to Göttingen and once again studied under Gauss.

In 1853, Gauss asked his student Riemann to prepare a habilitationsschrift on the foundations of geometry. A *habilitationsschrift* is the highest academic qualification a person can achieve in certain European and Asian countries. It is earned after receiving a doctorate such as a PhD. The work needed is extremely difficult and at a higher level than a doctorate. Clearly, Riemann was an exceptionably clever chap!!

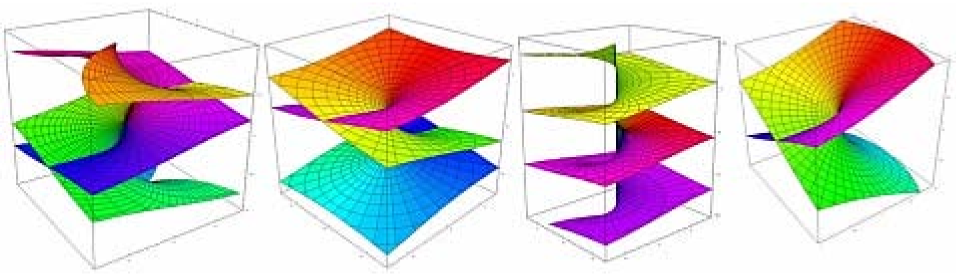
He spent many months working on his *habilitationsschrift* and developed a theory of higher dimensions which he very successfully presented to the mathematical public at his first lecture in 1854.

He continued his work in lecturing and was responsible for setting the stage for Einstein's theory on gravity through his approach to geometry.

Various colleagues tried to promote him to extraordinary professor status. They were unsuccessful but he was finally granted a salary, which he hadn't had before! In 1859, he became the head of the mathematics department.

In 1862, he married and shortly after had a daughter. He and his family fled Gottingen during the Hanover/Prussia troubles in 1866. His life was short, he died at the age of 39 from tuberculosis on one of his visits to Italy. He was buried in Italy, in Selasca.

Much of Riemann's work was unpublished because it was unfinished. His published works, however, opened up research areas combining analysis with geometry. He is well known for his Riemannian geometry, algebraic geometry and Riemann surfaces, among other things.



You could try experimenting with a primary school version of these Riemann surfaces! Have a look at Sierpiński's fractals in Issue 25 of the Primary Magazine and Mary Boole's string geometry in Issue 21 for

some ideas you can adapt to make your own, maybe in the style of a Barbara Hepworth sculpture. Let us know what you come up with - you could email us your photos!

Information from:

- Springer
- Wikipedia.

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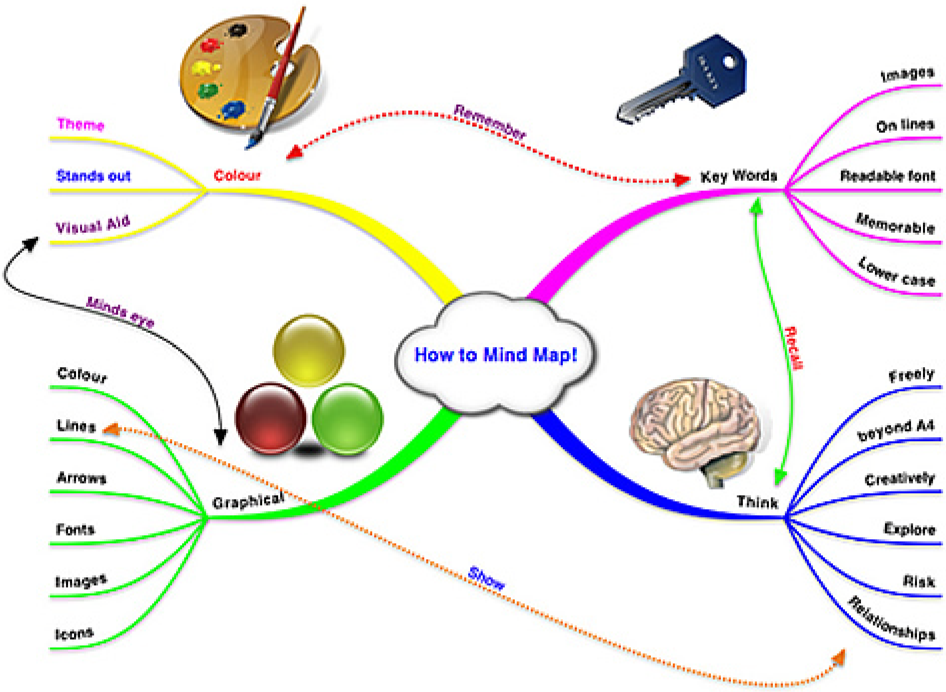
Maths to share – CPD for your school

Division

This issue of Maths to Share focuses on enhancing your individual subject knowledge – in this case, division.

Rowland et al. (2009) suggest that to teach mathematics effectively teachers need 'subject specialised knowledge' which includes deep knowledge of fundamental mathematics; knowledge of pedagogy specific to mathematics; and knowledge of the curriculum and progression.

To start, please consider: what are the big ideas in division?



Mind map by My Thoughts Mind Maps, some rights reserved

Make a mind map, similar to the one above, to show everything that you would need to consider when you teach division. You may want to consider:

- vocabulary
- key ideas, i.e. the processes or concepts involved
- children's prior knowledge
- what connections there are to other areas of mathematics, e.g. subtraction, inverse operation of multiplication
- common misconceptions
- models and representations to support learning
- how examples you choose to use could hinder/enhance learning

- assessment for learning opportunities.

Did you think about progression? On your own or with a partner in a different key stage, determine progression of division from YR to Y6/7 on a time line e.g.

Year R **Introduce chunking no remainder** **Year 6/7**

When you have exhausted your knowledge, check using the Primary Framework.

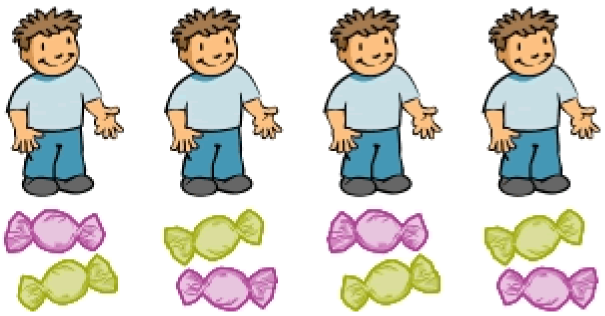
What does this calculation mean to you? Make up a word problem that corresponds to this number sentence:

$$32 \div 8 = 4$$

In your mind map, did you identify the two different structures for division?

Sharing

There are eight sweets and four boys. How many sweets does each boy get?

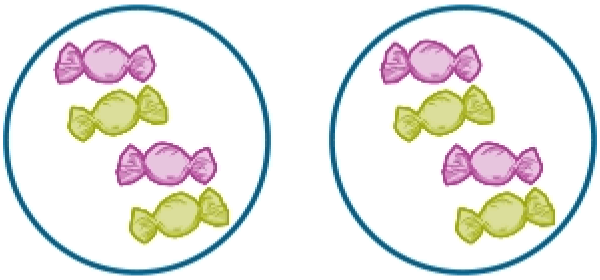


$8 \div 4 = 2$.

Were you able to identify the correct language? The dividend is the number you have to start with in this case eight (sweets) is shared between four boys (four is the divisor) each boy gets two sweets (this, the answer, is the quotient of a division calculation). Sharing is generally the first division structure children are introduced to at home and in school. Let’s now compare this with the other structure for division.

Grouping
Grouping is very closely linked to repeated subtraction, a necessary stepping stone in a child’s understanding of this area of division.

There are eight sweets. Each child is to have four sweets how many children will have sweets. This time we are taking four sweets away each time.



8 ÷ 4 = 2
Or...8 - 4 - 4 = 0, so 2 groups of 4.

The dividend is the number you have to start with in this case eight (sweets) is grouped in to piles of four (four is the divisor). Only two boys will get four sweets each (this, the answer, is the quotient of a division calculation). The grouping structure is closely linked to division being the inverse of multiplication and this is the structure that links most closely with 'chunking'.

It is important to be aware of both conceptual structures because if children are only aware of divisions as sharing it will create barriers for them later on when they meet situations that have grouping structures.

Now look at your own word problem and decide whether it had a sharing or grouping structure. If you chose one, see if you can make up a number sentence to fit the other structure. How would you explain these different structures to your class?

This may be a good time to evaluate your subject knowledge in this area before we move on to written calculation methods. Encourage staff to use the National Centre Self-evaluation Tools.

Written calculation methods
Using your preferred method, calculate 549 ÷ 9. As you solve the question listen to your internal patter. Are you using the numbers as whole numbers (quantity value) e.g. 'How many nines in 500?' or are you using the digit value of the numbers, for example, 'nine into five won't go'. What are the implications of this on your teaching and on children's learning? Look back at your mind map. How does the grouping structure support a division calculation like this? How does this lead to chunking? Are you fully aware of the progression from mental methods to chunking? If not have a look at Primary Framework Guidance Paper for Calculation.

But... remember to look with a critical eye, as Ian Thompson (2007) has done. Available with kind permission from the ATM: Deconstructing calculation methods – Division.

Further guidance for teaching division:

- Teaching Mental Calculations Key Stage 1 and 2
- Teaching Written Calculations Key Stage 1 and 2

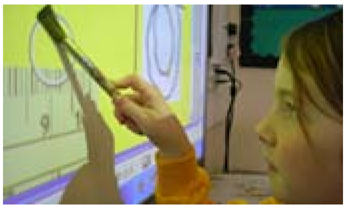
References:

- Rowland, T., Turner, F., Thwaites, A., and Huckstep, P. (2009) Developing Primary Mathematics Teaching. London. Sage

Further reading:

- Anghileri. J. (2001) Development of division strategies for Year 5 pupils in ten English schools (Updated) available online British Educational Research Journal, Vol. 27, No. 1, 2001, pp.85- . In this, the author suggests that the use of formal methods may inhibit children's understanding of mathematical problems unless it is underpinned by sound mental strategies.
- Newstead, K. , Anghileri, J. and Whitebread, D. (nd) Language problems and strategies in children's solution of division problems. This paper examines the strategies used by Year 5 and 6 children while solving a variety of written division problems.
- Haylock, D (2006) Mathematics Explained for Primary Teachers (3rd Edition). London. Sage.

Primary Magazine
Issue 27



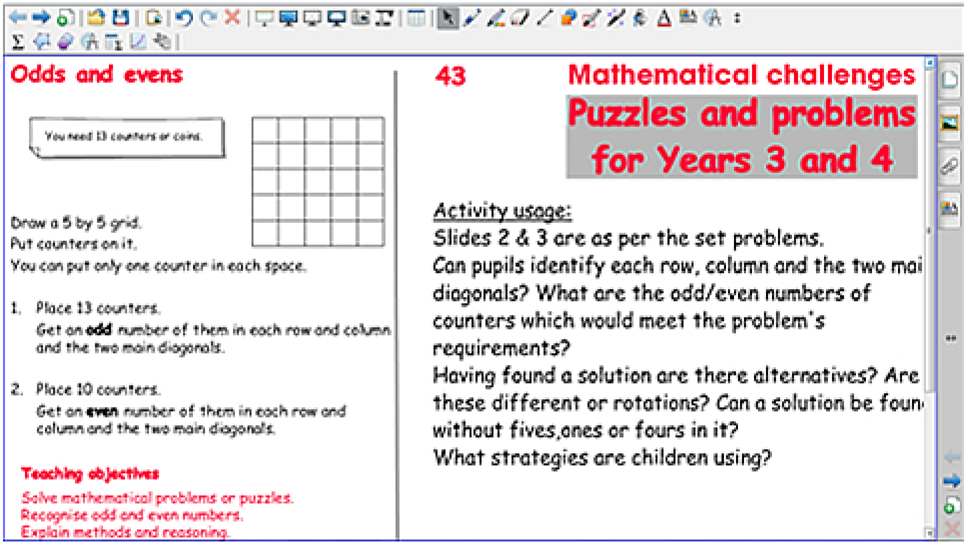
National Centre for Excellence in the Teaching of Mathematics

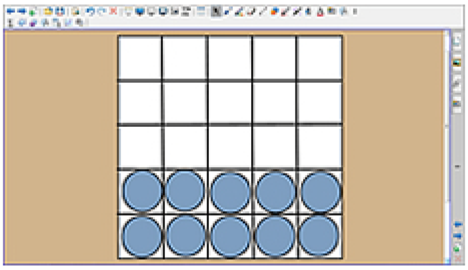
ICT in the Classroom

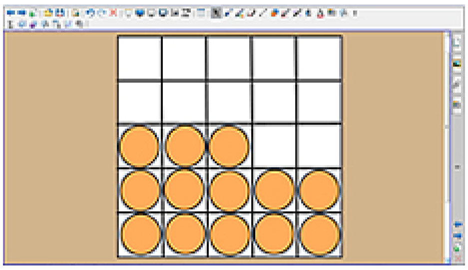
Collaborative problem solving using an interactive whiteboard
Mathematics is not always considered to be a social activity, but engaging children in collaborative problem solving can provide rich opportunities for reasoning, communicating and supporting each other's learning. An interactive whiteboard (IWB) can facilitate collaboration by giving children a shared point of focus, easily seen by the whole group. The IWB can simulate problem solving with practical equipment through the use of 'objects' that can be moved around the screen. Jottings can be made and diagrams annotated directly on to the screen. Listening in on conversations while children work collaboratively is probably the only way to accurately assess preliminary levels in reasoning and communicating.

To get started, try some puzzles from Mathematical challenges for the more able in Key Stages 1 and 2. These can be easily converted into IWB files. If you wish to use a facility to help you to do this and to locate your files without any difficulty, you could use these planning folders, which are linked to the primary framework blocks and units under the heading *Planning from the Framework*.

Activities like *Odds and evens*, below, from Year 4 Block D Unit 1, are ideal for introducing children to working together at the whiteboard. The graphics are simple.





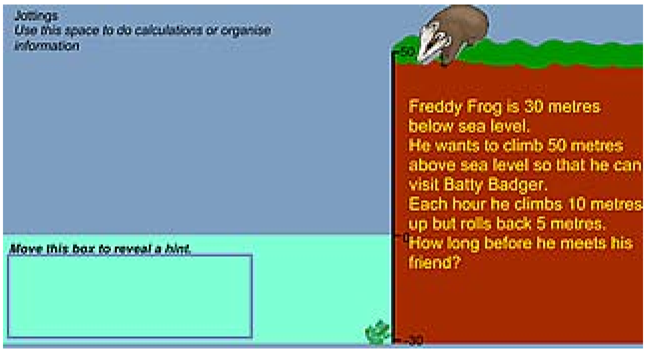


The problem can be accessed through trial and error initially, then by applying strategies and checking against a simple rule – the number of counters in a line must always be odd or even.

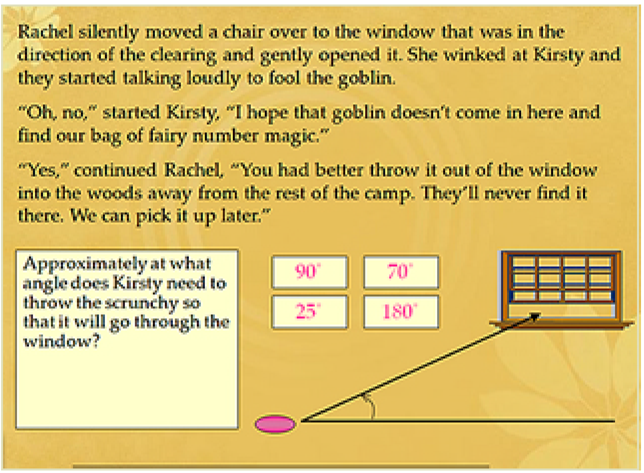
Another place to look for problems to solve collaboratively on screen is the NRICH website, where some of the problems, such as the Stage 1 puzzle Chain of Changes have an interactive feature.

There are many simulation software products intended for use in primary science that have mathematical problem solving aspects to them, for example a simulation that shows how different sizes of parachute behave, or where the children need to experiment through trial and improvement how much sun and water is needed for a plant to grow successfully at KS1 or KS2 levels.

Equally, problems such as making a screen turtle travel through a maze or creating a pentagon, can be solved as a group using a programming language.
When making your own interactive screens include moveable objects, space for jotting and calculations, and hidden clues or solutions that can be revealed by moving a panel. This problem-solving screen has a moveable frog to help children explore the problem practically.



Alternatively, presentation software such as PowerPoint can be a very effective way of presenting word problems. The children cannot move objects around the screen, but the presentation can introduce the problem in stages and slides can include buttons to show multiple choice solutions, so that the children can enter their solution and be taken to a congratulations slide, or further support with models, images or hints. Worded problems can even be put together to form an adventure story as in the extract here:



Presentation software can also be used by children to create presentations showing the steps they have used to solve a problem which they can present to the class or a wider audience at, for example, an assembly.

For more open-ended problem solving requiring real-life data, for example planning a class party within a budget, working at the IWB allows easy access to the internet and information can be copied directly on to the problem solving screen. Other benefits of using ICT include the facility that the screen is easily

reset if the group decides that they have reached a dead end, and work can be saved at different stages and stored for revisiting later or to continue investigations that go beyond a single lesson. The IWB can be both visually stimulating and support kinaesthetic exploration and learning through moving onscreen 'objects'. Using a microphone, children can also record verbal explanations with their work. The interactive whiteboard enables children to model a problem, work systematically and communicate ideas in an innovative way.

Younger children in particular may struggle with organising roles within a group, especially when only one child can interact with the board at a time. Allow thinking time for the children and keep all children involved with solving the problem by providing individual whiteboard slates and pens so that they can try out ideas on their own or in pairs before bringing them to the group. Initially, it might be necessary to structure children's groups while they are developing their speaking and listening skills, with rigid rules about taking turns at the IWB. Some groups may be able to work effectively by nominating a scribe at the board who is not allowed to write up or try out their own ideas until everyone else has had their say.

CPD and research opportunities
Try experimenting with different grouping at the IWB. Similar ability groups can be targeted with particular problems matched to their level and need. However, mixed ability groups can provide opportunities for lower ability children to work beyond expectations and meet higher ability children's need for purposeful reasoning and explanation. Also, it may be interesting to observe the impact of boys and girls working in separate groups if there is a difference in progress or attainment. Reflect on the impact on learning between children collaborating at the IWB compared to other methods, such as sharing a large sheet of paper.