Primary Magazine

Issue 3

National Centre for Excellence in the Teaching of Mathematics

Welcome to the third issue of the NCETM monthly Primary Magazine. In this issue we explore the mathematical possibilities of children's book week in our 'Focus'. Our feature, 'A little bit of history', looks at the Greek number system and our interview is with Johnny Ball, a well-known celebrity and television presenter.

## From the editor

This month's CPD opportunity in 'Something to share' focuses on effective questioning. It would be great to hear some feedback on how this went should you decide to use it.

If you are not considering this CPD, you may still be interested in reading the relevant research article, click on the grey tab 'Word doc 60kb' for a paper copy of the journal.

Please add any comments you may have to the Primary Forum.

Congratulations to Mel Clarke. She won a bronze medal in the Paralympics. We interviewed her in the last issue of the magazine. If you missed it and would like to read something about her and how mathematics has influenced her life, take a look in the archive section.

Have you thought about teaching financial capability to your children? This might be another initiative in primary education. If you have already worked in this area, it would be fantastic to hear what you have been doing in your school. Please contact us and let us know. We would love to share your work with everyone if you are happy to do that!

Financial capability includes three strands which link well with the 2006 framework for teaching mathematics, should you be following it. These strands are:

- Financial knowledge and understanding
- Financial skills and competence
- Financial responsibility.
-

PFEG (Personal Finance Education Group) has developed a programme that can be integrated into mathematics lessons for children from the foundation stage to secondary. It looks very interesting and is based on using money in various ways that are contextual and relevant to each age group. You can explore their site and ideas here.

What do you think?
We would love to hear your views and form a discussion in our Forum.

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## Starter of the month – Books

*Adapt the numbers used in these questions so that they can be used for any age range.*

There are 52 books in the book box. They need to be shared equally among five tables. How many books will there be on each table? Are there any left over? What could you do with them?

In a 16-page booklet (counting the front page as page 1), every fifth page is missing. Which other pages are missing? What if the booklet had 24 or 32 pages? What do you notice? Make some predictions for other booklets. Use scrap paper to test your predictions!

Tom stacked nine identical books on the table. Each book is 3.4cms thick. How tall is the stack of books?

I read 83 pages of my book in four days. Approximately how many pages did I read each day? Why is your answer approximate?

**See NRICH Lost Books and Book Codes for some longer mathematical book problems.**

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## A little bit of history – Greek numbers

Prior to the 4th century BC, the Greeks used a number system similar to that of the Romans:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ι | ΙΙ | ΙΙΙ | ΙΙΙΙ | Γ | ΓΙ | ΓΙΙ | ΓΙΙΙ | ΓΙΙΙΙ | Δ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

This table can be found online here.

During the 4th century, they developed a different system:

Tables adapted from those are available here.

| Arabic number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Greek number | α | β | γ | δ | ε | ϝ | ζ | η | θ |
| Arabic number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| Greek number | ι | κ | λ | μ | ν | ξ | ο | π | ϟ |
| Arabic number | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 900 |
| Greek number | ϱ | σ | τ | υ | φ | χ | ψ | ω | ϡ |

This system was closer to ours than the old one in that they created different symbols for the numbers 1 to 9, as we do. However, there the likeness stops because they did not use those to represent numbers greater than 9. They had a new set of symbols for the multiples of 10 to 90 and another set for multiples of 100 to 900. They could then use these in different combinations to make all the numbers to 999:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| ια | ιβ | ιγ | ιδ | ιε | ιϛ | ιζ | ιη | ιθ |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |

The symbols that they used were the letters from the Greek alphabet. There were only 24 of these and their number system required 27 symbols. So this meant that the Greeks had to find three extra symbols for the missing numbers of 6, 90 and 900. They used three letters which used to be in the alphabet but had been dropped because they weren't thought necessary.

You can see that the figures they used resemble the letters very closely:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Α | Β | Γ | Δ | Ε | ϛ | Ζ | Η | Θ |
| α | β | γ | δ | ε | ϛ | ζ | η | θ |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

To distinguish between the two they put an accent mark like this ʹ at the end of the number which meant "this is to be read as a number, not a word of the Greek language".

Obviously, they would have needed to count numbers above 999 and to do this they used this accent mark again but in a different place. When it was placed at the lower-left corner of the letter, it meant that the number was to be multiplied by 1000. So ͵α was 1000, ͵α α was 1001 and so on. There were other notations for these numbers at other times, like the dash in super script and placing a horizontal bar over the letters of a number.

For numbers over 10 000, symbols were place in front of or on top of **M**, a Roman symbol used to show thousands. So the Greeks could now make up all numbers to the one below a million. For higher numbers still, mathematicians such as Apollonius and Archimedes had their own methods for representing them.

The Greeks did not have a zero. It simply was not considered to be a number. Their word for zero, μηδείς, meant "not even one".

Today in Greece, the people use the same symbols that we do. However, for formal occasions the ancient symbols are often still used, just as we might use Roman numerals.

You could have some fun with your children by asking them to make up their name using Greek letters and then finding its value in numbers. If you would like to try this, here are some ideas on how to do this and an alphabet guide.

Another interesting website for Greek numbers can be found here.

Follow these links for interesting articles on Mathemapedia with a Greek flavour, although not specifically on their number system:

- Karate Mathematics
- Protasis
- What is a Number?

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## Focus on…Children's Book Week 6 – 12 October

Welcome to the Children's Book Week issue of the Primary Magazine. Children's Book Week is 6 - 12 October, 2008, and this year's theme is rhythm and rhyme. A free teachers' pack arrived in all primary schools last term, but if you can't find it, download your own.

The pack contains lots of great ideas for activities, including some mathematical poetry. However, one thing you won't find is any recommendations for mathematics story books, which is a shame because there are many fabulous books out there. An appropriate story can be used to support the introduction and development of a concept or to consolidate learning and help make the concept under consideration more accessible.


You can download a Children's Book Week poster here. I doubt the poster was designed to be a mathematical resource, but it certainly has the potential to be exactly that. Display a copy on your whiteboard and use it as a focus for number and shape questions. Try these: Which shapes have been used to make the floor? Name another shape which tessellates. Which two shapes will tessellate together? How many books can you see? Warning: These questions will cause some discussion! How many cones can you see? How many spheres?

In the Foundation Stage, try *Ten Black Dots* by Donald Crews. The rhyming text supports counting from one to ten, showing the relevant number of black dots in a variety of pictures. Children could make their own pictures using a specific number of dots.

One of my all-time favourites is *A Remainder of One* by Elinor J Pinczes. This is a fabulous story, perfectly pitched for Key Stage 1 children. The queen bug likes things tidy when her bug troops parade before her. Poor soldier Joe keeps messing things up by being a remainder of one. He tries various solutions to keep the squadron of 25 in equal lines and is a very happy bug when he solves the problem. The mathematical content is intrinsic to the story, not an add on. Although the main focus of the story is on problem solving using division and division with remainders, the patterned bugs in the illustrations mean you could easily use it for some data handling activities too. Try dividing the class by 2s, 3s, 4s and 5s. Can the children predict whether or not there will be a remainder? Will any remainder always be one? What is the largest possible remainder for each calculation?

Look at the bugs on the book cover. Count them - don't forget Joe in the middle! Can the bugs form two equal lines, including Joe? How about 3 or 4 equal lines – without leaving anyone out? How many lines must there be for Joe to be included? How many bugs in each of those lines?

How many bugs have red on their wing cases? How many bugs have zig-zags on their wing cases? How many have both red and zig-zags? Ask a question for your class to answer.

There's a lesson idea using this book here.

For Key Stage 2, books by Cindy Neuschwander have a great deal to offer. Titles such as *Sir Cumference and the First Round Table* and *Sir Cumference and the Dragon of Pi* give a clue to what each story is about. *The Number Devil* by Hans Magnus Enzensburger is a challenging mathematical adventure. After setting the scene with the first chapter, you could pick and choose relevant chapters to support your current area of learning. Although these texts do not rhyme, they are very memorable stories which will support the understanding of mathematical concepts.

You can get a brief look at the contents of these books from Amazon here – and then click the book covers.

There are many more books which can be used to support primary mathematics. See the Mathematical Stories Booklist. In fact, you can find something mathematical in almost any story if you read it with a mathematical hat on. Stories complement whatever you are doing in mathematics, whether you are following the primary framework, a commercial scheme of work or your own thing. So use a few of your favourites to help make Children's Book Week a truly cross-curricular experience!

**Five fascinating facts about books:**

- The Library of Congress, Washington DC, USA, contains 28 million books and has 532 miles of shelving. If you were driving past in a car at a constant 70 mph, it would take you just under 8 hours to pass them all.

- Use this one for a great starter. Ask questions such as: How many books would you pass in five minutes? How much room on the shelf does the average book need? How many books on a mile of shelving?

- The origin of the Latin word for book, '*liber*', comes from the Romans, who used the thin layer found between the bark and the wood (the *liber*) before the times of parchment. The English word comes from the Danish word for book, '*bog*', meaning birch tree, as the early people of Denmark wrote on birch bark.

- The smallest book in the world is called *Chemin de la Croix*. It has 119 pages. It is 5 cm (2 inches) high and 3.3 cm (1 1/3 inches) wide. The largest book in the world is an atlas which is in the British Museum. It is 1.8 metres (5 feet 10 inches) high and 1.2 metres (3 feet by 6 inches) wide.

- The first book published is thought to be the *Epic of Gilgamesh*, written at about 3 000 BC in cuneiform, an alphabet based on symbols.

**And a couple more you might like...**

In a 1631 edition of the *King James Bible* - in Exodus 20 verse 14 - the word "not" was left out. This changed the 7th commandment to read - "Thou shalt commit adultery." Most of the copies were recalled immediately and destroyed on the orders of Charles I.

The Bible, the world's best-selling book, is also the world's most shoplifted book.
A rare first edition of *Alice's Adventures in Wonderland* by Lewis Carroll raised $1.5m at auction in New York, making this the most valuable children's book ever sold. The book was Carroll's own working copy that he used to prepare the text for a simplified version for younger children.


Download the Mathematics Stories Booklist.

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## Links to the Primary Framework

**Securing number facts, relationships and calculating**
If you are following the PNS blocks and units, these suggested activities would fit in well with block D or C. It would provide a real-life context to the children's work and give purpose and meaning to their tasks. You could adapt and build on the ideas and links on this page. If you do, it would be great to hear your ideas: share them here.

The article in May's Primary Focus article stresses the importance of making mathematics real to children; you can join in an existing discussion on this issue.

**And finally...**
Can you think of other opportunities where you can link PE and mathematics? Talk to your PE co-ordinator to see if you can come up with any ideas for working together.

Encourage other members of staff to take part in the 'Olympics' – the more people you involve the greater the opportunities for more ideas and an increased scope of activities.

As a staff team, can you think of mathematics ideas that link the Olympics with 'Healthy Schools' e.g. Michael Phelps consumes 12 000 calories...



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

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## How mathematics has influenced my life: an interview with Mel Clarke

*Mel was a teaching assistant at Bignold Primary School, Norwich, but left last Christmas to prepare for the Paralympics and World Championships (6 –17 September). She hopes to return when training permits. We are pleased to announce that Mel has won a bronze medal for GB in archery. You can take a look at Mel's story and her journey to the Paralympics here.*

**What were your memories of mathematics when you were at school?**
Using lots of different equipment during sessions – especially the wooden tens and units blocks! At an early age, I enjoyed doing the 'physical maths' using the concrete objects rather than just working through books and worksheets. After that, I particularly enjoyed working out problems and looking at and making graphs.

**Have you always been a mathematician, or is it an interest that developed during your working life?**
I wouldn't say I was a mathematician but I liked maths during school. It was one of my favourite subjects especially at high school. It is now an invaluable part of my sport and also my job as a TA.

**How has mathematics impacted on your life?**
It is hugely important in my sport. I use it to calculate all sorts of things, for example scores, targets, achievements, wind speed, pressures applied through executing a shot, exact weights and forces on equipment and so on.

**How did you get to where you are today?**
Loads of hard work, practice, commitment, the desire to succeed, and plenty of support from family, friends, coach and team mates.

**What is your most entertaining mathematics anecdote?**
When my coach calculated my score incorrectly, he pulled the arrows out as he did it, so it was too late to query. Not really funny!!

**If you weren't working in a career that involved mathematics what would you be doing?**
I don't know really because I think generally maths is a part in pretty much anything, to the extent of even 'getting' to a job, putting petrol in car/distance/time etc. etc!

**And finally, if you lived in a world of cubes and spheres, which would you rather be?**
A sphere, so I could roll around wherever I wanted to!



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## Something to share
## Group work – can it work?

Before the staff meeting, ask colleagues to read the article from the NCETM Evidence Bulletin, Structured Group Work.
Also, download the DCSF Standards Unit Improving Learning in Mathematics: Challenges and Strategies (Malcolm Swan) for reference during the meeting.

**Something to discuss:**
Why do we, as teachers, plan 'independent group activities' in our mathematics lessons? Are we simply providing opportunities, out of adult earshot, for pupils to chat about last night's episode of the Simpsons or who is to be in goal once the bell rings? Or are we genuinely providing a secure, supportive setting in which pupils can draw on each others' strengths, benefiting from others' knowledge and perspective and gaining motivation from their peers?

There is a great deal of research to suggest that the latter is true, with the inevitable key to success being ensuring that the mix of children in the groups and the activities undertaken are well thought out and planned.

**In pairs or small groups, consider your current practice:**

- How often is group work part of your lessons? Daily, once or twice a week, occasionally, rarely?
- Are your groups of similar attainment who work individually through activities, or are they often of mixed attainment groups working together to solve a problem?
- How do you manage your group work? Would you consider it to be successful practice? Is there any way you could improve it?

Flag up Improving Learning in Mathematics: Challenges and Strategies. Encourage colleagues to read it as it contains a useful, very readable chapter on managing small group discussion and looks at the difference between working in a group and working as a group.

**It would be good to read this quote to colleagues:**

> *It is quite common to see learners working independently, even when they are sitting together. 'Disputational talk', in which learners simply disagree and go on to make individual decisions, is not beneficial. Neither is 'cumulative talk' in which learners build uncritically on what each other has said. For true collaborative work, learners need to develop 'exploratory talk' consisting of critical and constructive exchanges, where challenges are justified and alternative ideas are offered.*

**Together, consider these questions:**

- Can we then, as teachers, support pupils in their journey to gain a sufficient skill base to tackle appropriate group activities, with the aim of developing this 'exploratory talk'?
- What activities are already being used in our classrooms or those of our colleagues?
- How can we best model the skills required?

**Refer to the article from the NCETM Evidence Bulletin you asked them to read and together consider the extent to which pupils:**

- take turns, or whether they frequently talk over each other or interrupt;
- invite contributions from each other;
- listen to each other and respond to others' contributions ;
- ask for clarification, e.g. 'Why do you think that?
- modify what they say in light of others' comments;
- are able to pool ideas before reaching a group decision.

Clearly, all of these skills are inextricably linked to those considered by the DCSF (and many others!) as 'speaking and listening' skills. Issue 5 will explore speaking and listening skills in mathematics in more detail. The planned mathematical activities for group work will inevitably draw on these skills.

**Spend a few minutes sharing good practice**

- What activities are being used for group work among colleagues in their mathematics classrooms?
- Do they encourage the skills mentioned above?

Below are some excellent ideas for genuinely providing a secure, supportive setting in which pupils can draw on each others' strengths, benefit from others' knowledge and perspective and gain motivation from their peers.

**If you have time it would be a good idea to go through a few of these with your colleagues, working in groups.**

***'Group Cards'*** is an activity involving a group of pupils sharing information provided on cards to work towards solving a set problem or question. Rules and processes can be established as a whole class, where pupils can learn how to tackle such an activity. Often they are number-based problems, which need to be at a level to match the group's number skills. Problems can also be written to practise and consolidate directional, shape or data handling skills.
Download the sheet to go with this activity (pdf file).

***'Always, Sometimes, Never True'*** is another group activity where pupils are required to work together, justifying their thoughts and decisions, and reach a common conclusion. A set of statements have to be categorised into always, sometimes or never true. Some example statements are on the sheet to accompany this activity.
Download the sheet to go with this activity (pdf file).

**Next steps**

If as teachers we spend time planning appropriate group activities that are challenging and motivating enough to build the skills of collaborative working, and as a result minimise the 'Simpsons' chat, the question still remains as to why we are so intent on doing so. It cannot be ignored that working in groups mirrors working styles common outside the world of education; in business and

industry collaborative work is the norm rather than the exception. Our hard work then is rewarded with the knowledge that we are preparing our pupils for their future.

- Plan lessons where you have mixed attainment groups working together to solve problems and investigations.
- Monitor these to ensure all children participate.
- Try out some of the activities above