Primary Magazine
Issue 2

National Centre for Excellence in the Teaching of Mathematics

Welcome to the second issue of the NCETM Primary Magazine. In this issue we explore the mathematics of **The Olympics** and we continue our series about mathematics from ancient cultures in 'a little bit of history'. We also have some more starter ideas and a couple of new features...

From the editor

The first of these provides a CPD opportunity for mathematics subject leaders/coordinators to share with their staff during a short slot in a staff meeting or, if you wish, to extend for a whole one. In this issue the focus is group work.

It would be great to hear some feedback on how this went should you decide to use it.

Please add your comments to the Primary Forum.

In our second new feature, we will be interviewing various people about how mathematics has influenced their lives. In this issue, our interview is with Mel Clarke who competed in this year's Paralympics in Beijing (6–17 September).

- The NCETM commissioned Curee to write an evidence bulletin as part of a strategy to give teachers access to research that can inform their practice. The evidence bulletin is designed to summarise research in interesting ways and provide materials to support teachers who want to try out new methods. The bulletin chapter Structured Group Work provides advice for teachers on how to guide and model group discussion as well as suggested activities that could work well in groups.

- Recently, Professor Dylan Wiliam, deputy director at the Institute of Education, University of London, commented that: "There is no doubt that pressure, through assessment, can be very good for children: I have never been a believer in allowing children to just do what they want. But when the pressure is too great it leads to cheating, stress and disengagement among pupils, as we are witnessing in many schools today."

This came from the Civitas blog, which questions whether the KS2 results are in fact the best ever, with its title: *Faking it. 'Best ever' Key Stage 2 results - but how many children who reached Level 4 can actually read this sentence?*

It makes interesting reading. Read the full report here.

What do you think? Do your experiences bear witness to this?
We would love to hear your views and form a discussion in our forum.

- Have you explored the primary CPD module on the portal: Key ideas about making connections in mathematics? If not, why not have a look? It explores the importance of concrete to visual to abstract representations with research, ideas, planning and matters for personal professional development.

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Starter of the month – the Olympics

EYFS – say and use number names in familiar contexts
Tell the children that the gymnasts/athletes get one clap for every mark they get. Clap your hands - support children in counting the claps together. Then ask them to count quietly or silently and to shout out the last number. Confirm the number of claps and point to the number on a display such as a washing line or large number line. Repeat several times. Ask the children "When you were counting quietly, what helped you to keep track of the claps?" This could be developed so that you show the points an athlete got and ask the children to clap that number of claps.

KS1 - Ordering numbers on a number line
Using the Olympic medals chart give out cards with the number of medals won by each country. Ask children to place the numbers on a number line (vertical would prove a good visual image). Which country won more medals? Fewer medals? Which country won closest to 20 medals? How many more medals did *x* win than *y* - illustrate using < >. Extend by asking questions about the most popular number of medals. You can find information about the medals won over the years on the New York Times website.

KS2 – Ordering numbers on a number line
Give out some finish times of some Olympic athletes on card, ask one child to come and put their finish time on a number line or a washing line. Ask for children with times faster or slower. Who was fastest, slowest? How do they know? Talk about most significant digit. What was the time difference between the fastest and slowest? Choose two numbers on the washing line and use < > signs to show who was fastest/slowest.

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A little bit of history – Roman numbers

Roman numerals appear to have started out as notches on tally sticks. These continued to be used by some Italian shepherds into the 19th century. I is a notch on the stick to represent one of something, II is two, III is three and early IIII was 4. Λ or V represented a hand, and five because of the fingers; X represents two hands, one inverted, and 10 for 10 fingers. So the first Roman numerals would have looked something like this: IIIIΛIIIIXIIIIΛIIIIXII and so on, a bit like European tally marks today.

Carrying on in this way would become unmanageable for larger numbers so abbreviations were made and symbols introduced for specific numbers.

In the number IIIIΛIII, Λ implies four prior notches. It is not necessary to show them so the number would be abbreviated to ΛIII or VIII. Similarly, in IIIIΛIIIIXIIIIΛIII, the X would imply that there are nine prior notches, so the abbreviation became XΛIII. Another abbreviation was the number before each multiple of five e.g. IIII became one before five: IV; XΛIIII became one before 20: IXX.

Originally the symbols used for 50, 100 and 1 000 were independent symbols which weren't taken from the Roman alphabet: ⋔ 8 . Over the years, these symbols changed into many different forms but eventually they became L C M.

Roman Symbol	Name	Arabic Value	Derivation of Roman Figure
I	*unus*	1	A single digit.
V	*quinque*	5	Graphic representation of five fingers.
X	*decem*	10	Symbolises two hands joined together.
L	*quinquaginta*	50	Adapted from a Chalcidic sign.
C	*centum*	100	The first letter of the Roman word for one-hundred.
D	*quingenti*	500	One half of the Chalcidic sign for one-thousand,  .
M	*mille*	1 000	The first letter of the Roman word for one-thousand.

This table can be found at the website roman-britain.

The basic Roman numerals follow a pattern:

Units	I	II	III	IV	V	VI	VII	VIII	IX
Tens	X	XX	XXX	XL	L	LX	LXX	LXXX	XC
Hundreds	C	CC	CCC	CD	D	DC	DCC	DCCC	CM
Thousands	M	MM	MMM	$\overline{\text{IV}}$	$\overline{\text{V}}$	$\overline{\text{VI}}$	$\overline{\text{VII}}$	$\overline{\text{VIII}}$	$\overline{\text{IX}}$

Some digits duplicate e.g. CCC (300), others can't e.g. DD because they make a number that already has a symbol: M (1 000)

To translate any Roman numeral, partition it into separate chunks, these are found where a lower value follows a higher one. Each chunk can then be dealt with separately, and then recombined to give the whole number e.g.

CCCXLVI = CCC + XL + V + I = 300 + 40 (10 before 50) + 5 + 1 = 346
MCDLXIV = M + CD + L + X + IV = 1 000 + 400 (100 before 500) + 50 + 10 + 4 = 1464

Interesting fact from the website roman-britain**!**
It is quite a complicated task to add two Roman numerals together or even to subtract one from another, and multiplication and division are both extremely difficult. Mental arithmetic using the Roman numeric system would be beyond the capabilities of most mortals. The dreary toil of the Roman accountant is reflected in the Latin name for the occupation, *Tabularius* 'the worker of tables'. The *tabularius* was a highly skilled and thus a highly valued member of any senator's household. Though usually of the slave class, the lowest order of Roman society, he would be well looked after for his services. The Roman accountant's task would be simplified to some extent by the use of an abacus, or by utilising a complicated system of counting using both the digits and finger joints of each hand.

Roman numerals are commonly used today in numbered lists (in outline format), clock faces, pages preceding the main body of a book, chord triads in music analysis, the numbering of movie publication dates, the copyright year shown at the end of British TV programmes, successive political leaders or children with identical names, and the numbering of some annual sport events.

The roman-britain website shows Roman days of the week, months of the year, table of numerals, currency, measures: length, weight, capacity and area.

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Focus on…the Olympics

Did you know?

- The early Olympic Games were celebrated as a religious festival from 776 B.C. until 393 A.D., when the games were banned for being a pagan festival (the Olympics celebrated the Greek god Zeus). However, the modern Olympic Games started in Athens back in 1896 and have been held every four years since.
- The Olympic symbol consists of five circles or rings. These five circles stand for the five continents. The colours in the circle are green, yellow, blue, red and black.
- Extra yards were added to the running distance of the marathon, to make the total length of 26 miles and 385 yards, because Queen Alexandra of Great Britain decreed in 1908 that the marathon should end below the royal box at London's White City Stadium, which added the extra 385 yards!
- The word 'gymnasium' comes from the Greek root 'gymnos' meaning nude; the literal meaning of 'gymnasium' is 'school for naked exercise'. Athletes in the ancient Olympic Games would participate in the nude.
- Until recently, the record for the most gold medals awarded in one Olympic Games went to American swimmer Mark Spitz in 1972, with seven gold medals. The US swimming sensation Michael Phelps has now topped that at the Beijing Olympics with eight gold medals.
- Four Boeing 747 jumbo jets could have fitted, side by side, in the Olympic Stadium in Australia.
- Athletes this year produced as much as 2 million pounds (lbs) of dirty laundry.
- In the 1908 games in London, approximately 2 000 athletes participated, representing 22 countries. By the 1996 Games in Atlanta, this had risen to approximately 10 000 athletes, representing 197 countries.
- During the Athens Games in 2004, 50 000 meals were prepared daily at the Olympic Village, utilising 100 tons of food. The Olympic Village provided accommodation and free-of-charge services to 16 000 athletes and team officials.
- Three and a half billion people in 220 countries tune in to watch the Games on TV.

Why not use some of these facts to create interesting problem-solving questions for your class?

This is a fabulous opportunity to develop some **cross-curricular links**. Why not try these activities…

EYFS/KS1
Undertake a period of training for the Olympics. Include running, jumping and throwing activities. In practise sessions EYFS can talk about furthest/longest/tallest/fastest etc. KS1 can measure using non-standard units, progressing to measuring using standard units. Upper KS1 can then compare measurements - further than, etc.

More activities like this can be found on NGfL Cymru GCaD.

KS2

Set up an Olympic event, within class, within year group, within school or even across school! Undertake a period of training. Include running, jumping and throwing activities. Children can research Olympic records and measure that distance on the playground. They could then predict and measure their own efforts. Data could be stored on a graph and averages could be calculated. Comparisons could be made by more able mathematicians and shared with the rest of the group. You could then run the event. In the event, award marks for Gold, Silver and Bronze. Keep a table and work out averages.
Using decimal numbers and rounding, look at finish times for an event and ask questions.
For example:

- Who got silver?
- Who took the bronze?
- How much did first place beat second place by?
- What was the time difference between first and last place?
- How much faster would 4th place have needed to be to get the bronze medal?
- Which runner was closest to ten and a half seconds and what was the difference?
- Are we faster, fitter, stronger than we used to be? Compare current records with past achievements.

Useful web links for personal or children's research:

- Olympic facts and trivia
- Olympic Maths
- You could also do some mathematics around the medal totals by going to the New York Times Medal Count Map.

Extra challenge: Image of the month

You can download the Olympic Emblem image in a large, PDF format here.

The Olympic emblem is 5 overlapping rings:

- How many regions (shapes made by overlapping circles) are there?
- What is the least number of colours you can use to colour these regions so no adjacent regions are the same colour (assuming the rings are all black)?
- What if there were 7 rings? 51 rings?
- How many intersections (points where the rings meet) are there?
- How many intersections would there be if there were 7 rings, or 101 rings, in the same format?

(Solution: either $(n - 1) \times 2$ or $2n - 2$ if n is the number of rings)

If you enjoyed that, why not try the Olympic Magic challenge on the NRICH site, or adapt the activities from the Primary National Strategy Challenges for Able Pupils book to fit in with the Olympics. Problem numbers 1, 7 and 10 can easily be adapted. If you find more, share your suggestions with us on the Primary Forum.

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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...

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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.*

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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