



## Welcome to Issue 88 of the Secondary Magazine!

As Christmas approaches, the decorations are up, cards being sent and you are preparing for a good break. This issue should provide some articles to interest and engage towards the end of a busy term. Happy Christmas!

### Contents

#### From the editor – Developing higher-order mathematical skills

Did you think that 'painted cube' and 'max box' were tasks from the past? They feature in a new publication from the Welsh Government which is featured in this issue.

#### It's in the News!

This month's resource uses the story of six Russian 'cosmonauts' who took part in an experiment to see how they would cope with some of the demands made by a return trip to Mars, as a context to allow students to practise some proportional reasoning. In reality, they never left Moscow.

#### The Interview – Anne Haworth

Anne Haworth is the subject leader of the secondary mathematics PGCE course at the University of Manchester. She recalls counting bottles in a milk crate as an early mathematical memory – reading this interview will illustrate how that early interest developed.

#### A resource for the classroom – Transforming shapes mark 2

This issue's resource uses the Transforming shapes activity from the *Improving Learning in Mathematics* materials, revamped to suit a different group of learners.

#### 5 things to do

We identify some Christmas resources, give suggestions for CPD events to attend at Easter 2012, and encourage you to buy a Christmas tree!

#### Tales from the classroom

Are *always*, *sometimes*, *never* activities part of your classroom toolkit? This 'tale' may make you think about using these activities to stimulate higher-order thinking in learners.



## From the editor

Have you got a 'favourite' maths activity? I find it hard to identify one activity in particular, but I have a range of activities that I use regularly for certain topics, and then there are other activities that I remember fondly; that's usually because I have memories of the activity stimulating some good mathematical learning among groups of pupils. I'm quite surprised to find that some of these activities are actually the old coursework tasks that I got to know so well. 'Painted cube' and 'max box' are two such activities that appear in a recent publication from the Welsh Government, [Developing higher-order mathematical skills](#).

Alongside some less familiar activities such as '[curvy areas](#)', 'cheesecake' and 'UK coins', to name a few, these activities are the contexts in which pupils can demonstrate their higher-order mathematical skills. The document presents some work from different pupils, makes explicit the elements within the work that relate to Level 7, Level 8 and Exceptional performance grade descriptors and provides a sentence illustrating the 'way forward' (this makes me think about the high-quality feedback that pupils can receive when the task is suitably rich and challenging).

The Welsh Government has produced this publication to support teachers in preparing pupils for the new-specification GCSEs and increasing scores in the International PISA tests. The 'Implications for teachers' (page 19) advocates giving pupils more opportunities to solve problems: *'questions and tasks that are set should involve learners in collaborating to think their way through unfamiliar contexts and interesting situations, as well as consolidating their skills and knowledge in more familiar scenarios'*.

How will I use this document? There are some interesting tasks in the document; I will probably share one of these tasks at a department meeting. I'm particularly drawn to the 'curvy areas' as it would be nice to draw and the pupils' work demonstrates a wide variety of approaches to solving the problem. I'm intending to put some time aside in a future meeting for our staff to bring along some examples of pupils' work which we can compare - we can then talk about the scaffolding we provided in the classroom. I will then share pages 19 and 20 with the department as a discussion item, before suggesting that they read the rest of the document. The new GCSE is providing the necessary stimulus for further changes to teaching and teachers will welcome the support in this document – and I will enjoy revisiting some of those old coursework tasks!



## **It's in the News! Mars500 mission**

Did you hear about the [Mars500 mission](#)?

Six Russian 'cosmonauts' took part in an experiment to see how they would cope with some of the demands made by a return trip to Mars. They spent 520 days in a mock-up of a spaceship in Moscow with little contact with the outside world. This month's *It's in the News!* uses this story as a context to allow students to practise some proportional reasoning.

*It's in the News!* is a resource that explores a range of mathematical themes in a topical context. The resource is not intended to be a set of instructions but a framework which you can personalise to fit your classroom and your learners.

[Download this \*It's in the News!\* resource](#) - in PowerPoint format



## The Interview – Anne Haworth

### About you

I followed a pretty traditional educational and career route – school, university (mostly disappointing mathematically, apart from the late [Brian Griffiths](#)' topology lectures), then, despite that fact that I'd said I didn't want to be a teacher, a postgraduate teaching qualification. I loved the PGCE lectures but hated the teaching practice, though I happily taught mathematics in schools and colleges for 30 years after! I then moved on, in an utterly unplanned way and by a series of up and down and sideways steps, into teacher education. I am currently [subject leader of the PGCE Mathematics course](#) at the University of Manchester. It's a wonderful job from which I plan to retire happily later this year.

### Why mathematics?

I always liked mathematics at school and could do it most of it pretty competently, so, when it came to choosing A-levels, double mathematics, physics and chemistry seemed so much easier than subjects where you had to write at length - which, at the time, I found difficult and boring in comparison with doing mathematics and science. Or, maybe it was because when I was a young child and had just started school, I was counting the bottles of milk in the crate to find out how many there were and my brother, who was two years older but in the same class, told me I didn't have to do that, I could just multiply the number across by the number down. A perfect bit of mathematics at the right time - I understood how to get the answer I wanted and I understood why it worked.

### When have you used mathematics recently?

I am often engaged in conversations with my students about mathematics and teaching mathematics - that's what my job is all about and what makes it so fulfilling. Outside work, I use mathematics when I am sewing - I design and make most of my own clothes - which involves spatial thinking and some calculation. Every day, mathematics helps me to think logically and enables me to do all sorts of visualising, estimating and calculating.

### Some mathematics that amazes you is...

Well, it's all amazing! But here are a couple of examples that occur to me today - ask me again tomorrow for some different thoughts.

The way mathematics fits together is amazing - one bit of understanding, such as proportionality, can be applied in so many situations. It makes me very sad that many children are not given the opportunity to make such links, but instead experience mathematics as a subject in which you have to learn lots of rules.

In a recent class being taught by one of my students, the pupils were investigating the different perimeters that shapes made from five squares could have. I have done something similar many times myself, but, in this class, some pupils chose to allow squares to touch on half sides as well as on whole sides - this opened up a whole new set of results that I had never considered before and provided many opportunities for the pupils to make generalisations and prove them.

### A significant mathematics-related incident in your life was...

When I was in what is now Year 11, I found the book [Mathematician's Delight](#) by [W W Sawyer](#) on a bookcase at home (W W Sawyer had taught my father at university.) I was learning calculus at the time and Sawyer's explanation of what it was all about made perfect sense and really helped me to understand the 'why' not just the 'how'.

Later, in my first term in the sixth form, I found Cundy and Rollett's [Mathematical Models](#) in the school

library. That Christmas, our house was decorated with many wonders, including a large and beautiful [stellated icosahedron](#) in red foil. The book has been a constant source of reference ever since and has been the background to many of my best lessons.

### **The best book you have ever read was...**

Well, I am not sure what the best book I ever read was, but *Mathematician's Delight* and *Mathematical Models* rate highly. I also found Simon Singh's [Fermat's Last Theorem](#) very inspiring: he tells the wonderful tale of [Andrew Wiles' proof of Fermat's Last Theorem](#), skilfully intertwining mathematics and the human story.

And usually I read books that are not about mathematics - the intriguing [Room](#) by Emma Donoghue is a recent favourite.

### **The book I want to read when I retire is...**

[Gödel, Escher, Bach: an Eternal Golden Braid](#) by Douglas Hofstadter. I bought this book more than 20 years ago and have dipped in and out of it frequently since - but I really want to work my way through it properly. It's full of mind-bending stuff.

Another planned retirement book is [Possession](#) by A S Byatt - I have read it but I need to study it.

### **What inspired you?**

[The Association of Teachers of Mathematics \(ATM\)](#) has had a huge influence on my teaching life. I have to thank [Kath Cross](#), with whom I was fortunate enough to start teaching back in 1968, for encouraging me to join ATM and taking me to my first Easter conference in 1969 - I have been at conference every year since and Kath and I have run seminars and drunk wine together at many of them. Through ATM I have met many inspiring people from whom I have learnt so much. ATM helped me to find ways of teaching mathematics in ways that made children think and encouraged them to explore situations. By putting more into your work you get more out; the opportunities are wide and wonderful.

### **If you weren't doing this job you would...**

Well, as I plan to retire soon this is a real question! I don't suppose I will escape work entirely, but 'not get up early every day' is the first answer! Apart from that, I am certainly going to learn some mathematics for my own enjoyment, and I will also spend time painting and drawing and learning to use my [Wacom tablet](#) properly, do more sewing and other crafts, cook more meals for friends and family, read that pile of books by the side of the bed...

If I'd had to choose an alternative career, I guess it would have been in tailoring or in the restaurant trade.



## A resource for the classroom – New lamps for old?

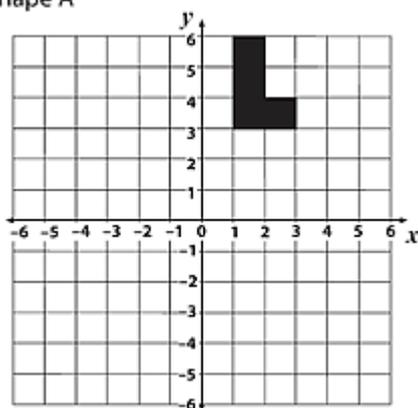
Thinking about transformations recently, I was reminded of the activity in the Improving Learning in Mathematics (Standards Unit) box. In the 'Mostly shape and space' section, activity SS7 [Transforming shapes](#) had lodged in my mind and I wanted to use it in some way with a Year 9 class. It is very easy to spend ages looking for that 'perfect activity' and not get the work-life balance right, so although this was not going to be perfect for my class, I hoped that I would be able to change it a bit and make it work (...and isn't it great that you can find so many resources in the [National STEM Centre e-library?](#)).

My class have 'done' transformations before. I don't need to tell them what a rotation, reflection or translation is (although a quick reminder of the term 'translation' would probably be necessary) but they do need some practice in 'doing' the transformations and even more practice in 'recognising' transformations. Having done the task before with another group, I know that their problem-solving skills are not refined enough to consider a task with this level of complexity so I wanted a task with more structure while retaining some of the challenge, as I did want pupils to have a chance to struggle! This is what I did:

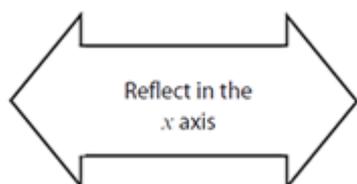
**Stage 1** – Put pupils into groups of three.

Give each group a different 'card' with a shape on it from Card Set A – page 6

Shape A



**Stage 2** – The pupils in the group use separate blank grids to complete the transformations described on each of the eight arrows from Card Set B – page 7



Each group now has their original card and eight pairs of cards comprising an arrow card and its corresponding grid.

**Stage 3** – Pupils in the group check that they agree with all the transformations that have been drawn.

**Stage 4** – Pupils leave the original shape and the transformation cards on the table. They pick up their arrow cards and move to a new table. They then try to lay down the arrow cards to identify the transformations on the grids that another group have drawn.

**Stage 5** – Possibly repeat Stage 4 several times.

**Stage 6** – Pupils return to their original table. They identify the transformation that they have found the hardest to recognise and draw an example of this in their book, commenting on why it was difficult (my pupils found the rotation about  $(2,2)$  quite difficult to recognise).

So how did it go? Well, pupils had experiences of drawing and recognising (a limited number) of transformations. I didn't have to remind them of very much at all but they didn't find the task straightforward – the challenge was high. Having moved tables once, they were used to the task and the moving was done without much fuss. I watched the groups getting quicker at identifying transformations as they moved on to the third (and fourth) tables. As the activity progressed, I included a set of pictures that I had completed prior to the lesson so that there was always a spare set (in case one group were not ready to move). Pupils reported that they had enjoyed the lesson, gained confidence and were able to identify the things they had found difficult.

An 'outstanding' lesson? I'm not sure but it had many of the features that could make it one!



## 5 things to do



The [archive issues](#) of the NCETM Secondary Magazine have some good Christmas resources. Why not try [Christmas is coming](#), which considers purchasing Christmas presents in different countries, or [Who killed Santa?](#) which gives a seasonal context for solving an important problem.



Following the theme of Christmas resources, [a thread](#) in the Maths Café from 2008 includes the *Introduction to Santa's Reindeer problem*. You will need all your wits to distinguish the jangle, neigh, snuffle and snorts!



Plan to attend the [Association of Teachers of Mathematics Easter Conference](#) which will be held at Swansea University from 2-5 April 2012. The theme for the conference is 'Enigmas', and keynote sessions include:

- Mathematics Education is not an Enigma - Doug Williams
- Teaching Styles - Barbara Ball, Kath Cross and George Knights
- Enigmas of the Mathematical Mind - Els De Geest.



Plan to attend the [Mathematical Association Easter Conference](#) at Keele University. The theme is 'Learning from others' and speakers include David Bedford (School of Computing and Mathematics, Keele University), Paul Andrews (Faculty of Education, University of Cambridge), Bob Burn, (University of Exeter) and Marcus du Sautoy (Mathematical Institute, University of Oxford).



Develop and use some functional maths. The *Time Out* [guide to buying a Christmas tree](#) encourages you to work out the height of your ceiling and think about your budget before getting needles on the carpet.



## Tales from the classroom

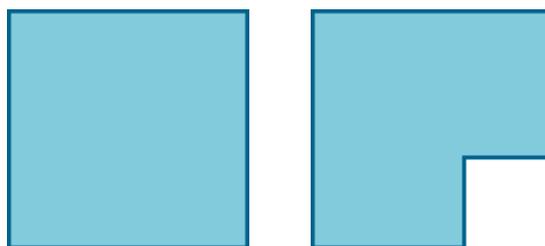
I feel a bit guilty about *always sometimes never*. It used to be that an always sometimes never (ASN) question was a frequently-used part of my toolkit. It would be rare that a day went by without me writing 'ASN' on the board but then, as so often happens, something else even more exciting came along (in this case the cause for my neglect of ASN was a new found passion for *odd one out!*) and ASN found itself relegated to an occasional and favourite outing.

Just recently however, I've been regaining my passion for *always sometimes never* after a few really interesting outings:

"Is it always, sometimes or never true that enlargement makes a shape bigger?" I asked my Year 11 group. After they'd mocked me for even considering that enlargement could mean 'gets smaller', the question opened up a discussion in one group of what we mean mathematically by 'enlargement'. "It's like when you multiply all of the sides by the same number isn't it?" was the favoured definition, and this then led to an opening to talk about what might happen with fractional scale factors with the whole class.

My Year 7 class explored the question, "When you add two numbers together, the answer is bigger than both starting numbers. Is that always, sometimes or never true?" Many of the pairs came to the conclusion that it was 'sometimes' true and many gave the reason, "Because when you add 0 it stays the same." In the quiet air of agreement, one brave girl put her hand up and said, "What happens if you add negative 1?" which took us into a whole lesson exploring negative numbers (and allowed me to use one of my favourite [It's in the News!](#) resources).

The third outing was with a Year 9 group, where I asked them, "Is it always, sometimes or never true that, when you cut a piece off a shape, both the area and perimeter decrease?" The general consensus was that it was always true, but again there was one brave one who said he thought it was sometimes true. He explained why he thought this by drawing a square on the board then wiping out the bottom corner of the square and inverting it...



...explaining that the area had decreased but the perimeter had stayed the same.

It's these moments of challenge where I feel that my students have genuinely seen deeper and understood something more than just a method, that have reawakened my passion for ASN questions. As with every change in practice, I now have to make a conscious shift to use ASN questions to 'rehabilitate' them into my toolkit, but these three recent encounters have, once again, convinced me that it's worth the effort.