



Welcome to Issue 40 of the Secondary Magazine. It's that lovely time of year when there is still some of the summer holiday left and now I'm not too tired to enjoy it. Make the most of this time to relax and recharge the batteries for the new academic year.

## Contents

### From the editor

There seems to be a strong connection between the disciplines of music and mathematics, so there may well be some mathematically-inclined promenaders bobbing away in the arena at the Royal Albert Hall this summer. What are they listening to? Are there really any connections?

### The Interview

Our interviewee in this issue is Erin Cox, a jewellery maker and designer. How does she use mathematics? Follow the link!

### Focus on...

What have 6, 28, 496, 8 128 and 33 550 336 got in common? They are all perfect numbers. Did you know that the sum of the reciprocals of the factors of a perfect number is always equal to 2? Plenty more intriguing facts like this here.

### An idea for the classroom

So how do pupils in your class learn about factors and multiples? Here is an idea to promote understanding and a resource for consolidation.

### 5 things to do

Having driven through France in August and seen the supermarkets with huge signs welcoming 'La rentrée', there is a strong emphasis on 'La rentrée' or 'Back to School' in these 5 things to do... or you could go to Notting Hill Carnival!

### Diary of a subject leader – Real issues in the life of a fictional Subject Leader

Do you find that often you are not the only adult in your classroom? What are these other people doing there? Do you make visits to other classrooms? Why? Our subject leader muses on the pros and cons of company in the classroom.

*Up2d8 Maths will be back later in the summer*



## From the editor – The Proms 2009

It's that lovely time of year when Radio 3 has a Prom concert on every night – sometimes more than one. This year there are 100 concerts – 76 Proms at the Royal Albert Hall, 19 chamber concerts at the Cadogan Hall, plus five Proms in the Park. Will you be at one or more of these? Knowing that there is often a connection between the disciplines of music and mathematics, I wondered what the attraction would be for mathematicians in the audience this year?

The amazing Ukulele Orchestra of Great Britain makes its first appearance at a Late Night Prom on [Tuesday 18 August](#) – many children in our local feeder schools have started to play the ukulele in recent years, which has given them access to a musical community of players and enabled them to participate in performances.

I know many colleagues are drawn to the very regular rhythms and sequences in music such as Purcell's Abdelazar Suite ([Tuesday 25 August](#)) or Michael Nyman's minimalist music ([Tuesday 25 August, Late Night Prom](#)).

The Prom that really drew my attention was the [Late Night Prom on Friday 21 August](#) which includes the Berg Chamber Concerto. This really is music for a mathematician! The work was composed for Schoenberg's 50th birthday so Berg used Schoenberg's name to create a 12-note tone row:



**Arnold SCHoenBErG** - (A-D-E flat-C-B-B flat-E-G) preceded by the missing four notes of the chromatic scale. He also took the opportunity to use the tone row to 'spell' out his name and that of a close friend Anton Webern. (Schoenberg, Berg and Webern were said to form the [Second Viennese School](#)).

**Anton WEBErn** - (A-E-B flat-E)

**AIBAn BErG** - (A-B-A-B flat-E-G)

Having established the 'theme' for the movement, Berg then composes five variations:

- variations one and five use the theme in its original position
- variation 2 uses the theme backwards (retrograde)
- variation 3 uses the theme upside down (inversion)
- variation 4 uses the theme upside down and backwards (retrograde inversion).

The second movement is a large palindrome also using different forms of the tone row. The turning point of the palindrome is marked by a brief appearance of the solo piano which changes the texture. The last movement is a rondo (a piece in the form ABACADA...) but the returning theme is unusually a rhythmic motif.

This may sound complicated but composers do use different motifs and forms to structure their music – these forms are highly developed and complex. All very interesting, you may say, but what does it sound like? You'll have to listen to the Late Night Prom on Friday 21 August and find out! Why not [tell us](#) what you think?



## The Interview

**Name:** Erin Cox.

**About you:** Erin designs and makes precious jewellery. She owns [a shop](#) in Exeter where she makes and sells her own jewellery and a collection of other hand-made homeware from British contemporary makers.

**The most recent use of mathematics in your job was...** I use spreadsheets everyday. Last week I had to do my VAT return which involved a lot of calculations. More interesting is the mathematics I use when I'm making jewellery, weighing, measuring, lots of converting weights (I do most of my rough work in silver – by weighing this I can then work out how much it will weigh in any other metal. Experimenting with gold is too expensive!).

**Some mathematics that amazed you is...** I was looking for ideas for a new collection and a friend talked to me about the [Möbius strip](#). When I cut it in half and then in half again I was blown away!

**Why mathematics?** I really enjoyed mathematics at primary school but then, when I went to secondary school we did lots of exercises but mathematics was never really seen as solving problems, just questions about quadratic equations. I love solving problems efficiently and that's what mathematics is for me.

**Your favourite/most significant mathematics-related anecdote is...**

When I make a chain for a necklace each link is made as a solid circle then cut and soldered to make the chain. Working out how to do this with the least number of cuts gives me a real sense of satisfaction. I was talking to a friend who's a mathematics teacher and he decided to set this as a task for a class which gave me a real buzz.

**A mathematics joke that makes you laugh is...**

This [pac-man joke](#) from boingboing.net.

**Something else that makes you laugh is...** [Family Guy](#).

**Your favourite television programme is...** I'm a real Buffy geek and a secret Trekkie.

**Your favourite ice-cream flavour is...** Cherry Garcia.

**Who inspired you?** My father inspired me to be brave and artistic, my mum to be skilful and efficient. Dave Parsons, my school music teacher inspired me to do something that I love. My career is a reflection of the influence of these three people on my life.

**If you weren't doing this job you would...** Be designing and making *something* – I have very itchy fingers!



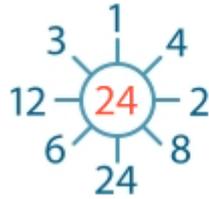
## Focus on...perfect numbers

- A perfect number is any positive integer,  $n$ , which is the sum of its factors (excluding the number itself,  $n$ ). The first perfect number is 6 because 6 has factors 1, 2, 3 and 6 and also  $6 = 1 + 2 + 3$ . The second perfect number is 28 ( $28 = 1 + 2 + 4 + 7 + 14$ ) and the third is 496 ( $496 = 1 + 2 + 4 + 8 + 16 + 31 + 62 + 124 + 248$ ).
- The first eight perfect numbers are: 6, 28, 496, 8 128, 33 550 336, 8 589 869 056, 137 438 691 328 and 2 305 843 008 139 952 128.  
[A list](#) of the first 44 perfect numbers is available online.

- The sum of the reciprocals of the factors of a perfect number is always equal to two. For example, the sum of reciprocals of 28 is:

$$\frac{1}{1} + \frac{1}{2} + \frac{1}{4} + \frac{1}{7} + \frac{1}{14} + \frac{1}{28} = 2$$

- All known perfect numbers are even, but the search to find an odd perfect number continues! You can [find out more](#), and be part of the search on the website [oddperfect.org](http://oddperfect.org).
- Euclid noticed that the first four perfect numbers are of the form  $2^{n-1}(2^n - 1)$  for  $n = 2, 3, 5$  and  $7$  and proved that, if  $2^{n-1}$  is prime then  $2^{n-1}(2^n - 1)$  will be a perfect number. This links perfect numbers with Mersenne Primes (a Mersenne prime is any prime of the form  $2^n - 1$ ). There are only 47 Mersenne Primes known, and these include the largest known prime number,  $2^{43\,112\,609} - 1$ . In the 18th century, Euler proved that Euclid's formula  $2^{n-1}(2^n - 1)$  will give all of the even perfect numbers and thus there are also 47 known perfect numbers, the largest of which (discovered in August 2008) is  $2^{43\,112\,608} \times (2^{43\,112\,609} - 1)$  with 25 956 377 digits.
- St Augustine wrote, *Six is a number perfect in itself... God created all things in six days because this number is perfect. And it would remain perfect, even if the work of six days did not exist.*
- The last perfect number to be discovered without the aid of a computer was 191561942608236107294793378084303638130997321548169216. It was found in 1911, has 54 digits and is equal to  $2^{88}(2^{89} - 1)$ . Although it's the most recent, this is not the largest perfect number to be found by hand. That honour goes to the 77-digit 14474011154664524427946373126085988481573677491474835889066354349131199152128 which was discovered in 1876.



## An idea for the classroom – factors and multiples

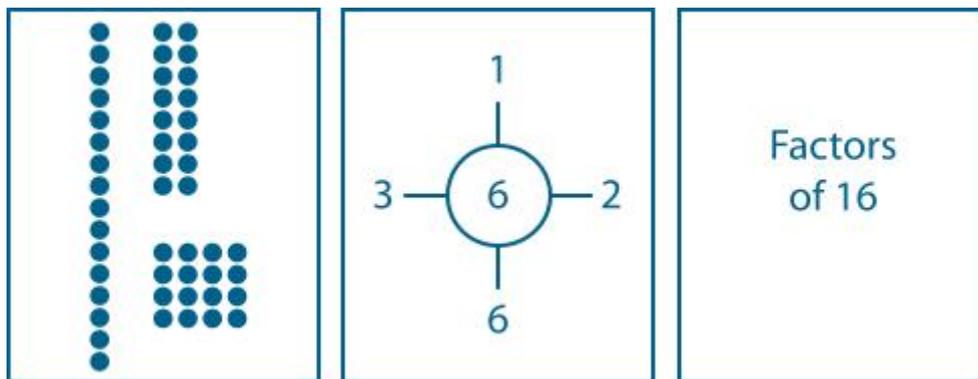
There are times in my classroom when I know that pupils have not ‘got’ something, but I’m not quite sure what it is they don’t understand. I talked in [Issue 31](#) about the difficulties pupils experience with area and perimeter: I thought they got the labels confused but they actually didn’t understand the concept. Recently, I have had a similar thought about pupil difficulties with factors and multiples – it’s not just putting the labels in the wrong place but understanding what the labels mean.

Perhaps you have always done this, but I decided, this time, to start in a practical way. Bring on the multilink! Having counted out 24 cubes (why not start big?), we put them together in as many ways as possible to make a rectangle and recorded our answers. Pupils recorded their answers and explained what they had seen. We talked about all these rectangles having the same area, we looked at different ways of writing this down and I encouraged them to adopt this way of recording the outcomes:

$$\begin{aligned} 1 \times 24 &= 24 \\ 2 \times 12 &= 24 \\ 3 \times 8 &= 24 \\ 4 \times 6 &= 24 \end{aligned}$$

We then used the language of ‘factor of 24’.

The resource offered here is a multiple representation task to consolidate pupils understanding of factors and multiples.



Pupils were given [the cards](#) to cut out and rearrange. Then they stuck down the cards to make a poster in their classroom. While this is a really useful exercise, I do think that when pupils have to make up their own sets of cards, it gives them an extra opportunity to consolidate their learning. As I was working with a group unused to doing this sort of activity, I decided to [scaffold the task](#) for them by providing some of the cards and allowing them to fill in the blanks.

Multiples of 16	16, 32, 48, 64, ...		

I hope you will find a place for this in your classroom in September – why not [tell us](#) how it went?



## 5 things to do this fortnight

- How will you introduce new members of the department to the way that you work and help to establish a shared set of beliefs about what good mathematics teaching is? The first couple of [Departmental Workshops](#) might be a good place to start for the first departmental meeting of term, particularly [Why do we teach mathematics?](#) and [Learning mathematics in my school](#) units.
- Is APP one of your priorities for next year? How will you work towards building a picture of students in your class? Teachers' TV recently showed [this programme](#) looking at the way one school in Gloucestershire is developing assessment. It might help you to make some informed choices.
- How does your scheme of work look? Is there an overview that shows which topics are being taught week by week? Are there key lessons that you want to include which set the tone for each topic? How are the process skills and/or functional skills included? Is the scheme of work a way to help everyone in the department push their comfort zone and drive forward teaching and learning? Every department has a different scheme of work which is, by necessity, personal to them. Have you all talked about how you're going to make the most of yours this year?
- What does it mean to do mathematics? Is the mathematics that we do in school real mathematics? Anne Watson claims it's not, in [an article](#) which states, *The relationship of school mathematics to adult competence is similar to the relationship between doing military drill and military leadership; between being made to eat all your spinach and becoming a chef; between being forced to practise scales and becoming a pianist.* What do you think?
- The last weekend of August is the [Notting Hill Carnival](#). Held each August Bank Holiday since 1966, it's the largest festival celebration of its kind in Europe. Every year, the streets of West London come alive, with the sounds and smells of Europe's best known street festival. Twenty miles of vibrant colourful costumes surround over 40 static sound systems, hundreds of Caribbean food stalls, over 40 000 volunteers, and over one million Notting Hill Carnival revellers.



## Diary of a subject leader

### Real issues in the life of a fictional Subject Leader

There never seems to be a day when I don't have another adult in the classroom. They may be a teaching assistant assigned to a particular class or student, but more often than not, they are there for a different reason. The additional adults can range from student teachers wishing to pick up pedagogical tips, to senior leaders undertaking formal lesson observations as part of our annual SEF. In addition, we regularly team-teach and peer-observe one another as part of our commitment to sharing good practice. I've now become so blasé about it, I hardly even notice they are there.

This practice is reciprocated, and as a middle leader, I am regularly required to conduct formal observations to measure the quality of teaching and learning. I am fully aware of the responsibility when grading lessons and the possible implications it may have for the teacher. In addition, I'm also sensitive to the fact that not all teachers feel as comfortable with this level of scrutiny as I do.

The number of staff within my department is continuing to grow and it's got to the point where I can no longer do all the required observations myself. My second in department is now going to share this workload. There is, however, a procedure and protocol that must be adhered to under the umbrella of 'professionalism'. Firstly, the reason and focus of the observation must be clearly defined beforehand. There are many factors that determine the merits of a lesson and as with good teaching, the success criteria must be shared and agreed in advance. Secondly, I believe the teacher has the right to receive verbal feedback within a reasonable period after the lesson. It not only makes the whole process more personal but provides an opportunity for discussion, especially when one or two contentious issues may need addressing.

The first couple of times, I joined in on the observations, i.e. to observe the observer. As well as the mandatory Ofsted criteria, we have been using the good lesson exemplars from [Mathematics: understanding the score](#). We hope it will ensure a high level of consistency in our judgements. I encourage the observers to assess the influence that the teacher has on the level of learning, challenge and engagement. Something that is not always easy to do.

The feedback is always interesting. There is a distinct hierarchy within schools. To have your lesson observed and judged by 'less' experienced staff may prove sensitive before you've even begun. The format is always the same: stick to the agreed focus of the observation and provide feedback on three positive aspects to every one negative... sorry, 'area for development'. It's important that the teacher gets something more than a judgement and is given advice on how improvements can be made. This is not forgetting the finer details such as body language, tone of voice, venue and timing.

It's not easy to observe and feed back to colleagues, but I'm encouraging all members of my department to gain some experience in doing so, if only to appreciate that the process can be just as daunting for both parties. There are times when we become somewhat insular in our pedagogy and need reminding that there are alternative ideas and approaches to consider, regardless of how long we've been teaching.