



Welcome to Issue 38 of the Secondary Magazine.

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Professor Marcus du Sautoy holds the [Charles Simonyi Chair for the Public Understanding of Science](#). He recently published an article in *The Guardian*, [The secret life of numbers](#), which has provided the stimulus for this article.

### Up2d8 Maths

The fortnightly Up2d8 maths resources explore a range of mathematical themes in a topical context. This Up2d8 asks students to consider their own daily diet in comparison to that of a top cyclist. Students are asked to analyse the calorific intake from particular foods consumed by an elite cyclist and to create a diet sheet of their own.

### The Interview – Jane Imrie

In this issue, the NCETM Deputy Director, Jane Imrie, talks about singing and brown bread ice cream alongside her love of mathematics.

### Focus on...the Fibonacci sequence

When the exchange rate was better, I used my knowledge of the Fibonacci sequence to do some approximate conversions of English pounds to euros most summer holidays. This summer I will have to limit my Fibonacci facts to some of those featured in this Focus on...

### An idea for the classroom – sequences

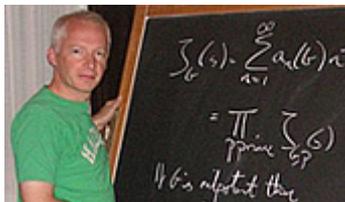
Do you get ideas from watching colleagues who teach different subjects? This resource was inspired by watching the lesson of a colleague teaching English.

### 5 things to do

Have you thought about becoming a Chartered Mathematics Teacher? Or maybe you would like to find out how a hamster can survive falling out of a plane without a parachute? Here are some answers...

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

Money, money, money? How do you think about your department's financial allocation? Is it a fantastic opportunity to do something innovative or the means to pay the photocopy bill? Find out what our subject leader thinks.



## From the editor – Marcus du Sautoy

Marcus du Sautoy is the holder of the [Charles Simonyi Chair for the Public Understanding of Science](#). This chair was founded in 1995 by a donation from Charles Simonyi, a renowned computer scientist who worked extensively with the Microsoft Corporation. Professor du Sautoy said:

*For me, science is about discovery but it is also about communication. A scientific discovery barely exists until it is communicated and brought to life in the minds of others. I am passionately dedicated to giving as many people as possible access to the exciting and beautiful world of mathematics and science that I inhabit. I want to reveal why it is such a powerful way to understand the world. A mathematically and scientifically literate society is essential given the huge role science now plays in our world.*

Schools may know Marcus du Sautoy from the Royal Institution Christmas Lectures from 2006, which were presented at the Royal Institution of Engineering and Technology under the title of [The Num8er My5teries](#). He has also written a book *The Music of the Primes* which would merit a place in any school library (alongside the books mentioned in [Issue 37](#)). The full title reads *The Music of the Primes. Why an Unsolved Problem in Mathematics Matters*. The paragraph on the cover of my copy says:

*At school, children are taught that prime numbers are divisible by themselves and the number one. What they are not taught is that primes represent the most tantalising enigma in the pursuit of human knowledge. How can one predict when the next prime number will occur? Is there a formula that could generate the primes?*

Marcus du Sautoy is not only passionately interested in particular mathematical findings (his research interests include understanding the world of symmetry using zeta functions, a classical tool from number theory) but also in the wider context of mathematics – why it is important and how people, especially school pupils, get access to those wonderful discoveries.

There was [an article](#) published in *The Guardian* some weeks ago by Marcus du Sautoy which made me think. ‘How do you spark off an interest in maths when the curriculum seems dreary?’ seemed a fairly provocative line. Is our curriculum dreary? He goes on to state:

*The teachers are required to teach a utilitarian and unadventurous curriculum that leaves them no room to explore the creative side of the subject. Indeed, most people are utterly surprised to discover that there is any creativity in mathematics.*

The article contrasts the teaching of English to the teaching of mathematics. In English, we spend time studying vocabulary and grammar but also have the opportunity to read great works of literature, whereas in mathematics we teach the grammar and vocabulary of percentage, number and algebra but do not provide access to the bigger picture of mathematics.

This is harsh criticism indeed. Is your classroom ‘utilitarian and unadventurous’? The changes that have been made to the QCA schemes of work at Key Stages 3 and 4 have positively encouraged us to create varied opportunities for our pupils. With the removal of SATs at Key Stage 3, it might be perceived that some of the pressure to cram in all that content and prepare pupils for a summative assessment has been removed. So what response have we made in our classrooms to these changes?

A couple of weeks ago, I accidentally left an old paving slab on a patch of grass in the garden. When I removed the heavy weight the grass looked dreadful, but a couple of days later I could see it turning green again and now it looks more verdant than the grass around it. Is this where we are ourselves? Are

we just turning green and looking forward to that growth spurt? What will our classrooms look like in one year or five years' time?

Why not read the article yourself and [tell us what you think?](#)



## Up2d8 maths

The fortnightly Up2d8 Maths resources explore a range of mathematical themes in a topical context. The resource is not intended to be a set of instructions but rather a framework which you can personalise to fit your classroom and your learners.

The task is centred on the Tour de France cycle race. Many sports require high levels of fitness, stamina and determination, but some might argue that the cyclists participating in the Tour de France leave others looking like mere mortals. The calorific intake over the gruelling three-week ride is testimony to the energy and power required to complete the course. This Up2d8 asks students to consider their own daily diet in comparison to that of a top cyclist. What are the best foods to consume? When is it best to consume them? Will they provide the riders with the calories required? Students are asked to analyse the calorific intake from particular foods consumed by an elite cyclist and to create a diet sheet of their own.

This resource is not year group specific and so will need to be read through and possibly adapted before use. The way in which you choose to use the resource will enable your learners to access some of the Key Processes from the Key Stage 3 Programme of Study.

[Download the Up2d8 Maths resource](#) - in PowerPoint format.



## The Interview

**Name:** Jane Imrie

**About you:** Jane is Deputy Director at the NCETM and has worked at the Centre since 2006. On graduating with a maths degree and PGCE from Durham she taught and managed mathematics in schools and FE for 23 years. In recent years she has worked on a number of projects and acted as a consultant and trainer for a variety of organisations such as LSDA, QCA, DfES and others. From September 2003 she was National Subject Lead for Mathematics in the DfES Standards Unit and led the development of a post-16 mathematics teaching and learning framework, encapsulated in the resource [Improving Learning in Mathematics](#). This work is now part of the LSIS STEM Programme of which she is joint Programme Director.

Jane is a member of the Mathematical Association (currently President and on its Council and Teaching Committee) and an observer to the NANAMIC Committee. She also serves on a number of groups focussed on current initiatives in mathematics.

**The most recent use of mathematics in your job was...** In addition to the routine budget monitoring, planning and scheduling that goes with the territory the role involves a great deal of reasoning, analysing and problem solving. Of course, the job also means there are times when we get to do maths for its own sake, which is great!

**Some mathematics that amazed you is...** I like it when there's a simple way of proving something quite complex. I also love the fact that the angles of a triangle can add up to more than 180 degrees...

**Why mathematics?** I suppose I fell into it at first because I was at a girls' school and anyone slightly interested was positively encouraged into maths and science. I had great teachers too. I wanted to teach, so the two naturally came together. I think my love of mathematics has developed through teaching.

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

One of my most significant teaching moments was when a student said to me "You know, we learn more when you don't know the answer" There was a temptation to stop preparing there and then! What it did make me realise though, was that I was perhaps doing more maths thinking than my students in the classroom and I had to devise ways of changing the balance.

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

A mathematician, a physicist, and an engineer were travelling through Scotland when they saw a black sheep through the window of the train.

"Aha," says the engineer, "I see that Scottish sheep are black."

"Hmm," says the physicist, "You mean that some Scottish sheep are black."

"No," says the mathematician, "All we know is that there is at least one sheep in Scotland, and that at least one side of that one sheep is black!"

**Something else that makes you laugh is...** All those brilliant Radio 4 programmes: [The News Quiz](#), [I'm Sorry I Haven't a Clue](#), and the various comedians who are on them.

**Your favourite television programme is...** Depends...at the moment, I quite like the American imports, [ER](#), [House](#) etc, and some of the Radio 4 spin-offs like [Have I Got News for You](#).

**Your favourite ice-cream flavour is...** brown bread

**Who inspired you?** Lots of people – my dad was a great teacher, I had great teachers at school, and I've been fortunate to observe and work with many inspirational teachers.

**If you weren't doing this job you would...** be singing (not necessarily to an audience...).



## Focus on...the Fibonacci sequence

- Each term in the Fibonacci series is generated by summing the previous two terms. The sequence begins 1, 1, 2, 3, 5, 8, 13, 21, 34...
- The Fibonacci sequence is named after the Italian mathematician [Leonardo of Pisa \(1170 – 1250\)](#), more commonly known as Fibonacci.
- Fibonacci is famed for the sequence which carries his name and also for spreading the [Hindu-Arabic numeral system](#) through Europe, mainly through his book [Liber Abaci](#) (*The Book of the Abacus* or *The Book of Calculation*) in 1202.
- Fibonacci did not discover the sequence but included it in a chapter about mathematical problems in *Liber Abaci*. This chapter also addressed the [Chinese remainder theorem](#) and [Mersenne primes](#).
- There's a [Fibonacci-inspired cartoon](#) in Bill Amend's *FoxTrot* comic series.
- A scrambled version of the first eight Fibonacci numbers (13, 3, 2, 21, 1, 1, 8, 5) appears as one of the clues left by the murdered museum curator in [The Da Vinci Code](#). In the film [Mr. Magorium's Wonder Emporium](#) (2007), Magorium hires his accountant after an interview in which he demonstrates knowledge of Fibonacci numbers.
- Wikipedia says that, in *Liber Abaci*, Fibonacci...*considers the growth of an idealised (biologically unrealistic) rabbit population, assuming that:*
  - *In the 'zeroth' month, there is one pair of rabbits (additional pairs of rabbits = 0).*
  - *In the first month, the first pair begets another pair (additional pairs of rabbits = 1).*
  - *In the second month, both pairs of rabbits have another pair, and the first pair dies (additional pairs of rabbits = 1).*
  - *In the third month, the second pair and the two new pairs have a total of three new pairs, and the older second pair dies (additional pairs of rabbits = 2).*

*The laws of this are that each pair of rabbits has 2 pairs in its lifetime, and dies.*

*Let the population at month  $n$  be  $F(n)$ . At this time, only rabbits who were alive at month  $n - 2$  are fertile and produce offspring, so  $F(n - 2)$  pairs are added to the current population of  $F(n - 1)$ . Thus the total is  $F(n) = F(n - 1) + F(n - 2)$ .*

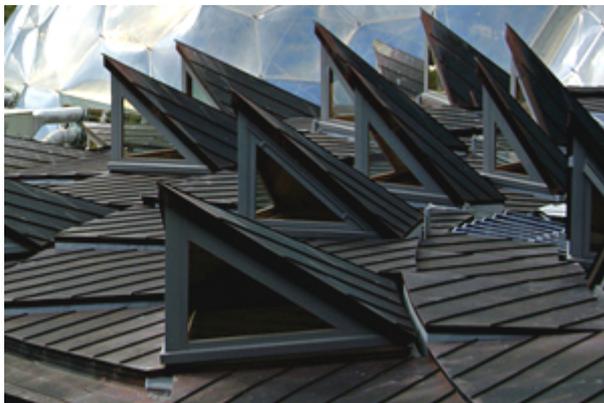
- The formula for finding the  $n$ th term of the Fibonacci Sequence:

$$\text{nth term} = \frac{1}{\sqrt{5}} \left( \left( \frac{1+\sqrt{5}}{2} \right)^n - \left( \frac{1-\sqrt{5}}{2} \right)^n \right)$$

was discovered in 1843 by [Jacques Philippe Marie Binet](#).

- To test if an integer,  $n$ , is a part of the Fibonacci series, the rule that  $n$  is a Fibonacci number if and only if  $5n^2 + 4$  or  $5n^2 - 4$  is a perfect square can be used.

- The American mathematician [R.D. Carmichael](#) gave his name to a formula which states that for  $n$  greater than 12, the  $n$ th Fibonacci number  $F(n)$  has at least one prime factor that is not a factor of any earlier Fibonacci number. The only exceptions for  $n$  up to 12 are:  
     $F(1)=1$  and  $F(2)=1$ , which have no prime factors  
     $F(6)=8$ , whose only prime factor is 2  
     $F(12)=144$ , whose only prime factors are 2 and 3
- Pairs of consecutive Fibonacci numbers appear in nature in settings as diverse as branching in trees, bumps on a pineapple and the flowering of artichoke. These natural occurrences inspired the roof of The Core, at the [Eden Project](#) in Cornwall:





## An idea for the classroom – sequences

After watching an English colleague teaching a lesson using the [Reading images](#) technique from the [Leading in Learning](#) materials, I wondered how and whether this would be transferable into a mathematics lesson?

We have been working on sequences, so I wanted to find out if my pupils really did understand what was happening. I gave them, in pairs, a copy of [this worksheet](#) and asked them to tell me what they noticed. I got a wide range of responses which included:

- continuing each of the sequences for several terms
- describing how to draw the next term in the sequence
- writing the numbers next to the pictures
- writing each of the number sequences
- working out the  $n$ th term for each sequence (\*)
- writing a title for the page
- drawing a new sequence that starts with the same two dots
- choosing a new starting pattern and drawing several new sequences.

(\*) I was delighted that some pupils, working on the red sequence, could write the  $n$ th term and put a little cross in the 'missing' space to show where the  $-1$  part of  $3n-1$  came from.

To finish, each pupil had a clean sheet of paper and suggested their own starting pattern to produce a similar image for others to read.

With pupils who are not used to working on open tasks you may want to offer some of those responses as suggestions.

Have you tried the 'reading images' technique in your classroom? Why not [tell us about it](#)?



## 5 things to do this fortnight

- Why not consider some professional development for next year? Maybe aim to become a [Chartered Mathematics Teacher](#)? The Chartered Mathematics Teacher (CMathTeach) designation reflects the balance between teaching skills (pedagogy) and mathematics knowledge that is necessary for a professional teacher to educate and inspire today's students. The CMathTeach designation can also:
  - identify you as being at the forefront of your profession
  - encapsulate standards of professional excellence across mathematics teaching in the 21st century
  - benchmark you at the same level as a Chartered Mathematician, Chartered Scientist, Chartered Engineer, Chartered Science Teacher etc.Why not [join a discussion](#) about the designation?
- What are you going to be working on next year? The [Departmental Workshops](#) are a good place to go for something to think about – maybe you'd like to work on [simultaneous equations](#) or [sequences](#).
- Do you fancy finding out about Hollywood's hippest mathematics? Or how a hamster can survive falling out of a plane without a parachute (and how they found out that this was possible?!)? If you're in the Birmingham area then why not put the [London Mathematical Society 2009 Popular Lectures](#) in your diary? The free lectures take place on 15 September but you'll need to apply for tickets by 10 September.
- What's going to happen to mathematics education in the next five years? This question was put to professors [John Mason](#) and [Anne Watson](#) at the ATM conference. View their thoughts, along with others, on the [ATM website](#).
- The [London Mela](#) on Sunday 16 August is one of the biggest celebrations of Asian culture and creativity in Europe. Mela is a Sanskrit word meaning 'to meet', used to describe all sorts of community celebrations and festivals in the Asian subcontinent. A long-standing tradition in South Asia, the Mela strengthens communities by bringing people together in a festival atmosphere where everyone can enjoy food, music and dance. The London Mela has grown to be regarded, nationally and internationally, as the most significant event of its kind. It's a truly family-friendly event, and one for all of London to enjoy.



## Diary of a subject leader

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

One of the unsung responsibilities of leading a department is the management of the capitation and resources. Sometime during the summer term, a slip of paper finds itself in my pigeonhole informing me of the year's capitation for maths. Often it is serious money.

The temptation is always to blow it on something big and extravagant, something that looks impressive which claims to transform your working life, something commercial and gimmicky. We all look at our laptops as they take what seems like forever to upload a document, convincing ourselves that an upgrade would increase the quality of learning within the classroom. We look at the cheap ballpoint pens, bought from the county suppliers, which fail to satisfy in comparison with the fibre-tipped, free-flowing ink pens displayed further down the catalogue's page. We then look at the dog-eared textbooks, on which the desires of some of our more passionate students are written. Surely it's time these were replaced?

Well, yes to all these requests and many more – in principle. Unfortunately, some requirements are more pressing than others and the capitation, although generous in comparison to some other subjects, has its limits. So how do I prioritise?

At this time of year, basic supplies are low. Exercise books, pencils and triangular spotted paper are in short supply and the shelves are bare. The essentials must be purchased. However, it is surprising how little of the department's budget they take up. I then turn to our development plan, carefully reading the intended actions for the next 12 months, trying to cost each in turn. We've been told that, once again, the school's CPD budget has been cut, so opportunities will be limited. Consequently, the department capitation may be used to free up teachers' time to plan, meet, observe and evaluate as and when necessary. Other considerations include wear and tear, one-off items, software and equipment.

It would be interesting if all subject leaders treated their department finance as they would their own. Some subject leaders are reckless in their initial spending, begging for additional money later on in the year. I am, however, by nature relatively cautious in my approach in and out of school. I like to think this is a reflection of my diligent planning beforehand, spreading the costs evenly and fairly over the course of the year. This may have something to do with it, but I also think it's just the way I am.