Welcome to Issue 47 of the Secondary Magazine. Have you written your Christmas cards yet? There are people who have got their presents wrapped too! Mine will be waiting for the end of term – I'll be too busy in the meantime reading the Secondary Magazine. Enjoy this issue!

Contents

From the editor – Engaging mathematics for all learners

Have you made some changes to your curriculum recently? We consider the Engaging mathematics for all learners project run by QCDA. Has this helped you to make mathematics engaging and relevant for your pupils?

Up2d8 Maths – Yotta Lotta Money

The fortnightly Up2d8 Maths resources explore a range of mathematical themes in a topical context. An American recently sued Bank of America in Manhattan's federal court for $1,784,000,000,000,000,000,000,000 or $1 784 billion trillion. This incomprehensibly large amount of money would make Dalton Chiscolm, the bank's customer, the world's first billion-trillionaire if the case is successful. This resource uses the idea of a huge amount of money to explore large numbers and standard form.

The Interview – Jeremy Dawson

Jeremy is a research fellow at Aston University who conducts research with psychologists into how the NHS is run. He's a mint and chocolate chip man!

Focus on…Constructions

If you are a dab hand with a pair of compasses and a straight edge, read on! Both Euclid and Gauss did substantial work on constructions which you can read about here.

An idea for the classroom – SET puzzle

Have you tried the daily SET puzzle published by the New York Times? You and your pupils will love this one.

5 things to do

Are you intrigued by the connection between mathematics and music? There is a conference for you here. Or perhaps you are preparing for the NSPCC's Number Day 2009 on 4 December?

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

In this issue, our subject leader reflects on the benefits – or otherwise – of a holiday…

From the editor – Engaging mathematics for all learners?

I think we may have mentioned before the fact that things tend to happen in threes? The newest set of coincidences started for me when I was trying to clear the piece of furniture that takes the place of a desk in my work room (actually it is our old dining table, but the cat used one of the legs as a scratching post for so long that it had to be relegated to a lesser place in the house – she doesn't touch it at all now). Anyway, during the clear out I came across the book I had been sent from QCDA last term entitled Engaging mathematics for all learners. It contains some interesting case studies from a variety of schools which all aim to use the opportunities of the new curriculum to make mathematics come alive for learners. Each case study aims to answer the questions:

- what were they trying to achieve?
- how did they organise the learning?
- how well are they achieving their aims?
- what does the school plan to do next?

The book does not give you any resources or instructions to try the project yourself but does provide all the stimulation you need to try something out for yourself.

The second event took place when I received an email from a colleague directing my attention towards the Teachers' TV series, Mathematics for All. I had a look at the secondary maths – Mathematics for All – Enrichment Tasks which is a programme about the staff at Comberton Village College, Cambridgeshire, who motivate students by using games and number puzzles in their lessons. You can see some clips of the pupils engaging with mathematics but also hear the teachers planning and reflecting upon the experiences they have had in lessons. This is related to the case study on the QCDA website.

The third event was the arrival of the latest copy of the ATM journal Mathematics Teaching 216. This is a special edition with many articles relating to the Engaging Mathematics Project. There is a welcome message from Sue Pope at QCDA and articles explaining some of the case studies. I was particularly drawn to 'Stretching the comfort zone' by Sara Santos, where girls at the Henrietta Barnett School explore the mathematics in fashion. A fashion designer had visited the school to start the project. One of the activities was to remove the sleeve of an old T-shirt, then create shape on the body of the T-shirt which you could sew that sleeve into – having an understanding of perimeter of shapes would definitely help with this activity.

So what will I do now, having had my attention drawn to this exciting QCDA project? Is mathematics in my classroom 'engaging for all learners'? I know that I need to read through some more of these case studies and think about some changes to my practice. How will you respond to this challenge? Do tell us.

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.

An American recently sued Bank of America in Manhattan's federal court for $1,784,000,000,000,000,000,000,000 or $1 784 billion trillion. This incomprehensibly large amount of money would make Dalton Chiscolm, the bank customer, the world's first billion-trillionaire if the case is successful. This resource uses the idea of a huge amount of money to explore large numbers and standard form.

The activity looks at large numbers and encourages students to use standard form as a tool to express large numbers. Students have an opportunity to explore prefixes such as mega, giga and yotta and understand their precise mathematical meaning. The activity also invites students to put a large number into context using either standard form or number prefixes

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: Jeremy Dawson

About you: I'm a Research Fellow at Aston University in Birmingham. I teach statistics and research methods to business students, but I conduct research with psychologists into how the NHS is run, and how the well-being of both staff and patients can be improved. My background is as a statistician: I did an MSc in statistics after completing a first degree in mathematics.

The most recent use of mathematics in your job was... calculating the impact of a patient safety initiative recently introduced in ten hospitals.

Some mathematics that amazed you is... probably the most staggering thing was when I first saw Euler's identity: $e^{i\pi} + 1 = 0$. I found it amazing that five of the most fundamental 'numbers' in mathematics could be connected in such a way: especially when one of them is defined as the ratio of a circle's circumference to its diameter, and another is actually imaginary!

Why mathematics? It underpins pretty much everything there is in the world, in particular science and technology, yet maintains a real beauty and significance of its own.

Your favourite/most significant mathematics-related anecdote is…
One of the great mathematicians of the 20th Century, Paul Erdős, co-wrote so many papers with other authors that mathematicians calculate their Erdős number – how many steps they are removed from co-writing with Erdős himself. So, for example, if you wrote a paper with someone who wrote together with Erdős, your Erdős number would be 2. There is a whole sub-genre of mathematics studying patterns of Erdős numbers, somewhat tongue-in-cheek! I have yet to calculate my own Erdős number...

A maths joke that makes you laugh is…
An engineer, a biologist and a mathematician sit in a coffee shop looking at an empty house across the street. They see two people go into the house, and a few minutes later three people emerge. The engineer says, "Hmm, we must have got our original measurements wrong – the house can't have been empty." The biologist says, "No, they must have reproduced while in the house!" The mathematician then speaks up, "You're both wrong. You see, if exactly one person enters the house now, it will be empty again..."

Something else that makes you laugh is… Alan Partridge and Monty Python.

Your favourite television programme is… The Wire or Outnumbered. Completely different types of programme but both brilliant!

Your favourite ice-cream flavour is… Mint and chocolate chip.

Who inspired you? Various teachers at school, my first boss, and many musicians who have used their talent to make a difference to others' lives without always realising it.

If you weren't doing this job you would… Be trying (and probably failing) to make a career as a classical musician.

Focus on...Constructions

- There are thee construction problems using only a straight edge and a pair of compasses that the ancient Greeks failed to solve, and that have since been proven to be impossible:
  - trisecting the angle
  - doubling the cube
  - squaring the circle.

- In 1796, a 19-year-old student at Göttingen University, Germany, proved that it was possible to construct a regular heptadecagon (17-sided polygon). This discovery may be the thing that tempted him away from his planned study of languages to mathematics, eventually becoming one of the greatest mathematicians of all time. His name? Carl Friedrich Gauss.

- Gauss went on to show that a regular polygon with n sides is constructible if n is the product of a power of two and one or more Fermat Primes. The proof that these were the only constructible regular polygons was given by the French mathematician Pierre Wantzel in 1837.

- Although Gauss proved that it was possible to construct a regular 17-sided polygon, there's no evidence that he actually went on to do it! The first recorded construction of a heptadecagon is by Johannes Erchinger a few years after Gauss' proof.

- Gauss concludes his 1801 work Disquisitiones Arithmeticae with the list of numbers:

  3, 4, 5, 6, 8, 10, 12, 15, 16, 17, 20, 24, 30, 32, 34, 40, 48, 51, 60, 64, 68, 80, 85, 96, 102, 120, 128, 136, 160, 170, 192, 204, 240, 255, 256, 257, 272.

  This is the list of the number of sides (under 300) of regular polygons that are constructible.

- Constructions for a regular pentagon were described by Euclid in his Elements around 300 BC. He also described how to use this construction, with one for an equilateral triangle, to construct a regular 15-sided polygon.

- Squaring a circle, that is, constructing a square with exactly the same area as a given circle using only compass and straight edge, was proved to be impossible in 1882 since it requires the construction of a square of side $\sqrt{\pi}$. This proof, finally laying to rest one of the three construction problems of antiquity, was a sub-result of the proof by the German mathematician Carl Louis Ferdinand von Lindemann that π is a transcendental number.

- The (impossible) problem of doubling the cube, that is, creating a cube with a volume twice that of the original, is also known as the Delian Problem. According to Wikipedia,

  The problem owes its name to a story concerning the citizens of Delos, who consulted the oracle at Delphi in order to learn how to defeat a plague sent by Apollo. (According to some sources however it was the citizens of Athens who consulted the oracle at Delos.) The oracle responded that they must double the size of the altar to Apollo, which was in the shape of a cube. The Delians consulted Plato who in turn gave the problem to Archytas, Eudoxus and

Secondary
Magazine

Issue 47

National Centre
for Excellence in the
Teaching of Mathematics

Menaechmus who solved the problem using mechanical means; this earned a rebuke from Plato for not solving the problem using pure geometry. However another version of the story says that all three found solutions but they were too abstract to be of practical value. In any case the story is almost certainly fictional, at least in most of the details. According to one theory, the ancient Hindus had devised similar problems involving altars, and this version spread to Greece.

An idea for the classroom

I'd like to thank Steve Humble for posting the link for this week's idea in the Maths Café thread
Distractions (which might be vaguely mathematical!). Steve does say, "So let me just warn you, click this
link and you will lose on average 5 mins every day!" – and I would like to re-iterate Steve's warning – this is
quite addictive. It is particularly perplexing and interesting while you are still learning the rules!

The puzzle below, is inspired by the daily puzzle which appears in the New York Times:
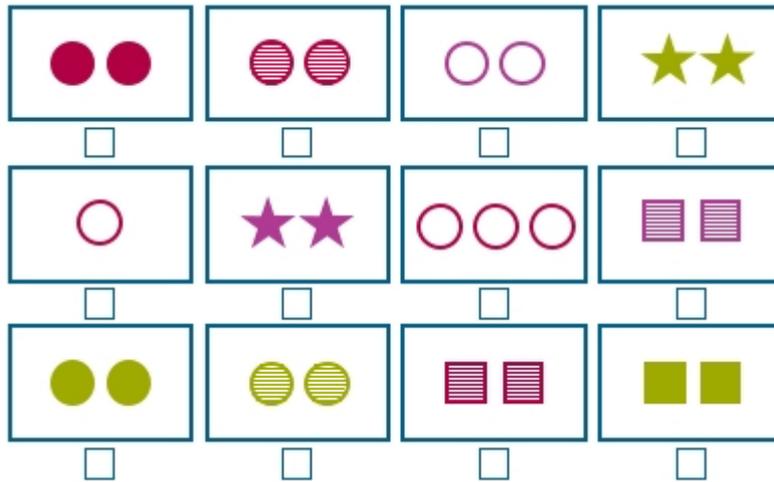
We are presented with 12 boxes containing coloured shapes. The task is to form six sets of three from
these boxes.
The boxes have four distinguishing features – colour, shape, shading and number of symbols. As the
tutorial says – "There is only one rule to make a set. A set is 3 cards in which each individual feature is
either all the same on each card or all different on each card."

If that sounds difficult, it's not when you get the hang of it. The website tells you if your sets are correct or
not, so there is an element of trial and error to start with if you don't quite understand the rules.

So how would I use this in the classroom?

This would be a great starter to have on the board as pupils come into the classroom. Once they are
familiar with the rules they can get on with this as they arrive. Steve suggests that he and his pupils used
to try to get faster times to find all six sets.

When pupils are familiar with the rules they could:
- pick one set and justify to a partner, or write down why those three cards make up a set
- explain why three cards could not be a set
- identify the process skills that they have used in finding a set
- identify strategies they are using to find sets
- make up their own 12 boxes in order to generate six sets.

If you use this puzzle – tell us how you use it in your classroom.

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5 things to do this fortnight

- Geometers study shapes and how they transform into one other, musicians create shapes and transform them. On 30 November at Gresham College, Holborn, London, there's an opportunity to explore these links further with examples that are interesting to both geometers and musicians in Wilfrid Hodges' lecture, The Geometry of Music; a second lecture exploring the links between mathematics and music, Composing with Numbers, takes place on 14 December.

- Also taking place on 30 November is a free lecture hosted by the NCETM and linked to its Engaging with Mathematics - A journey for teachers, learners and families event the following day. Values, Principles and Design in Mathematics Teaching, a free lecture by Malcolm Swan, will take place at the East Midlands Conference Centre, University of Nottingham. The lecture will begin at 7pm and there will be hands-on mathematics activities to enjoy from 6:15pm onwards.

- 4 December is the NSPCC's Number Day 2009. Once you've registered, you can download all the resources you will need, including:
  - exciting fundraising activity sheets
  - assembly plans to help you launch your school's Number Day event
  - posters so you can promote your event
  - and much more...
  The fundraising element of Number Day contains links to the citizenship and PSHE curriculum. An assembly plan explains all about the NSPCC and its work, and includes the story of how we help children overcome the damaging effects of abuse.
  There is information on the sponsorship forms as well, so pupils can see just how their hard work will make a real difference to the lives of vulnerable children.

- Teaching Mathematics 2010: A Compendium is a vibrant assortment of cutting-edge techniques presented by an exciting combination of expert teachers and renowned educationalists in the field of mathematics. It is hosted by the SSAT and takes place at Northampton Academy. Bookings close on 1 December. More details can be found by registering with the SSAT.

- Tuesday 1 December is World AIDS Day with events taking place from Bournemouth to Sheffield and beyond.

Diary of a subject leader

Real issues in the life of a fictional Subject Leader

Like so many teachers, my team was desperate for half-term. Students were tired; the newness of fresh starts for a new school year had long since dissipated into the murk of the fortnightly routine. We had fed SIMS with our effort, homework, behaviour and attainment grades. I left school at 5:35pm, having kept a grumbling premises officer at bay with a couple of chocolates for five minutes while I collected my half-term work. I was the only soul left in school and drove off sure that with less weary teachers and students there would be a better buzz in ten days' time.

What a shock it was to return. Was I really so naive as to expect a better focus and greater attention to learning just because students had the privilege of nine days' freedom. My own three children (albeit much younger –all under the age of five) were totally shattered at the end of the half term, and their mood and patience had improved with every day of the holiday. So why on the first day back was I feeling so horrible?

Unlike some schools I have taught in, our mathematics workroom tends to be a very positive place to be. Of course we have a moan, or vent our spleen from time to time, but it is always acute to an incident and quickly we are back to a positive, idea-rich atmosphere. I had taught all four lessons in the morning, and found them stressful. I was very conscious not to bite back, and to try to work with students rather than against them. Nonetheless, when I arrived in the workroom at lunchtime I was ready to drop. And it was not just me. We all seemed to have had a challenging and very disheartening morning. One teacher even suggested a ban on half terms! (Needless to say that was not welcomed with open arms.) It appeared to be a wider problem than my personal mood – good in a sense, but as a team leader, bad – I have to help these teachers look forward and keep positive.

On reflection, the mathematics timetable is KS4 lower-end heavy on Monday mornings. We have a bad mix of groups on at the same time. This could have contributed to the negative vibe. Yet even our better KS3 groups were irascible and more difficult to engage than normal. I don't remember feeling quite this way in other schools. We do teach in a context where behaviour is often acutely challenging, but beneath this acute behaviour is an underlying chronic struggle to enthuse and engage that is apparent in almost all areas of the school. Those areas of the school that have least issues with challenging behaviour tend to be those with the longest serving teachers in our school, and those where behaviour management is overt, and dare I say, coercive.

Is this 'first Monday blues' just revealing our lack of progress in inspiring students to learn, and showing that our school-wide behaviour management relies on sanction and extrinsic motivation? After a week where many, but not all, of our students would have experienced a more laissez-faire attitude, where boundaries at home were likely to be less clear, and expectation of engagement less, had our students just forgotten what was expected? It is only a conjecture, but my gut feeling is there is something in this.

For me it raises the question of how we continue to improve enthusiasm and increase engagement in mathematics. But would I do away with half terms if that was a solution...?