Secondary Magazine
Issue 21

National Centre for Excellence in the Teaching of Mathematics

Welcome to Issue 21 of the Secondary Magazine. As some of us are enjoying a long-awaited half-term break this week, you may have a chance to appreciate the fabulous colours of the autumn leaves but in between times you may find something here to interest your mathematical mind. You will notice this Issue is the first in a slightly new format – we hope you will continue to find it a stimulating and useful resource.

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From the editor – the life and work of Evariste Galois

What have being a mathematical genius and being killed in a duel got in common? Fortunately for most of our A* students at least, not much, but these events were linked in the life (and death) of Evariste Galois. Galois was born on October 25 1811, but he didn't live for very long because he was shot and killed in a duel in 1832, before he was 21. There is now a crater on the moon named after Galois and a street in Paris bearing his name in the 20th Arrondissement.

Galois had not been happy at school, his father committed suicide and he was imprisoned. His academic work was not readily understood by his teachers and he failed to gain admission to prestigious schools in France – there is a story that he got so frustrated in an interview that he threw an eraser at his interviewer. So how did such a young mathematician die in a duel? Paris after the French Revolution (1789) was a politically charged place. Galois joined a republican branch of the militia and was imprisoned twice because of his membership. In prison, he spent a lot of his time working on his mathematical theories but also found time to fall in love with the prison physician's daughter, Stephanie. The duel happened shortly after his release from prison and it's not exactly clear why he was shot in the stomach by Perscheux d'Herbinville: some say it was a feud over Stephanie and others that it was a political killing. We do know that his death started republican riots which lasted for days.

Galois made some significant contributions to group theory. His theory answered a question that mathematicians had been pondering for a while, determining when an algebraic equation can be solved by radicals. That means that when we can find the solutions for a polynomial with rational co-efficients using only rational numbers and the operations of addition, subtraction, multiplication and division and finding nth roots, we say that the equation is soluble by radicals. Galois found out that if the highest power in the equation is less than 5, then the equation could be solved using radicals, but there are equations where the highest power is 5 or higher that cannot be solved using radicals. You can also use Galois theory to prove that it is impossible to trisect an angle using only a ruler and compass.

If you are interested in reading more about this, then click here to read an article on the nrich website.

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 Gunpowder Plot was a failed attempt to assassinate the King, his family and much of the aristocracy by blowing up the Houses of Parliament during the state opening on 5 November 1605. The Remember, remember the 5th of November UP2D8 Maths uses the context of bonfire night and is ideally suited to a project leading up to the 5th of November. Students are asked to consider the siting and planning of a firework display and, in doing so, will practise proportional reasoning and loci content objectives.

Restrictions placed by the local police and Health and Safety limit the options available.

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.

Click here to download the Up2d8 maths resource - in PowerPoint format.

The Interview

Name: John Bean

About you:
John works as a consultant for pfeg (Personal Finance Education Group), an educational charity whose mission is to make sure that young people leaving school have the confidence, skills and knowledge in financial matters to take part fully in society. After gaining a degree in Computer Science from Manchester University (1974) he worked for a year in the computing industry before realising that he was an undiscovered teacher of mathematics. After doing a PGCE at Nottingham (when Ted Wragg was Professor of Education there), he taught at various schools in Nottinghamshire before moving to North Wales in 1989. After 12 years as head of mathematics at Rhyl High School he became a KS3 consultant in Doncaster and from there moved to Lincolnshire as Secondary Mathematics Adviser. (2001). He was appointed as a pfeg consultant for Central England in September 2006.

The most recent use of mathematics in your job was...
last week, when I prepared a worksheet about inflation for the mathematics department of a school in the West Midlands. The feedback from the school was very positive. Most teachers I work with really appreciate the support that my pfeg colleagues and I provide to help teachers raise awareness of financial issues in the classroom. (Did you know for instance, that although average salaries have increased by 227% over the last 25 years, the cheapest ticket at Manchester United has gone up by 1338%?)
Some mathematics that amazed you is… the power of spreadsheets. The fact that you can do so much maths, so quickly with a spreadsheet is a constant fascination to me. The formulas that you can set up and reproduce and the graphs and charts that you can create in an instant make it a fantastic tool for getting work done.

Why mathematics?
Mathematics was my favourite subject at school mainly because I had excellent teachers. I like the subject because it is very logical and hierarchical. Once you get started on the jigsaw of mathematics you can begin to see how all the pieces fit together. I'm sure the discipline of solving problems in mathematics has helped me to develop my abilities to think logically and to always question whether my solution to a problem, mathematical or otherwise, is the best one available.

Your favourite/most significant mathematics-related anecdote is…
about the most outstanding pupil I ever taught. To maintain confidentiality I'll refer to him as Harry, which is not his real name. Harry had been orphaned when quite young (his parents were both drug addicts) and was brought up by his grandparents. He suffered from dyslexia and found many school subjects hard to grasp because of his reading difficulties. He was very good at mathematics up to GCSE level however, even though his work was always untidy and showed little working. At A-level he took off like a rocket. He was the only one keen to do Further Mathematics and it wasn't timetabled, so we used to work on it together at lunchtimes. The strategy we adopted was to look through a chapter of the book, decide which questions looked interesting and race each other to get a solution. At first, I could beat him easily because I was familiar with the earlier topics, but by the spring term in Year 13 I couldn't keep up with him and our meetings consisted of him explaining his solutions to me. He had developed into a brilliant mathematician and it was very rare to find any fault in his work. He asked to be entered for as many Mathematics A-Level options as possible, and gained As in them all. He went on to study mathematics at King's College, Cambridge. For me it was a great privilege to have played my part in helping such an intelligent person along the road of mathematical discovery.

A mathematics joke that makes you laugh is…
an A-Level one which is a bit of a groaner, but it does help students to remember the integral of 1/x: What is ∫ 1/cabin. dcabin?

Something else that makes you laugh is…
I'm going to change this question to: Something that gives you fun is…. working with my consultant colleagues delivering presentations to teachers. As people who have worked in education for many years, my pfeg colleagues and I know how important it is to make our INSET presentations relevant, interesting, engaging and enjoyable. I have had some great fun delivering 'double acts' with various pfeg personnel. There is a real kindred spirit in us all. I think we all believe in what we are doing and this seems to come over in the presentations we make and the positive response teachers have to the support we can offer.

Your favourite television programme is…
Have I Got News for You, because I admire Paul Merton in particular for his quick wit and brilliant timing. I've also got into the habit of watching NCIS on Channel 5. Really though, I prefer listening to the radio, Radio 4 in particular. The pictures are so much better.

Your favourite ice-cream flavour is…
A double cone with Vanilla in one and 'Minty Choc Chip' in the other.

Who inspired you?
My parents and my teachers at primary and secondary school. I remember them all with great affection. In particular, a man called William Winters, who was my form tutor when I first went to secondary school and also an inspirational maths teacher.

If you weren't doing this job you would…
be out walking the dog or busy working in the garden. I am particularly proud of my tomatoes and cucumbers this year! However, I particularly enjoy working with teachers as a pfeg consultant and I would be very reluctant to give it up.

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Focus on trigonometry

The term trigonometry is believed to be due to Bartholomeo Pitiscus (1561-1613) and was first printed in his Trigonometria: sive de solutione triangulorum tractatus brevis et perspicuus, which was published as the final part of Abraham Scultetus' Sphaericorum libri tres methodicé conscripti et utilibus scholiis expositi (Heidelberg, 1595).

The word first appears in English in 1614 in the English translation of this work.

From an article in the ATM Magazine (click here to read it) involving the use of the image of a dot moving around the circumference of a circle Dave Hewett says:
A question I consider worth asking is What awarenesses do students need in order to engage in a meaningful way with the above? If I ignore for the moment the issue of introducing formal notation then my answer is Not a lot! There is a need to have a sense for height, symmetry and to know a bit about angles and that is nearly it. To follow the discussion about why the angle is less than 45° when the height is a half might need awareness that angles in a triangle add up to 180°. If students have these awarenesses then there is no reason why they cannot engage in such a lesson and be able to find general solutions to such trigonometric equations. The equations do not have to be stated formally but can be expressed in accessible wording using height, etc. I have worked with mixed ability Y7 classes with them creating and finding general solutions for a variety of trigonometric equations. What the image offers is direct access to trigonometry. By this I mean that relatively little knowledge of the mathematics curriculum is required in order to be able to engage successfully with this part of the curriculum.

Teachers in the Bromley Cluster reflected on the way that trigonometry was taught in their school as defined by the scheme of work and its interpretation in their own classrooms. Such was the concern for the students' understanding and learning of the topic they decided to undertake a complete review of how they might teach Trigonometry and the end product is called A Journey through Trig.
From the NCETM Access to London Mathematics Challenge community discussion 'Teaching Strategies - A Journey through Trig'.

Yesterday, I was teaching a revision class for trigonometry. All of the students could do the question I gave them but something didn't feel right to me. I asked them (on whiteboards) to draw me a triangle for which they'd use sine to work out the angle.
The triangles (and lack of) they showed me were enough to demonstrate that, although they'd got used to trigonometry (could do it) they didn't understand it.
From the NCETM Maths Café community discussion 'What is Understanding?'

Some mnemonics include:
Can Anyone Help Silly Old Hopeless Teacher On Arithmetic
Tommy On A Ship Of His Caught A Herring
Oscar Has A Hold On Angie
Oscar Had A Heap of Apples
The Old Army Colonel And His Son Often Hiccup
Studying Our Homework Can Always Help To Obtain Achievement
Some Old Hippy Caught Another Hippy Tripping On Acid

What's happening here? Is it useful in developing students' image of trigonometric functions?

An idea for the classroom

The Durham Maths Mysteries – "Putting a little mystery into mathematics"

You must have a look at these 'Maths Mysteries' downloadable from the Durham LA website (click here).

There are six mysteries covering:
- ratio and proportion
- directed numbers
- algebra
- properties of shape
- locus
- probability.

Each mystery consists of a series of a series of clue cards which pupils can use to solve a problem.

I was particularly drawn to the probability mystery which starts like this:

"Six friends enter a race. Use the following cards to determine who is most likely to win the race and with what probability. In what sequence would you expect the runners to finish the race?"

The clue cards are like this:

C is twice as likely to win as **B**.

One of the things that I like about this mystery is that there isn't a unique solution. Different groups of pupils can arrive at different solutions which could be equally correct if pupils can explain the reasons for their choice.

These activities would be helpful for you if you are trying to integrate the Key Processes into your scheme of work for Key Stage 3.

Why not try one and put a comment here to tell others how it went?

Click here to download these mysteries.

5 things to do

Form links into Europe

The NCETM is running a free, one-day conference to bring together teachers of mathematics from across Europe to share their experiences and innovations across professional development. The aim of the day is to enable teachers of mathematics from across all phases to explore their own CPD and learn from others' practice that might benefit them.

Workshops will be delivered by teachers who have been involved in NCETM-funded research projects and teachers working on CPD research with leading European organisations, including: University of Duisburg-Essen (UDE); Freudenthal Institute for Science and Mathematics Education and National Center for Mathematics Education at Göteborg University.
The date of the course is 25 March 2009. Click here to find out more.

Don't miss out

The 2009 ATM Easter Conference will be held at Swansea University from 6-9 April. The themes are: Wales, The Beach, Celtic Knots, and Unknotting Mathematics with Learners.
Click here to book your place now.

Read the new proposed GCSE subject criteria for mathematics

As recommended in the Smith Report (2004), the Government is committed to the development of a second mathematics GCSE which it anticipates would be taken up by more than half of the KS4 cohort. ACME's continued view is that the second GCSE should be accessible to at least two thirds of the KS4 cohort. This was made clear in its position statement on GCSE Mathematics published in February 2007, which linked attainment at KS3 mathematics to entry to the second mathematics GCSE.

Click here to view a PDF that outlines draft criteria for GCSE 1 (Mathematics) and GCSE 2 (Mathematical Thinking) which have been developed by ACME at short notice, as well as a letter from Ofqual to the Minister of State for Schools and Learners outlining the principles that Ofqual will apply to judge GCSE Mathematics criteria before they can be accredited for wider use.

One of its purposes will be to answer the following key question: "When and how should the new GCSEs in mathematics be rolled out nationally? Jointly or staged, and in 2010 or 2011?"

Download the Planning Tool

The planning tool enables users to:
- take words, images and resources from the Secondary Frameworks (or other) website
- store and categorise these words, images and resources as 'clippings' in the planning tool
- copy clippings or selected parts of clippings into plans
- share plans with other teachers.

Be cautious

Put antifreeze in your car. It's getting cold and you wouldn't want to be late for school!

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Diary of a subject leader

Real issues in the life of a fictional Subject Leader

Is intervention and good teaching inversely proportional, i.e. the less students learn within lessons, the greater the need to make this up in other ways?

Since the arrival of league tables and the numerous measures of attainment which have followed, schools, senior managers, governors, middle leaders, teachers and students are being subjected to increasing pressure in order to maximise results. One or two percent either way can mean the difference between celebration and commiseration for all concerned.

Having acknowledged the importance of maths and English to the school's figures, my line manager wishes me to employ 'early intervention strategies' next year to ensure success. I agree. However, we don't seem to share the view of what 'intervention' within the maths department is or should look like. I'm being put under pressure to hold more revision classes for Years 9 and 11, starting in the autumn term. My argument is that such provision is unnecessary at such an early time of the year. After all, both teachers and students run the risk of burning out too early. I'm lucky to have a stable and relatively experienced department, so I'm confident that they regularly teach to a satisfactory standard and through our departmental self-evaluations, I believe the students are receiving a 'good deal'. However, this doesn't mean that there isn't room for improvement and scope for tweaking the curriculum to suit the needs of the students.

I'm trying to encourage my staff to monitor and record the level of students' understanding within lessons. Through identifying the weaknesses, misconceptions and difficulties which arise, my staff should be in a position to amend their teaching accordingly within future lessons. These teacher assessments can be made through a range of sources, i.e. discussion, tests, written work, self-assessment, etc. This, to me, comes under the umbrella of intervention. When first discussed at a department meeting, many thought I was being idealistic in asking them to track the level of understanding of all students in every topic taught. I understood their reservations, however, I was keen to shake the assumption that the delivery of the curriculum alone is enough to ensure understanding. My job now is to provide practical yet sympathetic procedures to make this happen – and to convince the sceptics.

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