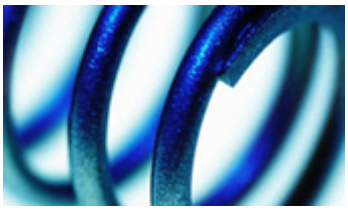
Secondary Magazine Issue 27



National Centre for Excellence in the Teaching of Mathematics

Welcome to Issue 27 of the Secondary Magazine. There is plenty of evidence that spring is now on the way: snowdrops, the odd daffodil and a feeling among Year 11 that things are starting to get serious. As half term approaches, there is a range of things in this issue to put a spring in your step – we hope you enjoy reading it.

Contents

From the editor – A number that can be divided by one and itself

Marcus du Sautoy states that *"prime numbers remain the most mysterious objects studied by mathematicians"*. Do your pupils appreciate this sense of mystery? This article may provide you with further ways to engage and stimulate such a sense of mystery among pupils in your classroom.

Up2d8 Maths

The fortnightly Up2d8 Maths resources explore a range of mathematical themes in a topical context. In this edition, we consider some of the world's richest people and how much they might value their money. Jealous? Read on.

The Interview – Paul Dobinson

Our interviewee in this issue has moved from the UK to Bermuda to work in Sales and Marketing. It does sound as if he is too busy to enjoy the sunshine!

Focus on…three

Is it buses that are supposed to come along in threes after you have been waiting for a long time? You will not have to wait to enjoy some other intriguing facts associated with the number 3.

An idea for the classroom – Maths in Work

Wouldn't it be nice to have some good quality video material to show how maths is used in the workplace? Look no further – the NCETM's *Maths in Work* is discussed here.

5 things to do

In this issue we highlight some national NCETM events alongside the new developments in Functional Mathematics and much more.

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

Are you drowning in targets? In this issue our subject leader thinks about the impact of a target on classroom practice and the role of the Head of Mathematics in achieving the school's targets.

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A number that can be divided by one and itself

Think back to the last time you taught the objectives below:

- Recognise and use multiples, factors, primes (less than 100), common factors, highest common factors and lowest common multiples in simple cases; use simple tests of divisibility.
- Use multiples, factors, common factors, highest common actors, lowest common multiples and primes; find the prime factor decomposition of a number, eg 8 000 = $2^6 \times 5^3$.
- Use the prime factor decomposition of a number.

Learning Objectives as outlined within the *Framework for Secondary Mathematics*

How did it go? Did your students show the enthusiasm, intrigue and fascination demonstrated by countless number theorists over millennia or were the majority quite content at learning definitions, facts and a tidy mathematical procedure? It would be unreasonable to expect all students to see what has perplexed a large proportion of the great mathematicians over the years, but there must be something about prime numbers.

> *Despite their apparent simplicity and fundamental character, prime numbers remain the most mysterious objects studied by mathematicians. In a subject dedicated to finding patterns and order, the primes offer the ultimate challenge. Look through a list of prime numbers, and you'll find that it's impossible to predict when the next prime will appear. The list seems chaotic, random, and offers no clues as to how to determine the next number.*
>
> *The Music of the Primes* – Marcus du Sautoy

Since Euclid (c330-275 BC) discovered primes and proved that an infinite number exist, the riddle of predicting the pattern and finding a formula remains unsolved. The fact that this accessible series of numbers has no recognisable order seems to have driven the maths community to distraction. So is it possible to engage secondary school students in a similar way?

Take two different yet related questions:

A Calculate 29 x 31
B Which two prime numbers multiplied together give 437?

Question A is straightforward enough, especially with a calculator. Question B however requires a little more thought, mainly because trial and improvement is the only way to reach the answer of 19 x 23. Can you think of another calculation where the reverse operation is so much harder to calculate? Now imagine trying to solve a similar question where the prime numbers used are three, four, 10 or 1 000 digits long? The problem is deemed so difficult that e-businesses around the world have used the above principle to encode and secure their emails, finances and communications. The sender and receiver can scramble or decipher information using codes created by the multiplication of two large prime numbers. Without primes, our PIN numbers wouldn't be as secure!

Primes have become part of people's lives whether they know it or not. So is it not our job to tell them?

Some Prime Examples

31 is prime
331 is prime
3331 is prime
33331 is prime
333331 is prime
3333331 is prime
33333331 is prime

So surely 333333331 is also prime?

Well, apparently not. 333333331 = 17 x 19607843! And who said maths was logical?

Take the prime number 73939133.
Remove any of the digits from the end and the resulting number remains prime. No other known prime can boast this fact.

A good example of the use of prime numbers in nature is the evolutionary strategy used by cicadas:

> *'Most cicadas go through a life cycle that lasts from two to five years. Some species have much longer life cycles, e.g., such as the North American genus, Magicicada, which has a number of distinct "broods" that go through either a 17-year or, in the American South, a 13-year life cycle. These long life cycles are an adaptation to predators such as the cicada killer wasp and praying mantis, as a predator could not regularly fall into synchrony with the cicadas. Both 13 and 17 are prime numbers, so while a cicada with a 15-year life cycle could be preyed upon by a predator with a three- or five-year life cycle, the 13- and 17-year cycles allow them to stop the predators falling into step.'*
>
> Cicada from Wikipedia

Prime Numbers Card Trick

> *'Remove seven cards from a 52 card pack. (It's probably best if they are consecutive and in the same suit, for example the Ace, 2, 3, 4, 5, 6 and 7 of Hearts.) Ask your assistant to check that these are ordinary cards. Now ask her to shuffle the cards, then take them back and shuffle them yourself. Secretly check the card at the bottom of the pile – let's suppose that it is the Ace of Hearts.*
> *Now tell the assistant that you have strong psychic powers, which enable you to prevent her from picking the Ace of Hearts. Give her the pile (face down) and ask her to think of any number between one and six. Suppose she picks four. Now tell her to count three cards from the top of the pack on to the bottom, one at a time, and then to turn over the top card. Predict that it won't be the Ace of Hearts, and sure enough it isn't. Ask her to place this card face up on the bottom of the pack and then repeat the exercise, counting three cards from the top on to the bottom one at a time, and turning over the fourth. She does this routine six times, and each time the card she turns over is not an Ace of Hearts. Only one card is left face down, and you tell her that, as usual, you managed to keep the selected card from appearing until the last moment. Turn is over to reveal the Ace of Hearts.*
>
> *The only requirement for this card trick is that the number of cards in the pile is a prime number…...To anyone familiar with the principle of prime factors this result may be blindingly obvious, but it makes a surprisingly effective trick, even when performed on mathematicians!'*
>
> *Why do buses come in threes?* – Rob Eastaway and Jeremy Wyndham

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.

In this issue, we use the context of two of the world's richest people to think about how they might value their money. J K Rowling, author of the Harry Potter books, is reported to earn £5 a second. Bill Gates, founder of Microsoft, was the richest person in the world for 13 years before his recent retirement. This resource invites pupils to consider the earnings of JK Rowling and Bill Gates alongside their own earning power. The question is then posed:

> *'If Bill Gates had dropped some ten dollar bills on the floor, how much money would it have to be for it to be worth him stopping what he was doing and picking up the notes?'*

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.

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The Interview

Name: Paul Dobinson

About you: Paul works in sales and marketing in Media & New Media, Bermuda. He is working towards an MBA in his spare time. He has a degree in Sports Science and an undergraduate certificate in Mathematical Sciences. Paul is a keen sports fan, particularly rugby, football, and most recently American football.

The most recent use of mathematics in your job was... to calculate the return on advertising spend based on enquiries, percentage buyers and required sales. From this I can calculate the percentage growth of sales contracts – every day, to make sure I'm hitting targets!

Some mathematics that amazed you is... the mathematics involved in Warren Buffet's preferred share purchase in Goldman Sachs – what a deal!!

Why mathematics? It's every day, everywhere and it's very logical…which I like.

Your favourite/most significant mathematics-related anecdote is… a mathematician organises a lottery in which the prize is an infinite amount of money. When the winning ticket is drawn, the mathematician starts to distribute the prize: 1 pound now, half a pound (50p) next week, a quarter of a pound (25p) the week after that...

A mathematics joke that makes you laugh is… What do you get if you divide the circumference of a jack-o-lantern by its diameter?
A: Pumpkin Pi!

Something else that makes you laugh is… someone told me that a topologist is someone who doesn't know the difference between a coffee cup and a doughnut.

Your favourite television programme is… *House*, *Supernatural*, the game on Sunday.

Your favourite ice-cream flavour is… Mint Choc Chip.

Who inspired you? Felix Dennis, Steve Jobs, Larry Page and Sergey Brin (recently), my parents and Bryan Robson when growing up.

If you weren't doing this job you would… work for myself doing something related to sales and marketing.

Focus on...3

3 was considered to be the first number by the Pythagoreans because it has a beginning, a middle and an end. Proclus also considered 3 to be the first number because it is increased more by multiplication than by addition (3 x 3 > 3 + 3).

The number 3 appears many times in religion and mythology. There were trinities of gods in Greece, Egypt and Babylon while, in Christianity, God is a trinity. Greek mythology had 3 Fates, Furies, Graces, 3x3 Muses and Paris was required to choose between 3 goddesses.

A circle can be drawn through any 3 points not on a straight line. View the construction here.

3 is the second triangle number. In 1796 Gauss proved that every integer is the sum of at most 3 triangle numbers, writing in his diary "Heureka! num= Δ + Δ + Δ."

$3 = 1! + 2!$

The volume of the smallest tetrahedron with integer edges and integer volume is 3.

3 is the only integer between e and π

In Vietnam it is bad luck to take a photograph with 3 people in it while, in many cultures, bad luck is said to come in threes.

An idea for the classroom – Maths in Work

Do your pupils struggle to understand why they study mathematics? You could work through the NCETM professional development activity available here and you could also investigate the NCETM Maths in Work web pages.

The site states:

> *'Maths in Work has been designed to offer glimpses of the real world of work via video clips, to help students appreciate not only the relevance of mathematics but its importance in every day life. The clips feature the people who are actually 'doing the job' and explain some of the maths processes that they are involved with on a daily basis. There is a brief synopsis of each clip which identifies the maths topics covered, and all clips end with the simple question, "What mathematics would be involved in the work you have just watched?" The teacher is free to approach the viewing in whatever way seems appropriate to his/her circumstances.'*

I watched the video Producing fuel from rapeseed. I chose this one because it is something I am interested in, and there is a lot of rapeseed grown around where I live – you see lots of bright yellow fields in the late spring. Choosing the right context is vital for engaging pupils – this could happen by finding a clip that relates to a particular topic or to a teaching and learning context or to an area of work that has a particular relevance.

The clip lasts about six minutes and takes the viewer through the production of the rapeseed crop and then gives details of the process used to extract the oil from the crop.

The text accompanying the clip on the website states that 'The mathematics involves percentages, decimals, proportion, and money, volume and weight.' The final frame of the clip asks the viewer 'What mathematics would be involved in the work you have just watched?' There is definitely a need for the teacher to control the use of the clip in the classroom perhaps by leading this subsequent discussion or by setting pupils an appropriate task to help them to make the mathematics explicit. For example, you could say that the rapeseed producer wants to appoint an assistant – what mathematical skills would he put on the job description?

5 things to do this fortnight

1. Do you work with other teachers in your region? Maybe you're an AST? Why not book onto the Influential Mathematics Teachers regional events? The NCETM is holding a number of regional events to help participants recognise that they are best placed to have influence in schools, and that the mathematics community and learners will benefit from their doing so. The events will give a higher profile to the work of influential teachers and the impact they can have. Find out more here.

2. Book a place at the NCETM International Research Conference: Transforming Mathematics Teaching and Learning Through CPD. This is a free, one-day conference which will bring together teachers of mathematics from across Europe to share their experiences and innovations in 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.

3. Have you tried out the Bowland Materials? *Reducing Road Accidents* might be a good one to have a go at. You can read how others are using it in the NCETM Bowland Maths Forum here.

4. Do you want to see a Functional Maths lesson? The Secondary Strategy have released some training materials for Functional Skills which includes a video sequence in which students build skills in a maths lesson and then apply the same skills in geography. The training materials are here.

5. Have a good half term break!

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Diary of a subject leader

Real issues in the life of a fictional Subject Leader

Apparently, weighing the pig doesn't necessarily make it fatter. Well I knew that, however there are times when I think that I'm the only one who does. Since the 5+ A* to C, including maths and English attainment target, became the singular most important statistic to a school, these departments are being subjected to increasing pressure to squeeze every last drop out of the 'pivotal' students. As a result, SLT are continually asking for regular updates on the students' performance. So I play the game, amending the lists which are then ping-ponged to and fro at regular fortnightly intervals, inserting the occasional question mark, highlight and word 'left' next to student names. But does this alone make a difference?

I've just returned from a meeting with the Head of English and Curriculum Deputy to identify which students are likely to achieve a grade C or more in both subjects with special consideration having been given to the borderline cases. From this discussion, the overlap of students targeted within both English and maths resulted in a list of 15 names. The success or failure of these 15 students would determine whether the school was to be seen as a beacon of good practice or a cause for concern.

As I left, I was still unclear as to how we as a maths department could ensure that the targets would be met and the identified borderline students would achieve in both subjects? Should these students receive preferential intervention above that of their peers? And what would this intervention look like? And shouldn't I be making sure that all students get good quality teaching in the classroom rather than relying on interventions?

I was adamant however that whatever strategies were to be implemented, they had to make a difference. Some would be applicable to all students, for example the tier of entry, access to revision classes, availability of resources, understanding of the curriculum and progression between grades. But this wasn't going to be enough. The new list of targeted students required something special and the overall responsibility had been given to both the Head of English and Head of Maths.

After much discussion and deliberation, the planned strategies fell into two camps, i.e. long and short term. The introduction of Process Skills within the renewed Programme of Study, together with our increasing understanding of Functional Skills, focussed our attention on looking for commonalities between the two contrasting subject areas. This was to include ways in which transferable skills could be collaboratively developed and applied by the students. Unfortunately, this was believed to be too ambitious for our Year 11s this late on in the year. The employed short-term strategies are to consist of increased dialogue with parents, mentoring and assistance with revision. It is important for me to ensure all students get access to the same level of support. However, in this target-driven environment some are now deemed more equal than others.