Secondary Magazine Issue 24

National Centre for Excellence in the Teaching of Mathematics

Welcome to Issue 24 of the Secondary Magazine. Another term is over and we have some well-earned rest before the New Year arrives – we hope this issue gives you some interesting reading for the festive period. The Secondary Magazine Team would like to take this opportunity to send you our best wishes for Christmas and the New Year.

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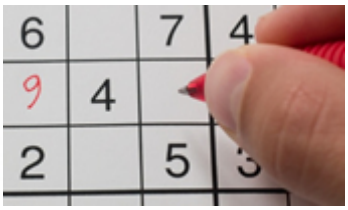

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Crosswords and puzzles

Good weekend? It's taken me some time to realise that as I formulate a reply to this regular Monday morning question, the 'yes' or 'not bad' is actually the answer to a very different question which is running around in my head: 'Did you finish the cryptic crossword on Saturday?' and could be extended to 'And what about the even more cryptic one in the magazine?'
I think my husband recognises the signs as I casually skim through the paper on Saturday morning before turning to the inside back page, and fold it to leave the crossword ready for the afternoon.

It was with considerable delight, as I sat down last weekend, that I realised there was a set of clues linked by a mathematical theme:

1 Figure as doctor to the sick swallowing a sad tear (13)
13 Figure reportedly of destruction and confusion (9)
16 Figure or letter (Greek) for doctor (American) (7)
26 Standard entirely of wood covering old Greek ship's returning figure (13
20 Pass 'ecclesia' to make such as 26 of 1, or 13 or 16 of 26 (7,5)

Answers at the bottom of the page. Don't cheat – have a go at solving these first. If you want a hint – try thinking about quadrilaterals … It's quite unusual to get such a specific link between crosswords and mathematics, so it may be more useful to consider what it is that attracts me and others to puzzles in general and crosswords in particular?

There is something very satisfying about solving a problem: we do this all the time in our professional life and I'm sure that a mixture of good problem solving and good organisational abilities makes my personal life run that much more smoothly.
If I think about the problems I pose for learners in the classroom, I take the following things into consideration:

- problems need to be accessible
- pupils should expect to be able to solve the problem but prepared to encounter some difficulties along the way
- there should be something that every learner can start by doing
- problems need to be pitched at the right level to keep pupils at their learning edge
- pupils need appropriate scaffolding
- there is more than one way to solve the problem.

Crosswords provide me with most of these challenges:

- there are always some easy clues which I can start with, usually the anagrams followed by the ones where the solution is contained within the letters of the clue
- I know that I can usually finish the crossword, but not immediately
- when there are some letters in place, I can use these as prompts for some of the more difficult puzzles
- some clues are solved by guessing the word and then working out why it fits the clue!

The importance statement for mathematics in the QCA Programme of Study states that:

> *'Pupils who are functional in mathematics, are able to think independently in applied and abstract ways, and can reason, solve problems… Mathematics has developed over time as a means of solving problems and also for its own sake.'*

As mathematicians, we are well-equipped to solve problems and perhaps enjoy finding recreational puzzles to solve to keep those 'little grey cells' exercised. Happy puzzling.

Answers (I think!)

1 quadrilateral
13 rectangle
16 rhombus
26 parallelogram
20 special cases

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 current financial climate raises a number of questions about the use of loans and the ways in which customers can get the best deal from the banks. This Up2d8 Maths resource *Credit where credit's due* explores the interest rates involved in taking out a loan to buy a scooter. At its simplest, students will need to make decisions about the best way to borrow the necessary amount for the scooter, but this resource can also be used as a context to give students the opportunity to access some of the challenging mathematics involved in calculating APR.

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: Mark King

About you: Mark is Site Quality Manager at a global pharmaceutical company, responsible for a department of over 60 people. After leaving school he completed a degree in Applied Biology and then joined his current employer where he started working in the laboratory as a technician. He is also one the company Qualified Persons. It is a legal requirement that each batch of product is certified by a Qualified Person before it can be released to market.

The most recent use of mathematics in your job was... checking active ingredient input calculations to ensure that one of our tablet products would be manufactured at the correct strength. This requires consideration of the potency of the input material, batch size and tablet weight. As the maximum batch size for some products can be up to 6 million tablets, it is vital this calculation is correct.

Some mathematics that amazed you is... the calculations used to calculate the speed of light (1 079 252 848 km/h) – now that is seriously quick!

Why mathematics? It is everywhere and we use it in all aspects of our lives from its integral place in my work, to checking the impact of those increasing mortgage rates.

Your favourite/most significant mathematics-related anecdote is… my dad (who is a retired maths teacher) told me about one of his pupils who, as part of an exam question, was asked to "show your working". This pupil just wrote the answer and drew a picture of himself sat at his desk in the exam room! In his mind, showing he was "working". This has taught me always to check people understand what I am asking them to do and never to make assumptions.

A mathematics joke that makes you laugh is… actually there is nothing funny about maths it is a very serious subject - but what about:
Lumberjacks make good musicians because of their natural logarithms
or
Old mathematicians never die; they just lose some of their functions.

Something else that makes you laugh is… the TV programme *Have I got news for you?* and watching Alan Carr.

Your favourite television programme is… *Top Gear.*

Your favourite ice-cream flavour is… chocolate of course.

Who inspired you? David Attenborough, amazing guy.

If you weren't doing this job you would… be a vet.

Focus on...quadrilaterals

Wolfram MathWorld defines a quadrilateral as *a four-sided polygon. If not explicitly stated, all four polygon vertices are generally taken to lie in a plane. (If the points do not lie in a plane, the quadrilateral is called a skew quadrilateral.) There are three topological types of quadrilaterals (Wenninger 1983, p50): convex quadrilaterals, concave quadrilaterals, and crossed quadrilaterals (or butterflies, or bow-ties).*

The area of a cyclic quadrilateral is the maximum possible area that can be enclosed within a quadrilateral with the given side lengths.
Brahmagupta's formula (Brahmagupta was an Indian mathematician who lived from 598–668) gives the area of a cyclic quadrilateral with side lengths *a*, *b*, *c* and *d*

Area = $\sqrt{(s-a)(s-b)(s-c)(s-d)}$

where *s* is half of the perimeter of the quadrilateral (sometimes called the semiperimeter)

Van Aubel's Theorem states that if, for any given quadrilateral, a square is constructed on each side and the centre of each square is joined to make a second quadrilateral, then the diagonals of this quadrilateral will always be perpendicular to each other. This can be seen in this demonstration.

A special case of Van Aubel's Theorem is Thébault's Problem 1, in which the original quadrilateral is a parallelogram and the second quadrilateral constructed from the centres of the squares, is always a square as is illustrated here.

All convex and concave quadrilaterals will tessellate.

Is a square a rectangle? Yes, but it's a special rectangle. So shouldn't we be more careful about what we call a non-special rectangle?

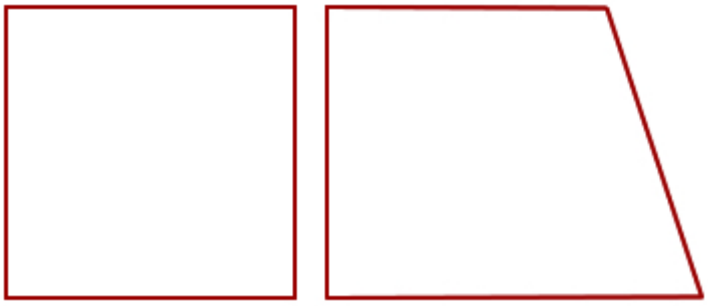
From the Mathemapedia entry Oblong or Rectangle?

…The girls were still struggling with the idea that the kite sometimes looked like a rhombus. A resolution to this paradox would have been to incorporate rhombuses into their definition of kites i.e. to see rhombuses as special types of kites. It seemed though that their definitions were close to the prototypical visually-based component of the figural concept. The pedagogical challenge here was clearly to find a means of helping the girls to focus on defining the figure in terms of its properties.

From Using an interactive whiteboard to facilitate pupil understanding of quadrilateral definitions

Try starting a lesson with this idea from the QIA document Teaching and Learning Functional Mathematics:

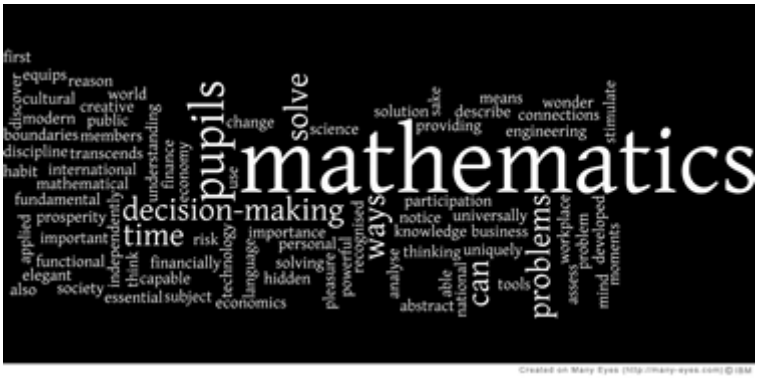
What is the same and what is different about these shapes?



Learners are given two diagrams or scenarios that are based on similar contexts. They have to contrast and compare them. They do this by dividing a large sheet of paper into two columns and heading one column 'Same' and the other column 'Different'. They write down every detail they can find that is the same or different about the two diagrams or scenarios, whether it is trivial or fundamental. They then compare their lists with other groups and add properties that they have missed. This can be used as an introduction to a new topic or idea to see what learners notice for themselves or to assess what prior learning they have.

An idea for the classroom – Wordles

A colleague who teaches humanities, recently introduced me to the amazing website which produces stunning visual displays from text. I copied and pasted the Importance statement from the QCA Scheme of work and produced this image:

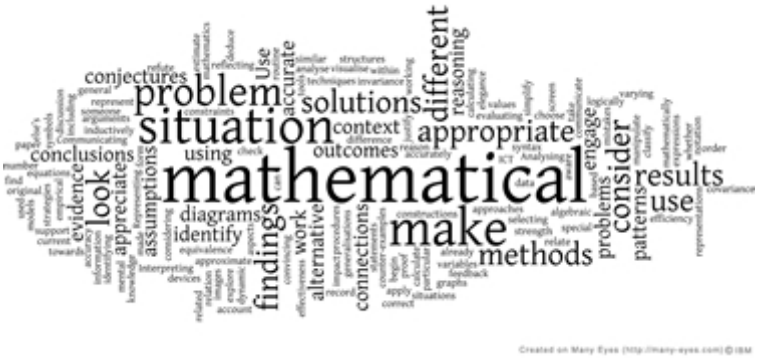


The website is really easy to use. Click here to view the website.

First you need to register, which is quick and easy. Then you can upload your own text and make some choices about how the image looks. The website decides on the size of the words: the more times the word features in the text, the bigger it is on the image.

For the 'Importance statement' it is interesting to see the words which are largest on the page and the prominence they have in our educational thinking.

Having 'got going' with the importance statement, I thought that the Key Processes deserved similar treatment:



Again, I was interested to see the relative size of the various words and asked myself if I prioritised in a similar way in my classroom?

So what will I do next?
I'm going to:

- make some posters to put up in the mathematics department

- make some postcards of these and similar images to add to the selection that we send home as rewards for good work
- use them as a plenary focus in lessons to focus pupils on different aspects of mathematics (and stick them in pupil exercise books)
- think about some other texts to input (the features of satisfactory and good teaching from the back of the recent Ofsted report Mathematics: understanding the score will be my next job)

What will **you** do? Please tell us!

5 things to do this fortnight

Get inspired

Maths Inspiration is a chance for sixth formers and Year 11s to experience the UK's most inspiring maths speakers live, in big venues, presenting mathematics in the context of real-world and often fun situations. They prefer to call their events 'shows' rather than 'lectures', because they are lively, professionally run and entertaining. The event format is almost always of three speakers giving interactive talks on a diverse range of topics. Typically there will be one pure mathematician, one statistician and one engineer in the line-up, and there is always a lively Q&A session at the end of each show. The content is ideal for sixth formers and for interested Year 11s (many of the ideas will be beyond most Year 10s).

Upload or download some resources

The **Times Educational Supplement** (TES) invites teachers to upload their favourite resources for others to share. Alternatively, check out the hundreds of downloaded resources ranging across all key stages.

Embed ICT in KS3/4 mathematics

This DCSF-funded project potentially supports one 'local' provider to spend some time in your school helping your department develop its effective use of ICT within mathematics. The focus, date(s) and length of time of your training are to be agreed between yourself and the local provider, with whom you will liaise directly.

The constraints on the local provider include the limited time they have available for this support – so early contact of the named person is recommended. Also, of course, the ICT skills of these local leaders differ from person to person – please contact them direct to see whether their skills and your needs match!

Make mathematics come alive

Watch engaging and entertaining presenter-led clips that complement and support traditional lessons by bringing the real world into the classroom, encouraging mathematics investigation and discovery. Real-life scenarios, or situations featured in typical mathematics questions, provide useful and interesting stimuli and demonstrate the importance and application of mathematical skills.

Don't forget…

…to relax and enjoy your holiday!

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Diary of a subject leader

Real issues in the life of a fictional Subject Leader

The Year 11 mocks have just finished and I'm sitting here scratching my head. Set 1 have exceeded all expectation, out-performing their target grades and looking on course to achieving a record number of A/A*'s. Set 3, our intervention group, haven't done too badly either, with the majority no more than a grade below target (as expected with it only being their mock). The problem lies with Set 2. All groups were originally placed in sets based primarily upon their SATs results. Consequently, we naturally expected decreasing grades as the sets went down the year. However, this was not the case with this particular group. Without question, they have underachieved.

The teacher in charge of Set 2 is one of our more established members of the department. She may not be the most dynamic, yet she has always been a stable and reliable teacher whom I would trust to do the job well. Despite having taken on this group only this year, it is now twelve weeks into term. Surely there had been enough time for her to establish procedures and expectations? So what has happened with this class and what are the next steps to take? And is this an isolated incident?

After discussing the results with her, I left feeling somewhat heavy-hearted. She was taking little responsibility for the attitude of the students. She informed me that their work ethic was poor, they were disorganised and uncooperative. At no point did she reflect upon her own teaching or offer proactive strategies for turning the group around; to her they were a lost cause.

I'm a great believer that the student is a teacher's greatest critic. As a result, I collared a few in the corridor and asked general questions about their mathematics lessons. Needless to say their responses were as expected. Relations between teacher and student had clearly broken down and as a result, so had the confidence of both parties in each other. With only six months left until their terminal exam, was the situation redeemable?

Putting my diplomatic hat on, we met again to discuss intervention strategies that she could employ to raise attainment. With the risk of patronising an experienced teacher, the steps suggested were somewhat elementary and would have been perfectly applicable had they had been said to an NQT. I try to promote a dynamic attitude within my department, with the philosophy that teachers should continually reflect upon their own practice. I encourage experimentation, as I believe that if you don't push the boundaries, you can't possibly develop. Although we compiled a set of procedural actions that she was to employ within lessons, it was this outlook that I wanted her to take away from the meeting. I think that sometimes we, as teachers, forget that a small change in behaviour from us can have a great effect on the behaviour of students, hopefully for the better.

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