



Welcome to Issue 31 of the Secondary Magazine. It really doesn't matter if you have eaten all those Easter eggs already because it is only your brain that needs to be in good form to digest this issue – you have the rest of the holiday to get fit.

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[From the editor – Euler](#)

It is sometimes hard to trace the impact of the history of mathematics on our lives today. This is not the case with Leonhard Euler whose legacy touches the mathematical experiences of most secondary pupils. Find out how here.

[Up2d8 Maths](#)

The fortnightly Up2d8 Maths resources explore a range of mathematical themes in a topical context. Michael Jackson's return has put The O₂ venue on the map. With 10 sell-out concerts and 360 000 tickets sold, just how big is The O₂ and can its size be put into context? This Up2d8 explores the facts and figures relating to The O₂, examining the authentication of its self-publicised facts and trivia.

[The Interview – Adrian Oldknow](#)

Adrian is well known for his innovative work using ICT in mathematics. This interview allows Adrian to share some other facets of his mathematical personality.

[Focus on...negative numbers](#)

Do your students have an image of negativity? Does this image help them to calculate with negative numbers? How did the use of negative numbers evolve in mathematics? These extracts could help to answer some of these questions.

[An idea for the classroom – area and perimeter](#)

Do your students really understand the concepts of perimeter and area? Perhaps there are more of them than we realise who struggle with these fundamental concepts, so here is one way of lifting the fog from this old problem. Can you suggest some more?

[5 things to do](#)

Getting ready for the spring? Is the April diary already filling up? There are some ideas here to help you plan ahead.

[Diary of a subject leader – Real issues in the life of a fictional Subject Leader](#)

As more and more schools are moving towards a 'themed curriculum' at Key Stage 3, what are the issues facing those of us who work in the Core Subjects and how should teachers of mathematics respond. Our Subject Leader wrestles with the pros and cons, and poses the question 'will it really provide a sustainable way of ensuring more creative teaching and learning?'

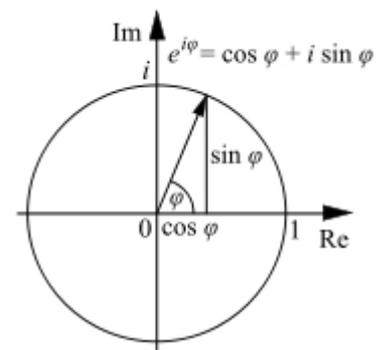


Euler

[Leonhard Paul Euler](#) was a Swiss mathematician. Born in Basel on 15 April 1707, Euler lost the sight in one eye as a young man, and later was virtually blind as he had a cataract on the other eye. He had an amazing memory and an ability to visualise problems which enabled him to carry on doing mathematics and publishing his results by dictating them. He published over 800 mathematical papers in his lifetime.

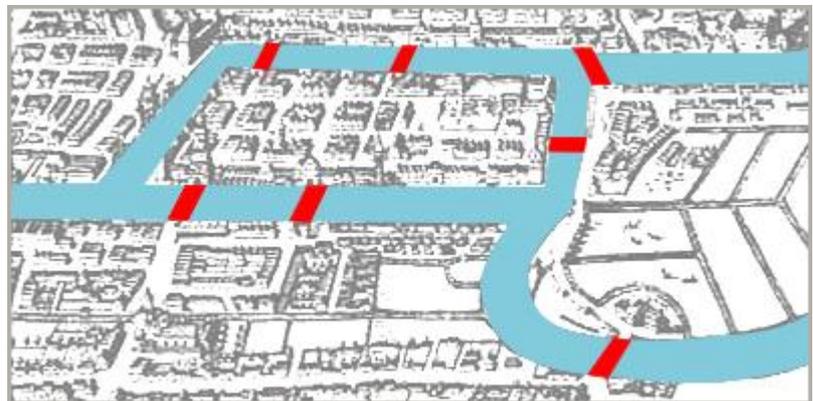
Having been tutored by Johann Bernoulli, Euler moved to Russia to work with one of Bernoulli's sons in St Petersburg. It was in St Petersburg that he married and had 13 children (only five of whom survived infancy). Euler worked in Berlin for 25 years but returned to St Petersburg and died there in 1783.

The impact of Euler's mathematical work is far-ranging. Most pupils will be affected by his work on standardising mathematical notation: he introduced the symbol 'e' to represent the base of the system of natural logarithms (see [Secondary Magazine Issue 20 'Focus on e'](#)), established the use of the Greek letter π for the ratio of circumference to diameter in a circle, used the small letters a, b, c to represent the sides of a triangle and A, B, C for the opposite angles.



Many pupils will also have met Euler's problem [The Bridges of Königsberg](#).

The city of Königsberg in Prussia (now Kaliningrad, Russia) was situated on the Pregel River, and included two large islands which were connected to each other and the mainland by seven bridges. The problem is to decide whether it is possible to follow a path that crosses each bridge exactly once and return to the starting point. Euler used the idea of arcs, vertices and regions to solve the problem; this area of mathematics is now known as



[topology](#), the most famous example of which is the [London Underground Map](#).

Euler also noticed that there is a formula giving the relationship between the number of faces, vertices and edges for polyhedra, which is accessible to most pupils. It may be interesting to 'notice' this formula with your pupils:

Polyhedron	Faces	Vertices	Edges
Cube			
Cuboid			
Tetrahedron			
Square-based pyramid			
Octahedron			

Euler is a prominent mathematician of the 18th century and one of the greatest of all time. How will you celebrate his birthday month in your classroom?



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.

Michael Jackson's return has put The O₂ venue on the map. With ten sell-out concerts and 360 000 tickets sold, just how big is The O₂ and can its size be put into context? This Up2d8 explores the facts and figures relating to The O₂, examining the authentication of its self-publicised facts and trivia. Students are introduced to the Michael Jackson story. The size of The O₂ is put into context by the number of tickets sold per concert, its dimensions and the related trivia on The O₂ website. Students are encouraged to use research and estimation to ascertain the validity of the given data and to conceptualise the numbers used.

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: Adrian Oldknow

About you: Originally a maths teacher in secondary schools and FE, then in HE. Retired as head of maths at what is now the University of Chichester (Emeritus Professor). Now freelance consultant. Recent past chair of the MA's ICT and PD committees. Treasurer/vice chair of the JMC. Chaired the JMC/RS Geometry Working Group.

The most recent use of mathematics in your job was... to calculate the optimum angle of release of a projectile (a STOMP rocket) to trace the longest parabolic arc for a given initial velocity.

Some mathematics that amazed you is... there are still new, fundamental things out there to be discovered, and proved – in my case in 2D/3D Euclidean geometry. That virtually no-one, however well educated mathematically, knows whether or not regular tetrahedra fill space in the way equilateral triangles tile the plane.

Why mathematics? Because it provides immense intellectual stimulus requiring few other resources than brain, memory, means of communication and means of computation.

Your favourite/most significant mathematics-related anecdote is... While doing some recent rocket modelling with Y9 students: "You mean to say that the stuff we've been learning about right-angled triangles actually has some use!"

A mathematics joke that makes you laugh is... if there are ten cats in a boat and one jumps out, how many are left?
None, they were all copycats!

Your favourite television programme is... Now there's little worth seeing – though I'm still addicted to *University Challenge*. *Have I Got News for You*, when it returns. It used to be *Drop the Dead Donkey*, but satire on TV is dead just now.

Your favourite ice-cream flavour is... coffee.

Who inspired you? Trevor Fletcher.

If you weren't doing this job you would... be rich.



Focus on...negative numbers

Negative numbers first appear in China in [The Nine Chapters on the Mathematical Art](#), which dates from the period of the Han Dynasty (202 BC – 220 AD) but may well contain much older material. The Nine Chapters used red counting rods to denote positive coefficients and black rods for negative.

Negative numbers were resisted in Europe until the 17th century, although Fibonacci allowed negative solutions in financial problems where they could be interpreted as debits.

In 1759, the British mathematician Francis Maseres wrote that negative numbers "darken the very whole doctrines of the equations and make dark of the things which are in their nature excessively obvious and simple".

Listen to *In Our Time* with Ian Stewart talking about negative numbers with Melvyn Bragg [here](#).

Learners can benefit from having access to multiple representations of positive and negative numbers and the use of such representations to support foundations of understanding that can reduce opportunities for misconceptions... Read more of the Mathemapedia entry **Addition and Subtraction of Negative Numbers**, including the 'tokens' model, [here](#).

Teachers usually introduce rules to help pupils remember results or steps in methods. However, few are always true and many are never fully developed so that pupils understand the context of a rule... [for example] 'Two minuses make a plus' $-5 \times -3 = +15$ but $-5 + -3 \neq +8$. This rule is an inaccurate simplification of a generalisation. Incorrectly applied 'rules' on signs and operations are the source of many errors for secondary pupils in work on number and algebra, usually because the 'rule' is learned without understanding and they do not take into account the different contexts of the operations of multiplication and addition, and the positive and negative states.

How might it be improved? Where it is considered that rules might be useful, they should be unambiguous and developed with the pupils. The unthinking use of rules should be discouraged. From page 14 of the Ofsted report [Mathematics: understanding the score](#).

[Adding makes bigger?](#) *It is quite natural for young children to associate 'making bigger' with adding. It is important for the teacher to value the pupil's generalisation and then at the same time reinforce the mathematics skill of testing out a hypothesis to see if it works for all circumstances.*

Why is $-2 \times -3 = 6$? I was trying to agree an explanation/justification for this with an intelligent non-mathematician: we weren't satisfied with our answer, can anyone help? Perhaps asking students to accept this sort of thing, with vague or unconvincing justifications, puts off many bright students, with questioning minds, at an early age?

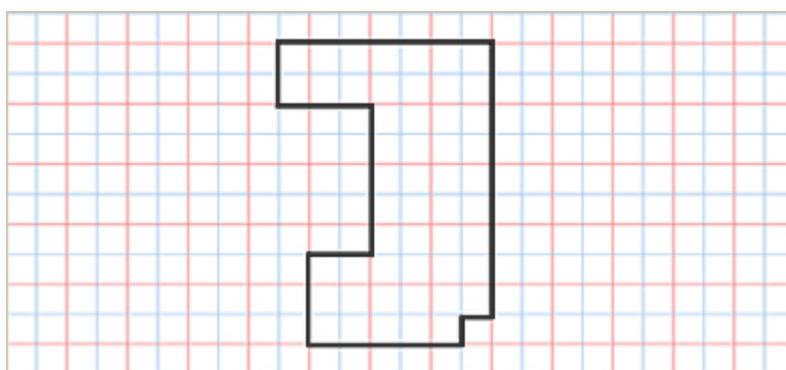
Join the discussion [here](#).

Is 10 bigger than -10? Find out how this question arose from a national lottery scratch card [here](#).



An idea for the classroom – area and perimeter

I have been reading an article in 'Mathematics Teaching' 211 – November 2008, written by John Mason concerning his address to the Easter 2008 conference. Included in the article are some activities which are 'designed to promote work on the awareness which underpin perimeter and area'. It is one of these activities that I have adapted and want to offer here as our idea for the classroom. It caught my eye because I have often been surprised that students have problems with perimeter and area, and thought for a long time that they merely got the labels wrong – confused the two things. More recently, I have changed my mind and am now aware that pupils do not actually get the concept of perimeter or the concept of area so I am keen to engage them with some activities which develop their understanding of the concept rather than just rehearse how to calculate 'it'.



The resource (which can be downloaded [here](#)) gives a shape drawn on squared paper. Students are invited to draw two other shapes on the grid as follows:

- a shape which has the same area and a longer perimeter
- a shape which has the same perimeter and a greater area.

It would then be good to ask pupils to draw the shape:

- a shape which has the same area and the longest perimeter
- a shape which has the same perimeter and the greatest area.

Good questions to ask would be:

- have you got a technique for increasing the perimeter and keeping the area the same?
- have you got a technique for increasing the area and keeping the perimeter the same?
- can you explain how your new shape relates to the original shape?
- how do you know you have the longest perimeter?
- how do you know you have the longest area?

Having done some work on the two shapes provided, pupils could suggest their own shapes to work with – this is an integral part of the activity rather than a 'bolt on' for those that finish quickly.

Good questions to ask pupils would be:

- how did you choose the starting shape?
- why was this a good shape to choose?

At no time is the intention of the activity to calculate the area or perimeter, but to use mathematical reasoning to justify the decisions the pupils make.

Have you got a nice activity to reinforce pupils' understanding of these concepts? Why not tell us about it?



5 things to do this fortnight

- As the weather improves and spring arrives wouldn't it be nice to get a bit of fresh air? This [professional development module](#) might be a good place to start to help you see the environment around you with new eyes!
- You might be aware that the exams are approaching! What does it mean to revise maths? Do all of your department share the same ideas? This [professional development module](#) might be a good place to start.
- Book your place for the [Institute of Mathematics and its Applications conference](#) on 23 April. The aim of the conference is to bring together people with an interest in mathematics and its applications to consider current issues in the subject. The conference topics will cover mathematics education at school and higher levels, research topics in mathematics and industrial applications of mathematics.
- The next [Women in Mathematics Day](#) will be held on 24 April at De Morgan House, London. Sessions will include talks and posters by practising women mathematicians in a variety of appointments and at different career stages. Aimed at women mathematicians, particularly students and those at an early stage in their career, it is hoped that an opportunity to see women who are active and successful in mathematics, and to meet them informally, will be beneficial. Feedback from previous meetings has shown that participants find this useful. While this is an occasion particularly for women active in mathematics to get together, men are certainly not excluded. More details [here](#).
- How are you celebrating the 500th anniversary of Henry VIII's accession on 22 April? There is a lot happening to honour the occasion, including: [Henry VIII: Dressed to Kill](#) (Tower of London, Apr 3-Jan 17 2010), an exhibition of artefacts and paintings; portraits of [Henry's Women](#) (Hampton Court Palace, Apr 10-Aug 3), plus re-enactments of feasting and debates; and David Starkey's [Henry VIII: Man and Monarch](#) (The British Library, Apr 23-Sept 6) which uses documents to address the changes that took place during his reign.



Diary of a subject leader

Real issues in the life of a fictional Subject Leader

There was a rumour circulating around school and it wasn't until the agenda for our fortnightly curriculum team leaders' meeting arrived in our pigeon holes that it was confirmed. *Item 1: Thematic Curriculum.*

Other schools in the area had introduced a thematic curriculum within Year 7 with many more were contemplating undertaking a similar initiative. I knew that responses from maths departments had been somewhat mixed with many wishing to protect the purity of their subject. That mixed response was echoed during the meeting, with departments split on whether they believed it to be a worthwhile venture. Although initially sceptical, I was experienced enough to realise that by the simple fact that we were having the discussion, decisions had already been made – it was going to happen in some form or another.

Our Curriculum Deputy argued that a thematic curriculum would raise standards, creating a more meaningful, exciting and fun learning environment that would equip students with generic life skills. It would provide an opportunity for students to experience a variety of learning styles and promote creative and purposeful teaching. The net result would mean improvements in student motivation, behaviour and attitude to learning. Who could argue with that?

Well, as it happened, half the room! Time was the major concern. To introduce such a radical curriculum change across the whole school would require careful planning, discussion and resourcing. It was rare to have any teaching and learning dialogue across subject areas as it was, so when was this to happen? Although overlaps inevitably occur across subjects, there was an agreed need for meaningful and relevant links whenever possible. And more to the point, what exactly were the themes to be and would they be appropriate for all?

I left the meeting with mixed feelings. I was finding it difficult to argue against any of the points raised, both for and against the idea. Yes, we need to develop the teaching and learning which takes place within the school and a thematic curriculum could be the lever for driving this change. However, any changes must be pragmatic with careful consideration given to its feasibility and sustainability. The staff need to believe in it for it to be successful and at present, I don't think enough of them do. Personally, I'm in favour of a 'process'-driven curriculum whereby the process skills are made explicit to students and integrated within everyday lessons. If presented with a 'theme', I, like many others, may be inclined to shut my classroom door and pretend it isn't there.