Secondary Magazine
Issue 64

National Centre for Excellence in the Teaching of Mathematics

Welcome to Issue 64 of the Secondary Magazine.

Contents

Contributors to this issue include: Paul Ernest, Mary Pardoe, Richard Perring and Peter Ransom.

National Centre for Excellence in the Teaching of Mathematics

From the editor

Welcome to another issue of the NCETM Secondary Magazine. You may have come across articles from the *Philosophy of Mathematics Education Journal*, founded and edited by Professor Paul Ernest of Exeter University – Paul has given us an interesting Interview for this issue.

If you are talking in your department about fresh approaches to consider for the next school year, have a look at It makes me think – it's a sketch of how some teachers in Somerset are trying out new ideas, and sharing and reflecting on their experiences, during a professional development project.

As in the previous issue, some ideas for the classroom can be found in the Focus on, which this time looks at structures of labyrinths. It suggests some starting points of the kind that sometimes appear when students want to 'get to the bottom' of procedures that they are shown – when they ask themselves why the methods work.

Students are unlikely to have come across 'algorithms' for creating labyrinths, there are many variations, and the results of following them are intriguing. For these reasons 'recipes' for creating labyrinths are good examples of 'shown methods' that, rather than just being accepted and followed, students are likely to enjoy exploring. Students can look for similarities and differences between their own different examples of procedures that they try out, and between the patterns that they create. The differences and similarities can suggest conjectures to test – and while students are doing these kinds of things, they will be *feeling* what it is like to *act as mathematicians*.

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It's in the News!
Satellites

The fortnightly *It's in the News!* resources explore a range of mathematical themes in a topical context. The resource is not intended to be a set of instructions but as a framework which you can personalise to fit your classroom and your learners.

We're all familiar with Google Earth's images of our streets and houses from space, but these might soon be supplemented with 3D images from a pair of recently launched German satellites. The TanDEM-X was launched in June and joins the TerraSAR-X which was launched in 2007. The two satellites will orbit together, giving a 'stereo' view of the planet rather than the familiar two-dimensional images.

This resource uses the idea of satellite images as a context for exploring 2D representations of 3D objects. Students look at the plan view of some well-known landmarks and are asked what they might look like from the front or side elevation, and then to match the image with a photograph of the landmark.

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 this *It's in the News!* resource - in PowerPoint format

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The Interview

Name: Paul Ernest

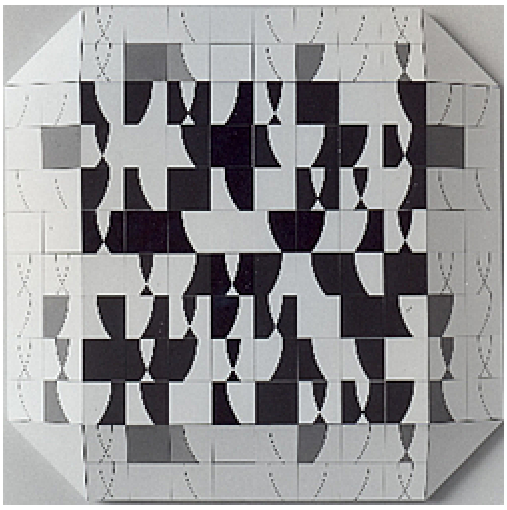
About you: My first degree from Sussex University, in mathematics, logic and philosophy, and then my masters degree from London University in mathematical logic, were followed by my doctorate from King's College London in the philosophy of mathematics. But when I became a maths teacher in a London comprehensive school the focus of my interest shifted towards mathematics education – in which I have since made my career! However, my background in logic, philosophy and mathematics, has always shaped my research agenda.

My best-known book is The Philosophy of Mathematics Education, and I founded, and continue to edit, The Philosophy of Mathematics Education Journal – it features philosophically or theoretically interesting papers on mathematics education or the philosophy of mathematics.

Having previously lectured in a number of teacher education institutions and universities, since 1984 I have been at Exeter University where I am currently Emeritus Professor of Mathematics Education. At Exeter I developed and ran specialist doctoral and masters programmes in mathematics education – which now have graduates among teachers and lecturers in virtually every continent of the globe. In the past few years I have taken on visiting professorships at various places including the University of Oslo, Trondheim Teachers' College and Liverpool Hope University – working with both staff and advanced students.

My research interests are wide, but I continue to focus on theorising mathematics and mathematics education, using philosophical, social and semiotic theories; also on the question Why teach and learn maths?, and on issues of social justice and critical mathematics education. My research has mostly been theoretical and reflective – which means I usually sit at my desk and think and write. The miracle is that others seem to find what I write interesting and helpful!

The most recent use of mathematics in your job was…
Last year I wrote an article - John Ernest, A Mathematical Artist - on the mathematics in my father's paintings, some of which he based on group theory. Typically they have a central 8´8 grid, such as in his *Iconic Group Table* shown here:



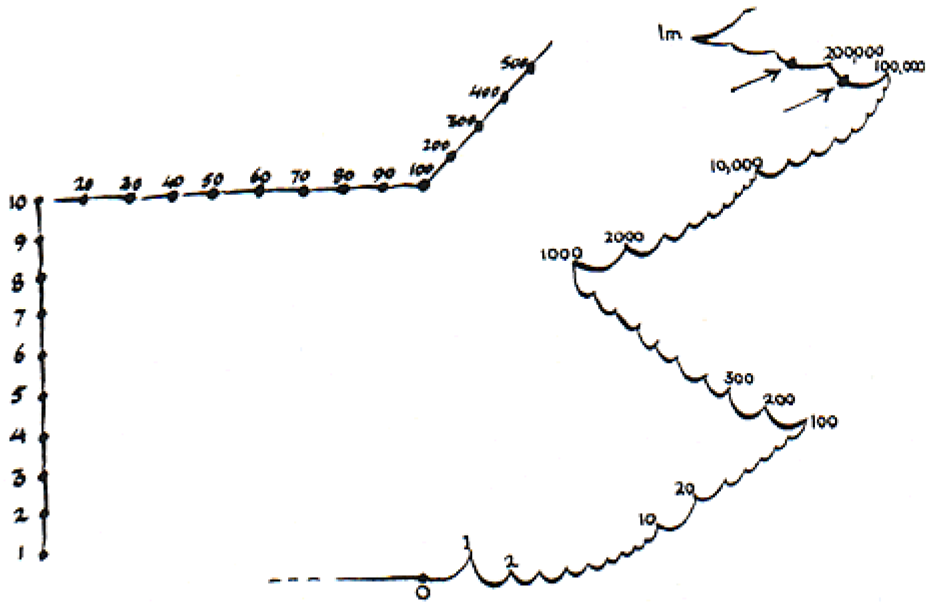
What I wanted to do was to verify that it does indeed represent a group multiplication table and, if so, to identify which of the order 8 groups it is, out of the five different possibilities. It turns out that the table is a group table – the piece represents the group in which all elements have order 2 – they are self-inverse (technically the group is $C_2xC_2xC_2$). In addition, I identified the group operation as the set operation of symmetric difference operating on the regions viewed as Venn diagrams. To analyze this, and some other pictures, I had to retrieve my knowledge of group theory, studied long ago. I also consulted Frank Budden's excellent book The Fascination of Groups, a bestiary of small finite groups, which has sat in my personal library for many years.

In fact, the quest to identify what group might be given in a table was started earlier last year when I asked myself (and others on the MathsEdList) the question *Do completed Sudoku tables form groups?* The answer is – no, most do not, even though the grids are permutations of 1 to 9 on each row!

Some mathematics that amazed you is…
Lots of different bits of mathematics have amazed me, from first meeting Euclid's proof of the infinity of primes, to reading Gödel's original paper in which he proved his Incompleteness Theorems.

As a child I remember once being amazed that the size of the number 1 and the size of the gap between 1 and 2 were the same.

However, a nicer example concerns an accidental realisation. Around 1980 I picked up a book called *The Creatively Gifted* at a jumble sale. In it is a diagram of one person's mental image of the number line. When this person thought of numbers between 1 and 1 000 he brought to mind a picture – shown below on the left – and identified numbers with points on the line. As I read this, I realised with a shock that I too have a mental number-line image. I ran my mind over it from 1 to 1 000 000, and could see it as something like a wire on telegraph poles attached at significant points, looping up a hill as it recedes into the distance with something like an exponentially growing scale – shown below on the right – this is from *Mental images of number lines*, an article that I contributed to an issue of *Mathematics Teaching*:



I realised that whenever I think of a number, say 100 000, my understanding of that number – my concept image if you like – includes the image of its approximate location on this number line. I had never explicitly reflected on this accompanying image until that moment at the jumble sale!

In uncovering this image I also noted that two non-significant (non-rounded) number points stood out on the line, marked at 239 000 and 186 000. I recognised these numbers: they represent the distance to the moon in miles and the speed of light in miles per second, and must derive from my boyhood fascination with space travel. Thirty years later, the marks were still indelibly there in my mind, showing that I had constructed my image during my primary school years at the latest!

Something else that amazed you…
the Kerala contribution to mathematics. Two of my colleagues, Dennis Almeida and George G Joseph, researched the Kerala contribution to analysis – which you can read about in the Philosophy of Mathematics Education Journal No. 20.

They found that quite a few of the series that were fundamental to the development of analysis, such as the Maclaurin Series and the Taylor Series, were discovered in Southern India a couple of centuries before they were known in Europe. What Dennis and George were investigating is whether this knowledge was transmitted to Europe and so sparked the well-known revolution in calculus and analysis. In my view the evidence for the transmission is weak, but the undisputed fact that another culture developed these complex results so far in advance of the later discoveries in Europe is amazing - and reminds us to remain humble about the origins of western science and mathematics.

Why mathematics?
I had a certain facility in mathematics at grammar school, but it was only when I did A-level pure mathematics at the City of Westminster FE College that I became switched on to it. I had a brilliant teacher called Derek Yandell who inspired me to take it further. So I applied to the recently opened Sussex University to study mathematics alongside philosophy. I don't think I really knew what I was letting myself in for!

I'd read Russell's An Introduction to Mathematical Philosophy, but didn't understand it! However, by a happy accident I fell in love with mathematical logic, which was in no little part due to an inspiring lecturer Dr Yoshindo Suzuki. The external examiner for the undergraduate degree was Imre Lakatos, and he suggested that I study for a PhD with him. Instead I opted for an MSc in mathematics at London University specialising in mathematical logic. Sadly Lakatos died that year so I never did get to meet him. However, my MSc lecturers John Bell and Moshe Machover continued to inspire my fascination with mathematical logic. I went on to take a PhD supervised by Moshe Machover, applying mathematical logic to the problem of meaning in the philosophy of mathematics.

By now I was married to Jill and with a daughter, Jane, and needed some means of support. So I became a school mathematics teacher, thus opening the door into the world that would dominate my interests for the rest of my professional life – the world of mathematics education!

A significant mathematics-related incident in your life was…
When I was in my first teacher education position at Homerton College, Cambridge during 1979-81, I attended a course by Keith Hirst on divergent series. At one sticking point in a proof I got lost and Keith asked everybody who didn't understand to raise their hand. I put my hand up and suddenly realised that I was no longer ashamed of, and so needing to be secretive about, my difficulties – I could openly admit them! Previously the mathematics I had studied had what I might best describe as a 'macho' ethos, where you never showed your weaknesses. I realised that after some years in school-teaching and teacher education I was free from this ethos. Keith explained the sticking point, and we all understood easily – but it meant more to me than just that.

A mathematics joke that makes you laugh is...
Bertrand Russell defined the order of a joke as follows:
"Why did the chicken cross the road?" is a first order joke. Whereas *"A chicken met a duck at the side of the road and said "Don't cross that road, you'll never hear the end of it!"* is a second order joke because it refers to a first order joke, namely the first example. Russell goes on to define the hierarchy of jokes inductively in this way. At the end he claims that transfinite order jokes do exist, but they are incomprehensible to us and evoke only the inaudible laughter of the gods! Of course, this itself is a transfinite order joke! So this is Russell's paradox in a jokey way!

The best book you have ever read is…
Excluding fiction, I got a lot out of Kuhn's The Structure of Scientific Revolutions, Karl Popper's and Imre Lakatos' works, and Frege's writings. I especially value Philip Davis and Reuben Hersh's The Mathematical Experience. The book I read and got the most out of during my studies is A Course in Mathematical Logic, by J. L. Bell and M. Machover.

Who inspired you?
In addition to my maths and logic teachers named above, I was inspired by philosophical lecturers Peter Nidditch and Jerzy Giedymin, whom I met as an undergraduate.

If you weren't doing this job you would…
...be doing I don't know what. When I was at school, chemistry was my first love – linked to my childhood love of, and experiments with, fireworks and bombs. A careers adviser suggested I should be a biochemist when I was 18 years old, because I was also studying Zoology and Pure Maths. But I have learned that I need people in my work – something I didn't know when I was younger. I worked for two years as a computer programmer in the early 1970s during a study break. I suppose I could have stayed in that industry and watched it really take off from the inside! But I did find writing simple computer applications for businesses unsatisfying. Of course, had I continued, the job would have grown and developed out of recognition. But through a series of lucky chances and choices I ended up doing what fascinates me the most!

Focus on…labyrinths

Philosophy is written in that great book which ever lies before our eyes – I mean the universe. This book is written in mathematical language and its characters are triangles, circles and other geometrical figures, without whose help it is impossible to comprehend a single word of it; without which one wanders in vain through a dark labyrinth.
Galileo Galilei, from Il Saggiatore, published in 1623

A conventional definition

When we try to apply mathematical language to the study of labyrinths we need to be clear about exactly what we are using the word 'labyrinth' to describe.

History suggests that we define a labyrinth as a single path from the outside 'world' that intertwines with itself, until eventually it reaches a dead-end, which is the 'centre' of the labyrinth.

If you travel through a labyrinth you never have to choose between possible routes. When you reach the centre there is only one way back – along the path that you have already trodden.

It is helpful to regard labyrinths as special mazes.

Origin

Thinking about, and making, labyrinths are very ancient human activities.

People have assumed that the legendary labyrinth in which Theseus killed the Minotaur is the 'circular' labyrinth depicted on a 3rd century BC tetradrachm coin found in Crete. The coin also bears the inscription ΚΝΩΣΙΩΝ (Cnossus) thus linking it to the Palace of Knossos, which is traditionally associated with the Minotaur legend. This particular labyrinth is therefore known as the Cretan labyrinth.

You can see it on the cliff face at Rocky Valley at Tintagel in Cornwall, where it was cut into the rock – possibly during the Bronze Age.

It appears in a 14th century Farhi Bible as a plan of the walls of Jericho.

It also appears on the portico of the Duomo di San Martino at Lucca in Tuscany.

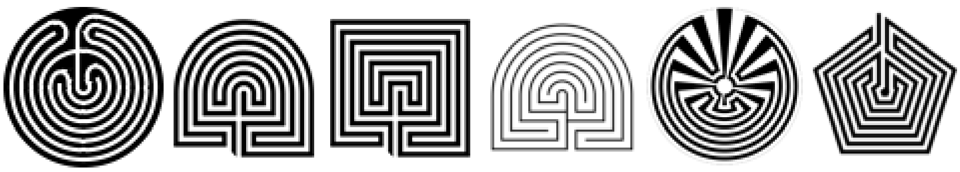
The Latin inscription to the right of the labyrinth has been translated as *'This is the labyrinth built by Dedalus of Crete; all who entered therein were lost, save Theseus, thanks to Ariadne's thread'.*

The Minotaur is represented at the centre of a different labyrinth that is carved on a 16th century gem that is now in the Medici Collection in the Palazzo Strozzi in Florence.

The same or different?

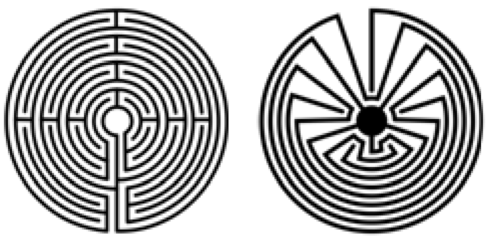
In most representations of the Cretan labyrinth, the path 'sides' are drawn. The path itself is then the space between the lines – as in this image that was first published between 1876 and 1899 in one of the 20 volumes of the first edition of the Swedish encyclopedia Nordisk familjebok...

...and as in these other depictions of the Cretan labyrinth…

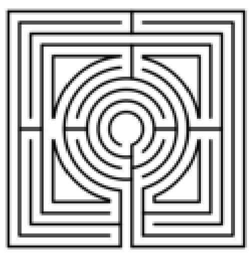


All seven images above are topologically equivalent drawings of the Cretan labyrinth – what others could your students design?

These are also labyrinths, but they are not topologically equivalent to each other. Is either one equivalent to the Cretan labyrinth?



This maze is not a labyrinth because there is not one unique way to journey from the outside to the centre with the traveller passing just once along every part of the maze.

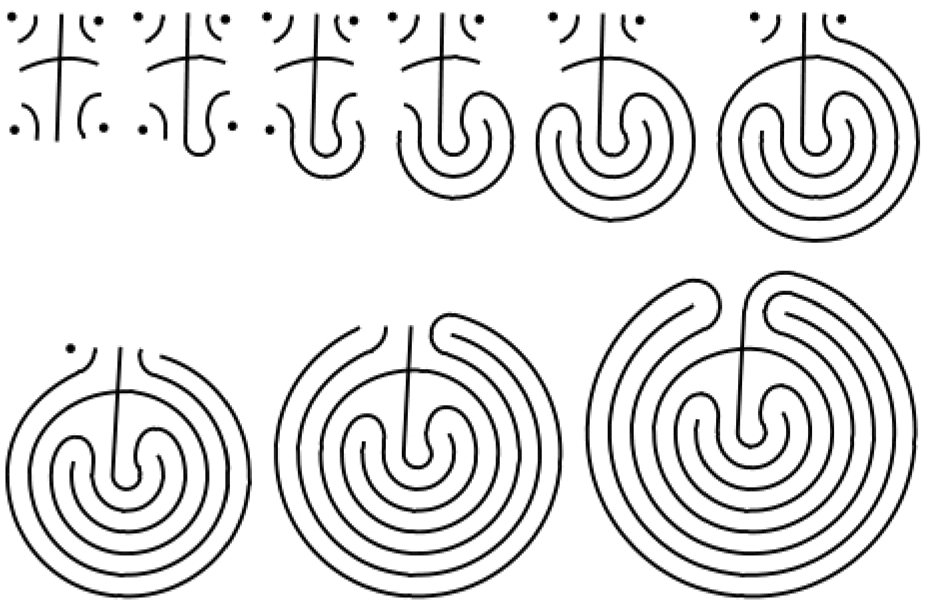


'Recipes' for drawing labyrinths

To draw a labyrinth you can follow instructions found in books or on the Internet, such as those in this YouTube video, or in this one.

Would your students enjoy making an enormous labyrinth as these did?

You are instructed to start with a 'nucleus' or 'seed', consisting of an arrangement of short line-segments and 'dots'. You then proceed to join up, systematically, end-points of the line-segments and dots, linking a dot, or the end-point of a line, on one side of the 'seed' to the nearest available one on the other side. For example, to draw a Cretan labyrinth you are usually told to start with a particular 'seed' – shown at the top left below - and draw eight connecting lines like this:

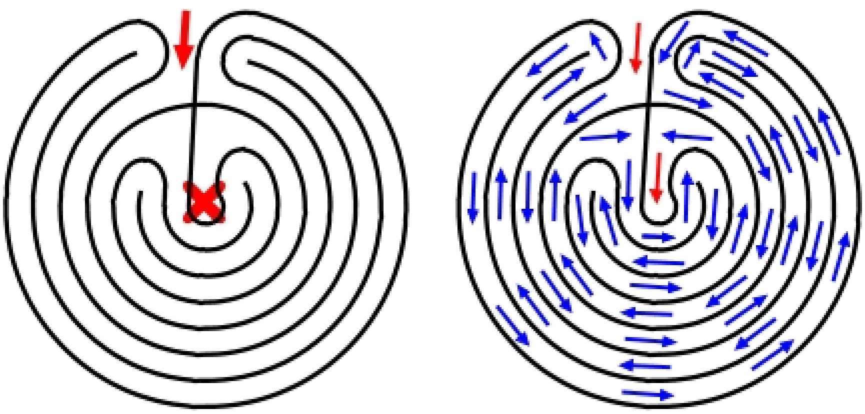


Why this method?

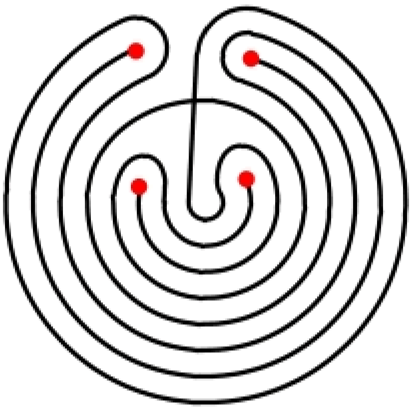
We can copy procedures like this without really understanding them. When we ask ourselves why they 'work', and begin to explore possibilities, we start to act mathematically. If we notice properties – that perhaps some examples share and that others don't – we may be able to make some conjectures, that we can test and then try to explain.

Some initial observations

We see that the pattern that we've drawn is a labyrinth because there is just one route from the outside to the 'centre' that takes us just once over every part of the space between the lines:

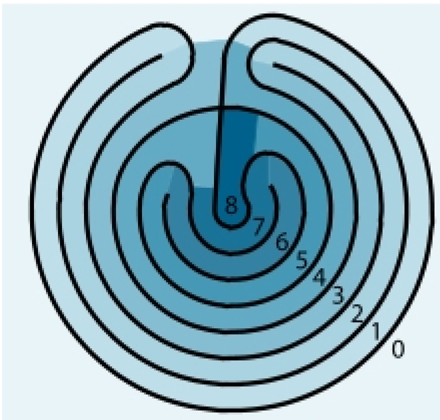


There are ***four*** end-points - at what were originally the dots of the 'seed'.



So there must be ***two*** line-segments – which are curved in this diagram – we might think of them as two pieces of elastic string.

We can also see a series of 'levels', shown here in different colours. If we regard the outside as a level, there are nine levels – we could number them from 0 to 8:



Exploring possibilities
What questions do these initial observations suggest?

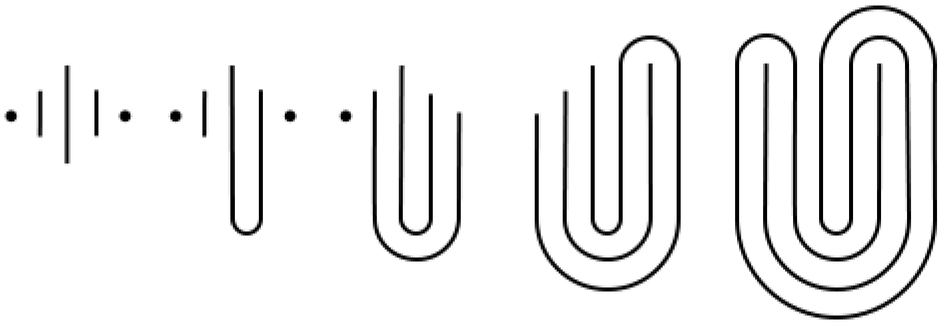
Perhaps it might be illuminating to think about the 'seed'.
Can the 'seed' be just any arrangement of dots and line-segments?

Suppose we start by exploring these three 'seeds':

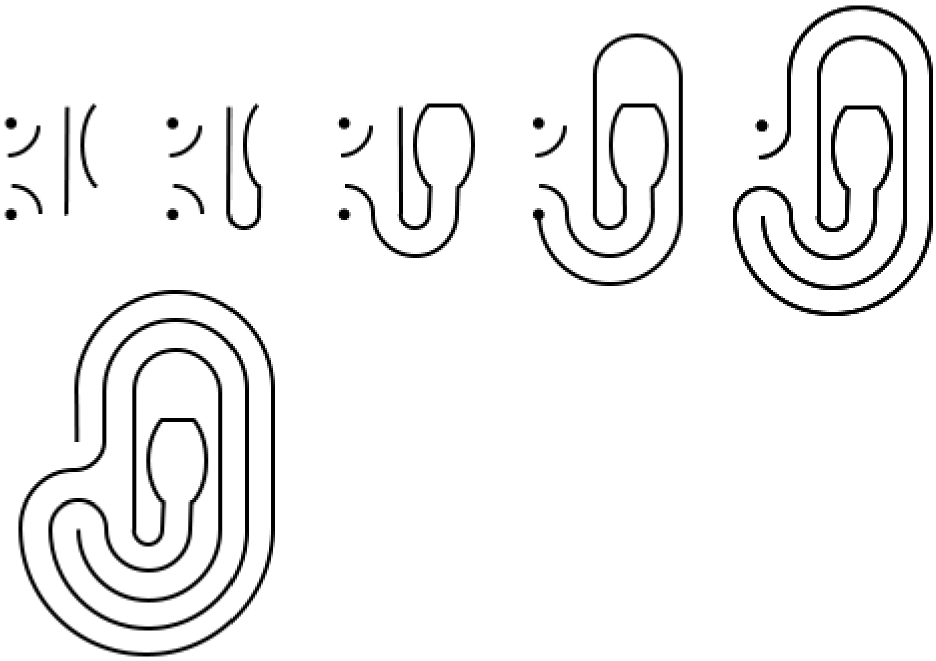
We already know that we can make a Cretan labyrinth by joining up, in a particular way, lines and dots of the first 'seed' on the left.

I have 'made up' the other two 'seeds'. What happens with them?

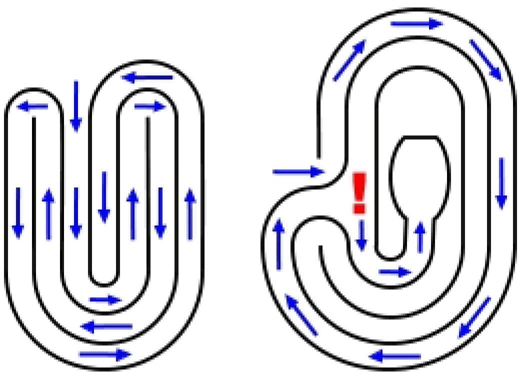
We could join points like this…



...and like this:



Have we created labyrinths?

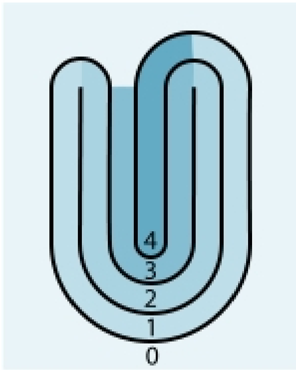


The pattern obtained using the middle 'seed' is a labyrinth, but the other one isn't.

However, if you experiment, you will find that other ways of joining the points of the middle seed do not create labyrinths!

An interesting line of enquiry would be to make up other 'seeds', and experiment with various ways of joining their points. Maybe you can discover common properties of successful 'seeds', and what has to be true about successful systems for joining the points?

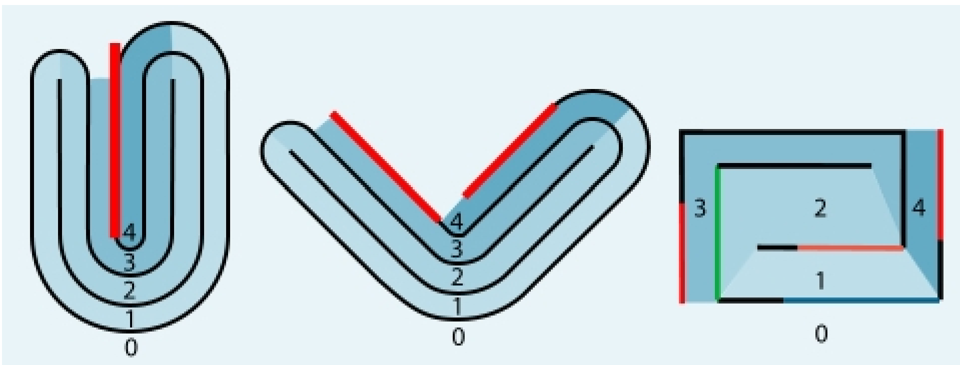
Or you might first investigate further the new labyrinth that we have managed to create:



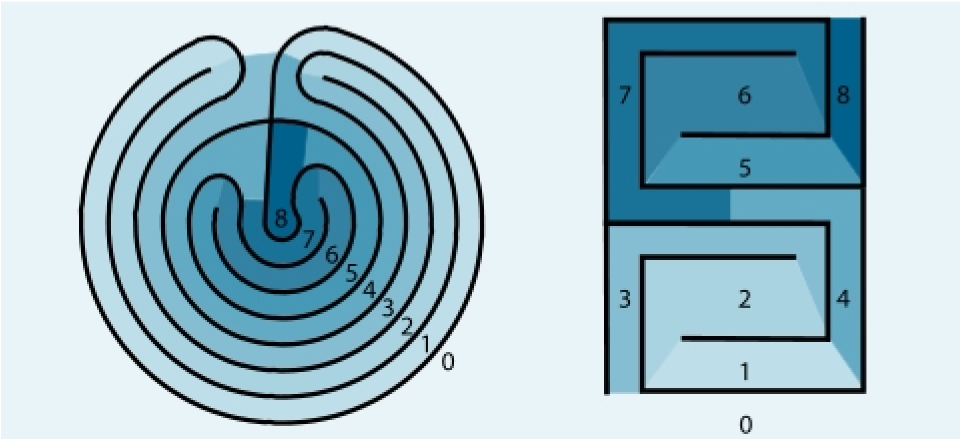
It has only five levels – fewer than the Cretan labyrinth.

Having earlier seen several superficially different-looking versions of the Cretan labyrinth, you might think of bending and stretching the new labyrinth to look at other topologically equivalent versions of it.

After playing around with this idea for a while, you might go one step further – before bending and stretching the lines, cut into the labyrinth by splitting down the middle of part of one side of the path just beyond the entrance. We can bend and stretch this labyrinth into a 'rectangular' shape:



The 'rectangular' shape that we have 'chanced upon' gives rise to a promising-looking new line of enquiry – if you do a similar thing to the Cretan labyrinth you may begin to see a link between this five-level labyrinth and the Cretan labyrinth:



Seeing this labyrinth...

...might encourage you to persevere further with this line of enquiry.

Questions have arisen that we haven't yet answered. And there's much about labyrinths still to find out.

Here is a more structured class activity - designed by Tony Phillips, Professor of Mathematics at the State University of New York - in which students are shown criteria that help them design their own labyrinths.

Wanting to 'get to the bottom of' ideas and situations that appear to have little or no practical significance has driven mathematical enquiry for hundreds of years. And sometimes, perhaps many years later, the findings of apparently 'recreational' mathematical enquiries have proved to be profoundly useful in scientific discovery.

It makes me think

The mathematics teachers who are taking part in a professional development project in Somerset are reaping rewards. By reflecting on their teaching habits, taking risks in introducing some new kinds of student activities, and adjusting their roles in the classroom, these teachers are finding that their students' roles and attitudes are also changing. As one student said, 'This is good – it makes me think'.

The **SITiM (Somerset Improving Thinking in Mathematics) project** was launched last October. There are 17 schools and 34 teachers involved. Malcolm Swan, who is Professor of Mathematics Education at the University of Nottingham, and an expert in the design of similar initiatives, is leading the project.

A core of teachers within the mathematics team of each school are acting as 'agents of change'. All the 'core' teachers meet regularly, about twice a term.

At their first two-day session in October they explored new resources, such as student tasks like this:

Always, Sometimes or Never true?

If **Always**, can you prove it?
If **Sometimes**, can you work out when it is true?
If **Never**, can you prove it?

"Buy one get one free"
Is a better deal than
"3 for the price of 2"

The teachers looked at how students learn mathematics through discussion and reflection – how they build concepts and meaning, and how they question and reason naturally, while considering important aspects of the teacher's role in managing productive classroom discussion. They left the session with a task to work on in their own schools.

When they were back in school the participants were supported by local authority mathematics consultants, a National Strategy adviser and a mathematics AST. Pete Griffin, National Centre South-West Regional Co-ordinator, also visited some schools to encourage the teachers and students, and to see what they were doing.

When the teachers met again for a one-day meeting in December each teacher gave a short presentation about their task and responded to questions. A resulting written reminder of each teacher's experience was copied to everyone, to support each teacher's own reflections. Then everyone turned their attention to designing and using tasks to develop conceptual understanding, before leaving with more ideas to work on in their schools.

Back in school the 'core' teachers continued to be supported from outside as they interacted with their students and the rest of their school mathematics teams.

Having again shared, reflected on, and discussed, full reports of their tasks in the next session in January, the teachers considered the design and use of student tasks that develop problem solving processes, taking a related task back to their schools to prompt new ways of working.

During the March session thinking about the selection and design of formative assessment tasks built on the teachers' reflections on their previous tasks and experiences.

As the 'core' teachers gain confidence they are increasingly supporting each other and other teachers in their own school teams, and leading their own in-school professional development sessions.

During the project the gains of both teachers and students, in relation to attitude and achievement, are being monitored by the teachers themselves, and from outside.

Their findings on this long-term project are growing ever more positive. Teachers' comments during interviews from early in the project have included:

"I would normally sort their problems – now they sort them. But is that more efficient?"

"Good to have the discipline of having to try something out and then come back and talk about it to others."

"…struck by how much some pupils (often the ones who do not usually shine) enjoy the discussion element."

"One very quiet pupil has come out of shell as a result of more discussion lessons and activities."

In later interviews teachers have commented that their 'professionalism has been respected', and the project has helped them:

- *'crystallise their thinking', giving them 'permission to try things out',*
- *'re-kindle early ideas and enthusiasms'.*

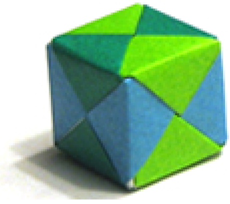
When asked how their thoughts about what they want to get out of this project were developing, teachers said:

"...it is changing the way that the class actually functions… it has gone from me doing the teaching to them doing the teaching."

"SITiM has helped me think outside the box."

Commenting on changes in their teaching, one teacher said:
"I question a lot better – I think about the questions to ask a lot more now. The project has made me think more about it."

Just like the student quoted at the start!



5 things to do this fortnight

- Explore the interactive article, The answer is 'Parabola'...now, what's the question? in MTinteractive - for example, model slicing through carrot - and then add your own ideas on the MTi forum. MTi is an interactive web publication that is complementary to Mathematics Teaching, the journal of the Association of Teachers of Mathematics.

- Take a look at bshm Education, a website of the British Society for the History of Mathematics aiming to inspire you to use history in the teaching of mathematics. The secondary pages summarise why, how and when bringing the history of mathematics into your classroom will enhance your teaching and your students' learning. There will soon be free downloadable resources, and you will also find links to resources at other sites.

- Watch a Teachers tv video in which a Year 9 class of students use computer software to explore mathematical relationships that they find in a playground. The students and their teacher talk about how these activities help them learn, and why they enjoy them.

- Have you considered booking a Hands-On Maths Roadshow from the Millennium Mathematics Project? You can download a Roadshow package of NRICH activities that are linked to the Hands-On Maths Roadshow. They are designed to stimulate curiosity, encourage creativity and develop strategic thinking.

- You could unwind by folding an Origami cube.

Diary of a subject leader

Issues in the life of an anonymous Subject Leader

Phew! GCSE Mathematics done and dusted for this year now and a fairly relaxed weekend with the family, including my eight-month-old grandson. I seem to have the magic touch in getting him to eat by singing all the numbers from one to a hundred in order, throwing in many interesting facts along the way – 54 is twice three cubed, 28 the second perfect number since it is the sum of its factors apart from itself, and so on…the tune just seems to flow and the bairn troughs well to the sound. We examine the barometers on the wall, with me talking about the circles and squares that we see in the surrounding glass. With 42 barometers – all of which we count every week – this keeps us both out of mischief.

Faculty meeting on Monday and the new head of mathematics attends since she is taking over next term when I move on. As part of our sharing good practice, I show the faculty members the latest pieces of hardware and software I'm using with my students – the Texas Instruments Navigator and handheld (TI-Nspire) that goes with it. Everyone logs on through their own handheld and I send out a wireless quick question to check. They reply and seeing their answers added to the results stimulates further exploration. I wire them a small file of statistics problems that they work on in pairs, and I collect in their files wirelessly. All the screens are shown on the IWB, so no slacking! The potential of this tool is mind-blowing – so I look forward to the next day when I will have a visitor looking at some of the ways in which I'm using this technology with my Year 9 class of low-attainers.

The visit goes far better than I expect. The students pick up the technology like they've been using it every day, yet this is the first time we've dealt with the wireless aspect. They keep asking for more 'quick polls' since they are desperate to get their (correct) answer in first – the times are recorded so that's an added bonus since we review the way time is written and they work out the time difference between the first and last correct answer.

The lesson revolves around Galileo's pendulum work – 'Galileo's swingers' as they call it. The file I send the students is simple, giving a short summary of Galileo and his pendulum discoveries and challenging them to check out some of them. This way it is cross-curricular with science and history. They decide first to investigate if there is any connection between the length of the pendulum and the time of swing. They can see there is string available and a variety of items to tie to it, so their first question is *'How much weight should I put on it?' 'Why?'* I reply. *'Because it might make a difference.' 'Then what would you do to see if it did make a difference?' 'Oh – OK – I'll try some different weights'*. I had deliberately tried to free this up as much as possible, since I wanted to address a number of PLTS in this lesson. And we sure did that! – independent enquirers, creative thinkers, team workers, self-managers and effective participators…. tick, tick, tick, tick, tick, tock (well, it is about pendulums after all!). The students collect their data and enter it on the handheld ready for analysis. This was a lesson to remember.

The next day, Wednesday, was a day to forget. I attend one early morning meeting on reviewing the policies for the Governors. I then find I should be at three simultaneous meetings after school. One is directed time on IT training about Word, another is a revision session with the Y10 GCSE Statistics class preparing for an exam on 25 June – and the third? – it's my turn for after-school detention! Due to the directed time meeting there is nobody to swap that with, but there is a volunteer to do the revision class, so I go and do the after-school detention.

On Saturday I catch an early morning train for a small meeting planning a conference in York. We meet at the London Mathematical Society and have an enjoyable time planning the programme. I meet up with my younger daughter and we go for a meal, then on to see the standard measures at the back of Trafalgar

Square. Visitors look up at the very large ship in a bottle (HMS Victory). We look down at the foot, yard, chain, pole and perch in brass, taking pictures. At least it gets some others looking!

Then we take in a film – Sean Bean in Black Death. Not much there I can use in the classroom, though some of the punishment scenes give me ideas.

The next week goes quickly. The Heads of Mathematics meeting at a local school is always a stimulating event, and there is another governors' meeting.

Then Olympic Day! We have invited in Natasha Hunt, a mathematics teacher, who is now training to be a pentathlete for 2012. She has rotating groups of students spellbound – the four groups spend 30 minutes on each of four different activities over two hours. This includes a javelin event - throw a straw as far as possible, and each team works out the mean throw length for their group. The discus is a paper plate! There are other Olympic questions to answer to gain points to decide an overall winner. Mathematics was the overall winner of course!