Primary Magazine

Issue 22

National Centre for Excellence in the Teaching of Mathematics

Welcome to the 22nd issue of the Primary Magazine. Our famous historian is Euler, our artist is Kenneth Nolan and our CPD opportunity aims to develop subject knowledge in the area of visualisation.

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Editor's extras

In this issue, we tell you about some Ofsted findings, give information about the latest round of MKNs and share a great little interactive programme on the internet for creating art work.

Up2d8 maths

We look at earthquakes, following those in Haiti and Chile at the beginning of the year. The spreads provide opportunities for work with such mathematical concepts as time, angles and probability.

The Art of Mathematics

This issue explores the art of Kenneth Nolan, an American artist famous for his work on large-scale square canvases of concentric circles, in bold, flat colours and also chevrons, diamonds and stripes. Great for shape work!

Focus on…

Our focus is the looming election. We thought this was an ideal opportunity to get your class and school involved in some relevant and appropriate mathematics and citizenship activities featuring the effective use of ICT.

A little bit of history

A potted history of Euler, who is thought to be the greatest mathematician of the 18th century, making important discoveries in calculus and graph theories and introducing much of the mathematical terminology and notations that we use today.

Maths to share – CPD for your school

We continue our series on mathematics subject knowledge by exploring visualisation. For this session you will need to download a copy of Thinking Through, and By, Visualising for each participant and a copy of the National Numeracy Strategy booklet, Shape and space activities.

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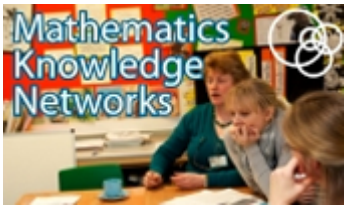

National Centre
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From the editor

Someone on our team sent me a link to the American National Gallery of Art kids website, which I thought would be great to share. It is great fun and enables you or your children to create your own art work. Enjoy it!

Recently available to download is a report from Ofsted, which evaluates the aspects of the National Strategies that have been effective, and those that have been less so, and how leaders and managers at regional and local levels of the National Strategies have judged their impact. Almost all the schools visited considered that the National Strategies had contributed to improving the quality of teaching, learning, the use of assessment and valued their materials. However, they felt that the frequent introduction of new initiatives has led to overload and diminished their potential effectiveness: it is worth a read. As always we'd love to hear your comments in the Primary Forum (or you can contact us by email, if you prefer).

Did you know that more money has been allocated to support a second cohort of Mathematics Specialist Teachers (MaST) as an on-going commitment to Sir Peter William's recommendation? If you are interested in seeing whether you would be suitable, why not have a look at the Self Assessment Tool and find out? Or you can find out more about the role on the MaST microsite.

Finally, for the last few issues of the magazine we have told you about regional projects and tried to encourage you to apply for one. If you would like to try something a little more substantial you might like to apply for funding for a Mathematics Knowledge Network (MKN). There is more information about these and how to apply for them on the MKN area of the portal; applications must be received **no later than noon on 10 May 2010**.

Up2d8 maths

In this issue of Up2d8, we look at earthquakes, following those in Haiti and Chile that hit the news headlines earlier this year. This issue looks at earthquakes in general and the mathematics that you can develop from this theme – for example, measurement including time, distance, angles and also probability.

You may find it helpful for the discussion part of this Up2d8 to refer to the following news articles:

- BBC (details of the Haiti earthquake)
- TheTimes (details of the Chile earthquake)
- Time Magazine (details of both earthquakes)

The BBC website also has some background information about why earthquakes happen

This Up2d8 resource provides ideas that you can adapt to fit your classroom and your learners as appropriate.

As always, we would be extremely grateful, to those of you who have used the Up2d8 resources, if you could give us some feedback (either by posting in the Primary Forum or contacting us by email) on how you have used them, if they have worked well, and how they might be improved.

Download this Up2d8 maths resource - in PowerPoint format.

Download this Up2d8 maths resource - in PDF format.

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The Art of Mathematics
Kenneth Noland (1924 - 2010)

Kenneth Noland was born in Asheville, North Carolina, in 1924. After serving as a glider pilot and cryptographer during World War II, he took advantage of the 'Servicemen's Readjustment Act' of 1944, known as the 'G.I. Bill'. This provided training for veterans and enabled Noland to enrol in Black Mountain College, a local university, to study art. Here he became familiar with the works of many now well-known artists, including Mondrian, but he was particularly interested in Paul Klee's use of colour. He died earlier this year, aged 85.

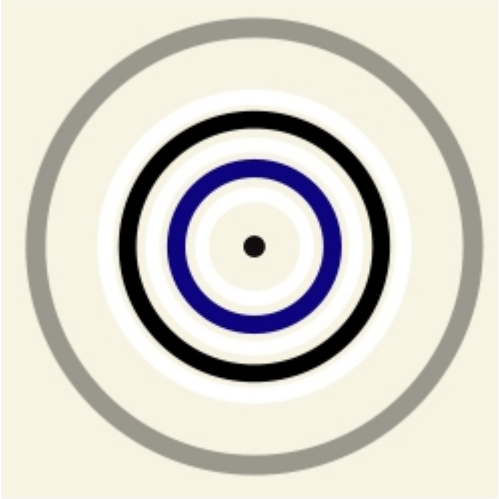
Many have tried to categorise Noland's work; describing him as an 'abstract' painter, an 'abstract expressionist', a 'minimalist' painter, and most commonly an 'American Colour Field' painter. The latter seems most fitting and is characterised by large expanses of flat, solid colour, spread across the canvas. This was mostly achieved through experimentation with the 'stain technique', learned from Helen Frankenthaler, where thinned paints are allowed to soak into the canvas.

By the mid-1950s, Noland was painting what became his trademark; large-scale, square canvases of concentric circles, in bold, flat colours. He painted nearly 200 of these. Like many artists, his work changed as time progressed. The circles or 'targets' developed into chevrons, diamonds and then stripes, with Noland also pioneering the use of the shaped canvas.

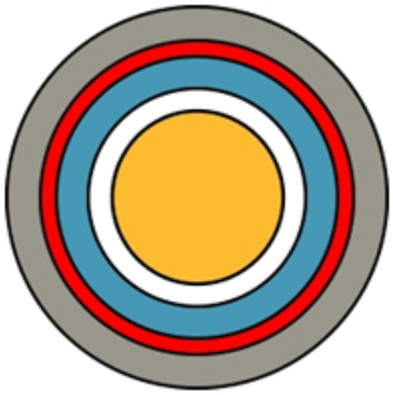
The official website of Kenneth Noland provides a valuable background to the artist, as well as clear images of much of his work. Several international newspapers (for example, The New York Times, The Washington Post, The Guardian, and The Independent) provide interesting discussions relating to his style and popularity in their obituaries.

In the classroom

The geometric, regular design of many of Noland's paintings lends itself well to inspiring mathematical activities in the classroom. Here are just a few to get you started. Let us know of any other ideas you have.



Very young children will enjoy naming and counting simple shapes shown in Noland's work. For a more open-ended activity relating to the concentric circles in many of the pieces, ask pupils to count how many circles they can see in total, using all widths. Encourage them to record their work in a systematic way, and explain how they will know when they have exhausted all possibilities. Spring Cool, painted in 1962, is a useful, relatively simple starting point; other 'circles' paintings can be found on the Sharecom website.



In this example, there are five separate circles or 'rings'. However, circles of different widths can be found by combining these. For example, the grey and red rings together make a different sized ring, and also those coloured red and blue. The pupils will need to discuss their 'rules' around the term 'different'.

How many possibilities can they find?

Can they design their own image that has a total of twelve different circles? How many 'rings' do they need to draw?

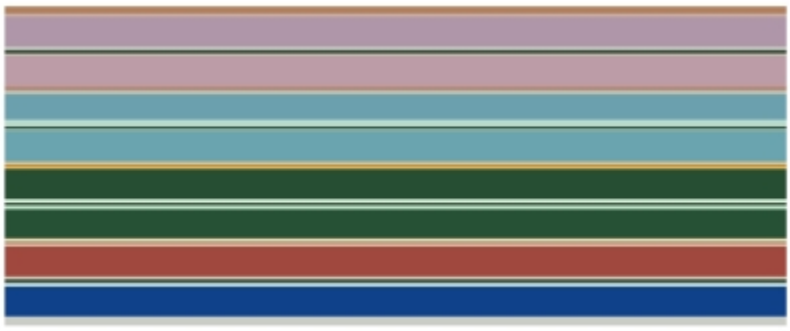
A similar activity can be carried out using one of Noland's later works, representing a tartan or checked design formed with straight lines. Four such works, all created in 1973, can be accessed on the Kenneth Noland website.

- What shapes can the pupils see?
- How many lines are there?
- How many rectangles?
- How can they work systematically to ensure they have included all possibilities?

These paintings could provide an interesting stimulus for older pupils investigating the relationship between the circumference and diameter of circles. Allow them to measure the outer circumference using a length of string and compare it to the diameter. What do they notice? Let them explore with other circles in the picture. Now measure the diameter of one of the circles. What would they expect the circumference to be? Measure and check.

You could use this as an opportunity to explore drawing concentric circles using Logo.

If these paintings were targets (similar to those used in archery), which colour would an arrow be most likely to hit? Why? Which would be least likely? These conversations, using early language of probability, can be enjoyed successfully even with young children.



The striped paintings can provide a useful starting point for work on fractions and proportion. Select one of Noland's more simple examples and discuss which is the most dominant colour. What fraction of the canvas do they think it covers? Half? One tenth? How can they find out? Ask them to construct a similar image (either on paper, or with the use of ICT) that satisfies given criteria relating to the proportions of various colours.

Noland's chevron paintings fit well with work on classifying, estimating and measuring angles in Key Stage 2. Similar images can be created using ICT and then pupils can be asked to visualise how they would change if the angles were made into acute/obtuse/reflex angles.

When working on simple 'area' activities, display the chevron painting known as C-1964, and ask the pupils to consider which colour covers the largest area on the canvas (white). Can they visualise how many of the small red squares would fit into the green stripe? Is there a relationship between the green and pink? Overlay the image with a square grid and demonstrate how, by counting the squares, the area of each colour on the canvas can be found.

Focus on… The election

With an election looming we thought it was an ideal opportunity to get your class and school involved in some relevant and appropriate mathematics and citizenship activities; learning outcomes will also provide opportunities for PSHE and ICT.

History of Parliament
For an in-depth description of the beginnings of Parliament visit the Parliament UK website, where there is also a page about how Parliament works today; for more information about the Prime Minister and Number 10 Downing Street visit the Number 10 website.

The starting point for discussion around elections in the UK is the consideration of the question 'What is democracy?'

The main focus of this article is the use of handling data and you will find it helpful to read the advice prepared on the use of spreadsheets.

Activities that promote or illustrate democracy, in which children can vote on their preferences, will involve handling data. However, using secondary sources (and there will be plenty as the election approaches) will really provide more opportunities to make the most of a broad range of activities across the handling data cycle (National Curriculum, 2000).

It is also worth noting that children are more involved if they pose their own questions (Graham, 1991)

If you really want to study the UK general election, you may want to become involved in a mock election in your school, maybe using, for example, the resources available from the Y Vote Mock Election website, run by the Hansard Society. The project has received funding from the Department for Children, Schools and Families, and the Electoral Commission. This site contains all the resources required to enable your school to create all the drama of a real UK election.

Short activities

Ask the children: 'How many times can you write your name in one minute?' You can then input the information onto a prepared frequency table that is displayed to the whole class. Ask children to see if there is any relationship between their names and the number of times they have written them. Ask pupils to discuss whether this is a fair competition? Ask pupils to use the data to predict how many times it might be possible to write their names in two minutes/three minutes etc. What might the data show? (Your hand begins to ache and you get slower.) Test out their hypothesis.

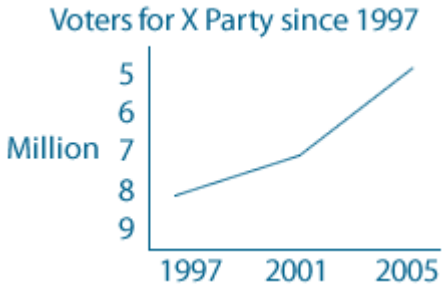
Ask children questions about their preferences about favourite films, songs, stories etc. Ask them to sort themselves into groups, and then encourage them to line up one behind the other in their groups. You can then ask:

- Which is the biggest group? How do you know?
- Which is the smallest group? How do you know?
- How much bigger is the x group than the y group? What does this tell you?
- What would happen if…?

An extension of this would be to use Venn diagrams and Carroll diagrams to sort children, for example. These could be set out on the floor and children could move to sort themselves into the categories.

	Boy	Not boy
watches The X Factor		
doesn't watch The X Factor		

Older children could look at graphs that misrepresent the information (pie charts are really interesting to look at with children as they are often misleading). Ask the children what is misleading about the information presented. Discuss why people might want to present information that is misleading. Discuss how the data might be better presented. This activity could also be linked with persuasive texts in literacy. Stress that just because the information is misrepresented it does not necessarily mean the graph is incorrect.



Longer activities

If you are taking part in the Y Vote Mock Election you may want to consider:

- choosing a political party (real or fictional)
- electing a party leader using a secret vote
- voting for political/school parties (real or local)
- voting on local or national issues. You may want to look at the main political parties and identify the major issues that affect children or ask children to vote on issues that affect them in their school the Y Vote Mock Election website gives details of these
- selecting a local issue in the community, for example asking the council for re-cycling facilities

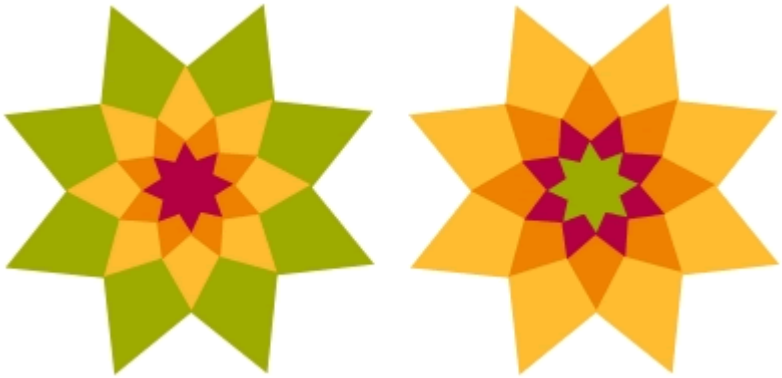
- conducting opinion polls of who the children want to vote for at interim periods of the campaign and compare

Older children could listen out for opinion polls regarding the real election (use of secondary data) and look at factors that may be affecting the polls.
If you proceed with the mock election, children could sort and count the votes.
Post election: children could compare and present data about turnout etc (primary or secondary data).
Past general election data is available on BBC website:

- 2005
- past elections

If you decide not to take part in a mock election you could simulate the democratic process by asking children to plan and organise an event e.g. planning a picnic/end of term disco/sports day/school trip. Planning and then organising an event can provide plenty of opportunity to gather and process data. Work with the children to break the problem up into smaller components. Different groups can then work on different areas, gathering and processing data to help them make decisions e.g. going on a picnic could mean gathering data on preferred venue/sandwiches/drinks etc.

Problem-solving activities
Design an election rosette
Pose this problem: Your campaign manager has asked you to design a campaign rosette. Your rosette of 4 layers – largest, large, medium and small, must be made up using one each of the party's campaign colours: green; red; orange and yellow. How many different rosettes can you make?



This could be simplified so that only two or three colours are used dependent on the age and the ability of the children. You could also get them to make campaign rosettes – this would make a wonderful display of children's reasoning skills.
You could do this activity using Logo. The pupils could design a single rosette and decide what variable needs to change to make the rosette larger and by how much the next largest rosette would need to rotate to sit below it.

Other activities linked to the democratic process can be found on the website of The Electoral Commission.

A little bit of history
Famous Mathematicians – Leonhard Euler (1707 - 1783)

Euler, (pronounced *oylar* in English – not *ewla*!) was born in Basel, Switzerland, but spent most of his life in Russia and Germany. He is thought to be the greatest mathematician of the 18th century. He made important discoveries in calculus and graph theories and he also introduced much of the mathematical terminology and notations that we use today. He is well known for his work in mechanics, fluid dynamics, optics and astronomy.

He was so well thought of he has featured on a Swiss 10-franc banknote, on many Swiss, German and Russian postage stamps and he has an asteroid named after him!

His parents were Paul Euler, a Christian pastor, and Marguerite Brucker, a pastor's daughter. He had two younger sisters, Anna Maria and Maria Magdalena. Soon after his birth, the Eulers moved to the town of Riehen, where Euler spent most of his childhood. His father was a friend of Johann Bernoulli, regarded at the time as Europe's foremost mathematician, and who would become the most important influence on Euler.

At 13 Euler joined the University of Basel, and at 16 he received an MA in philosophy, with a dissertation that equalled the works of Descartes and Isaac Newton.

When he was at university he was tutored on Saturday afternoons by Johann Bernoulli, who quickly discovered Euler's incredible talent for mathematics. He was also studying theology, Greek and Hebrew at his father's request because he wanted him to become a pastor. Although he was a Christian, he wanted to pursue a life in mathematics and Bernoulli convinced Euler's father that this was what he should do because of his extraordinary talent.

In 1727, when he was just 20, he entered the Paris Academy Prize Problem competition in which he came second. During his life, he was to win it 12 times!

In the same year, Euler accepted a position at the Imperial Russian Academy of Sciences in St Petersburg as a physiologist which had become vacant after the death of one of Bernoulli's sons. He was soon promoted to a position in the mathematics department. Four years later he was made professor of physics and two years after that he became head of the mathematics department – at 26!

On 7 January 1734, he married Katharina Gsell and they had 13 children, of whom only five survived.

In 1741, due to problems in Russia he moved to Germany taking up a post at the Berlin Academy. He lived in Berlin for 25 years and wrote numerous articles and books connected to mathematics.

In 1732, Euler suffered a near fatal fever and three years later he became nearly blind in his right eye. In 1766, a cataract in his left eye left him almost totally blind. This seemed to have little effect on his career as he had great mental calculation skills and a photographic memory.

He returned to Russia and spent the rest of his life there working at the St Petersburg Academy. Unfortunately, this second stay in St Petersburg was marred with sadness – in 1771 a fire cost him his home and nearly his life; in 1773 he lost his wife of 40 years. He died in 1783 after suffering a brain haemorrhage.

His contributions to mathematics were numerous but mostly recognised in secondary- and degree-level maths courses. However, he has produced an interesting formula for polyhedrons which you might like to try out with your class:

Euler's formula: V – E + F = 2

V equals vertices, E equals edges and F equals faces e.g. cube: 8 vertices – 12 edges + 6 faces = 2.

You could ask your children to see if this works for a variety of 3D shapes.

Article sourced from these sites:

- Wikipedia
- University of St Andrews History of Mathematics

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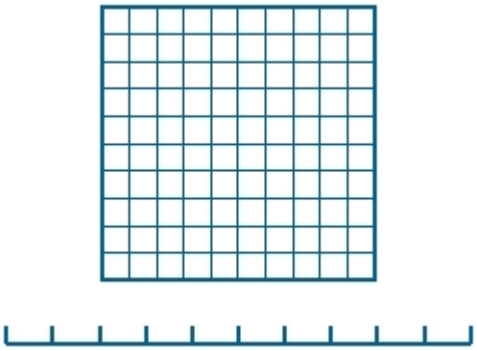
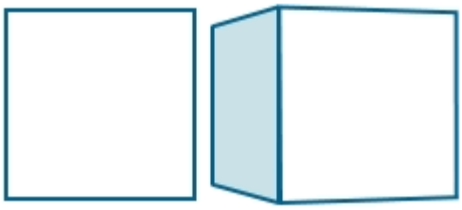
Maths to share – CPD for your school
Visualisation

A common metaphor for understanding something is that we 'see' it. 'Visualising' means being able to summon a mental image of something, seeing it in your mind. The image may be of some geometrical shape, or of a graph or diagram, or it may be some set of symbols or some procedure. While some people can actually close their eyes and 'see' a picture, for the rest of us it has more to do with imagining. There are many aids to visualisation. Drawing a diagram helps us to share our visualisation with others and we also mentally adapt physical apparatus.



There is a great deal of visualisation in mathematics. If you really want to grasp a concept or idea, struggling to visualise it is worthwhile. The empty numberline is a useful image for children to use to support their manipulation of number, but they are also visualising the order of the numbers as they use it. All the various models and images we encourage children to use to support their mathematics become visualisations, particularly when used without the apparatus being present.



We use visualisation in almost every area of mathematics. Blocks B and D of the National Strategies primary framework frequently refer to visualisation in relation to 2D and 3D shapes, including reflection, rotation and translation and also with position, direction and distance. They also produced a very useful CD with posters, for teachers to show all the different ways of visualising number. It would be worth flagging these up with staff to find out how many have seen or used this material. If appropriate you could explore them at the end of the session.

Before the meeting
You will need to collect the following items:

- a flip chart or large sheets of paper
- a whiteboard, pen and rubber each
- a copy of Thinking Through, and By, Visualising for each participant
-

- a pack of 1 to 100 cards
- a tray of interlocking cubes
- a copy of the National Numeracy Strategy booklet, Shape and space activities, for each participant.

At the meeting
Begin the session by asking colleagues what visualisation is. Ask them to discuss their ideas with the person next to them, then share with everyone. List the ideas on a flip chart.

Next, ask when we use visualisation in mathematics. Again, list ideas on the flipchart.

Activity 1
Now ask everyone to do some visualising. Explain that you will describe a scenario and you would like them to draw what they visualise on their whiteboards.

1. imagine a large, deep bowl of water. Take a ball and float it on the surface. What shape is cut into the surface of the water? Compare drawings
2. imagine the same bowl of water. This time, take a cube and push one corner into the water. Draw the shape cut into the surface of the water and compare with colleagues. Some people will find this task easier than others
    - push the cube in further. What is the shape cutting the surface now?
    - what if the shape was a square-based pyramid?
    - what if it was a fork? First, just breaking the surface, then deeper
    - try a shoe, a hat, a coathanger up to the hanging hook...

Activity 2
Give everyone a copy of the NRICH article and ask them to read to the end of the section headed 'Visualising to model a situation'. Split the group into two and ask one group to have a go at the card problem, the other to explore the cubes problem. If necessary, split into four, with two groups trying each activity. Give the groups around 15 minutes to try out the problem, then ask them to report back. How did they find the activity? Were the instructions easy to understand? Did they try a simple case first? Could they use this activity with their classes? How could the activity be simplified for use with younger children?

Activity 3
Read the section in the NRICH article on visualising skills. Focus on the list of skills: Internalising; Identifying; Comparing; Connecting; Sharing.
Working with your year group partners, in key stages or in small groups appropriate for your setting, identify which skills are developing in your class and which ones you need to focus on.

To round off

Revisit the flip chart sheet, what visualisation is and when we use visualisation in mathematics. What can participants add to the sheets?

Give everyone a copy of the National Numeracy Strategy leaflet, Shape and space activities, which focuses on helping children to visualise and describe shapes and their properties. Pages 3, 4 and 5 contain 15 short mathematical imaginings, while pages 6 and 7 contain three longer mathematical imaginings. Ask everyone to choose an activity to use with their own class. If it is possible to have a few minutes at the beginning of another session to discuss experiences, then give a date for reporting back.

The Open University offers a free six-hour short course Using visualisation in maths teaching as part of their OpenLearn Learning Space. Although aimed at Key Stage 3, much of it is nevertheless relevant to primary school teachers.