# Equals

mathematics *and* special educational needs

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MATHEMATICAL ASSOCIATION
supporting mathematics in education

Equals
mathematics and special educational needs



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# Editorial

"They should put darts on the maths syllabus", so proclaimed eleven-times world darts champion Phil 'the Power' Taylor in a recent article in *The Guardian*.[1] He went on to say what a wonderful discipline it is for children.

"Say you've got a 107 finish. What's the best way to get there? Treble 20, 7 and double top is the obvious one. But if you miss out on a 20 and you hit a big 1 or big 5, you can't finish. So you have to use your head, take a different route. If you go treble 19, that leaves you with 10 and double top. Easy."

Perhaps one of our readers could explain why this is 'easier' but nonetheless the enthusiasm for the mental mathematics in the article is infectious. At the end of the article he sets the challenge of how to finish when you are on 161 – remember you have to finish on a double.

Enthusiasm is an essential ingredient for a successful mathematics lesson or for learning anything for that matter. How many people loved to watch Patrick Moore talking about astronomy, did not understand a word he said and yet still became interested in the subject as a result? It is enthusiasm that excites the mind and stirs interest in people young and old.

We hope our contributors to this edition of *Equals* will fire your interest and enthusiasm. The game of darts is an obvious way of developing mental mathematics skills and Carla Finesilver describes how she uses a simple table top game to develop her pupils' numerical thinking. Mark Pepper continues the games theme through discussion of various games he has used within the mental and oral starter as well as other engaging activities for this much misunderstood part of the mathematics lesson. (Am I the only one who cringes when I hear the phrase 'mental warm-up'?) Jane Gabb shows ways in which the simple counting stick can be used to provide engaging activities during all parts of the lesson and links her ideas to objectives in the yearly teaching programmes.

Stories have always enthused children and Alan Edmiston tells us how he uses stories to provide the stimulus for CAME thinking mathematics lessons[2]. I remember being fascinated by the Konisberg Bridge problem[3] just because it was in the context of a story of people wanting to go for an evening stroll without going over the same part of the route twice. We would be fascinated to hear about stories that teachers have used to inspire mathematics for their classes or stories which have inspired them to do some mathematics themselves.

Art is full of mathematics (& not just geometry) and a Berkshire school's 'Maths in Art' day was clearly a great success. Joanna Alexander talks about what she did and shares some of her pupils' work. Citizenship is one of the whole school cross-curricular themes which is often deemed to be unsatisfactory by Ofsted. Our centre spread, reproduced from a recent publication of Amnesty International, reviewed in this issue, shows one example of how mathematics can contribute to pupils' understanding of this aspect of the National Curriculum. The whole idea of mathematics across the curriculum has not really taken off in either primary or secondary schools. We would be really interested to hear of anything that your school has done in this field.

'You need hands' so proclaimed Max Bygraves in his famous song (1958 Decca Records) and Rachel Gibbons proclaims the same mathematical message in her history of the 'earliest counting machine'. Related to this is the amazing response to our request for information about 'gypsy' mathematics. Read our readers' responses on p 20. We were also interested to note that the latest issue of *Circa Maths Magazine*[4] devotes two pages to the use of fingers for number work ("You can always count on your fingers" and "Medieval Multiplying").

Inclusion is rightly at the heart of the government's education agenda and therefore, the whole editorial team were very disturbed that schools are allowed to discriminate in the way that 'Dotherkids Hall School' did. The parents' anger expressed in their letter to us was certainly well founded. Also contributing to the inclusion debate is Dylan Wiliam and Hannah Bartholomew's research into setting and streaming.

Finally, we want to give away some money! Now we have grabbed your attention we are once again looking for entries to the Harry Hewitt Memorial Award. Any pupil, who through their efforts and the efforts of their teacher(s), has overcome a difficulty in mathematics, is eligible for the award of a £25 book token. We will publish the winning entries in future editions of *Equals*.

As we go into our second decade of publication of *Equals* please accept the editorial teams' best wishes for a very happy mathematical new year!

1. " Inside Story", *The Guardian*, 19th November 2004
2. Cognitive Acceleration in Mathematics Education
3. http://library.thinkquest.org/25672/konisbur.htm
4. *Circa Maths Magazine*, Vo.l 0 issue 28. www.circamaths.co.uk

## Harry Hewitt Memorial Award

Do you have a pupil who has struggled with mathematics and is now winning through?

Celebrate their success in *Equals*!

We are offering a prize of £25 to the best entry we receive.
The winning entry will be published in *Equals*.

Choose a piece of work from a pupil that you and the pupil consider successful and send the original piece of work to *Equals* together with:

• an explanation from the teacher as to how it arose;
• a description of the barriers which the pupil has overcome in doing it;
• the pupil's age, school and context of the class.

Entries for should be received by June 30th 2005.

# It's the Way I Tell Them!

Ensuring the attention of children is the key to their engagement, leading to a meaningful lesson. **Alan Edmiston** recounts his discovery that stories at the start of lessons make a difference with children of all abilities. He thinks of story-telling as a strategy both to engage and to challenge.

I have already shared with *Equals*' readers[1] my thoughts concerning the impact of the interactive thinking lessons approach (CAME) upon a particularly disadvantaged group of pupils. Then I gave an outline of one particular lesson that helped me gain an insight into the social nature of the mathematics classroom: in particular how important it was to give attention and time to ways of talking and sharing ideas by pupils in their own ways and at their various levels.

In this article I propose to focus on one small aspect of this methodology that has become very important to me (and those mathematics teachers I work with) – the very start of a mathematics lesson. Simply stated this is about my regular use, across Year 1 to 8, of a story telling strategy to begin many of my lessons. As a consultant I do work across these ages and this article is merely a story about the telling of stories in some of these mathematics lessons.

**A teacher stumbles on something seemingly valuable**

My discovery of this strategy began when I was teaching science to a difficult Year 9 class. While trying to bring some meaning and excitement to the topic of friction I related an account of the time I crashed a car, steering the talk gradually to use of brakes etc. Something must have worked, for during their remaining 2 years I was constantly asked to tell 'that' story again and again. The path of my future professional development, unknown to me, was now set in motion with that single encounter.

The story telling strategy further developed through two key encounters with new approaches:

- Cognitive Acceleration through Mathematics (CAME) project for Years 7 & 8
- Philosophy for Children (P4C) training course for 'enquiry' Reception onward

All the 'enquiries' I carried out involved in the initial stages discussions of popular children's stories. All I had to do was to read them a story and in response to this the pupils would decide (and vote upon) the questions they would like to discuss. Obviously all of this was new to me as during each enquiry I had no control over the direction which the resultant discussion would take. As a teacher used to delivering content, my role in P4C was very different but it allowed me to see how I could still guide and stimulate fruitful thinking. I found such thought explorations both challenging and rewarding and as a direct consequence my ability to ask the right question to both probe, engage and challenge improved considerably. All this came in handy in the mathematics classroom too.

At the same time I was experimenting in the reception class, I was also involved in supporting teachers with delivering the Thinking Mathematics lessons. For me this was a belated mathematical eye opener as I was brought up, mathematically so to speak, on a diet of "Sit still and be quiet" and "The next person to talk will get the cane!" instruction-type lessons. For me such experiences during the early part of secondary school fostered the notion that mathematics was all about individual effort and silent toil over pages and pages of sums. This became so much the norm that I began to be obsessed with the ticks the teacher used to annotate my work. So much so that by Year 9 this had manifested itself into a competition among peers to see who had got the 'biggest tick' that day.

**Higher challenges are possible across the ability range**

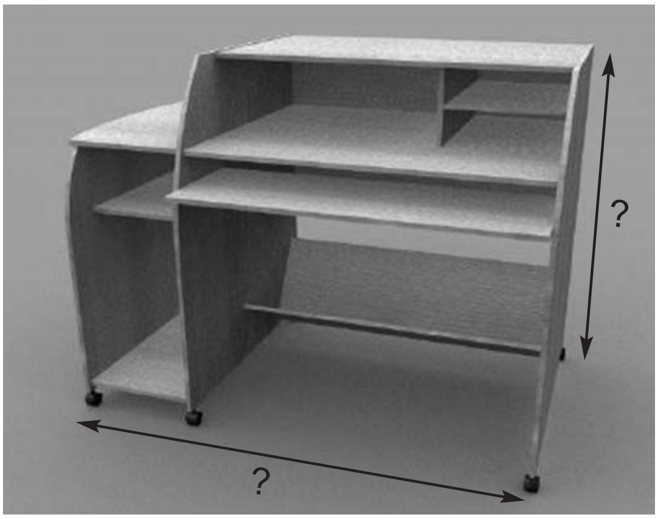
With practice in different classes it slowly became more comfortable for me to challenge pupils to reach out towards higher levels of mathematical attainment rather than work at their comfort levels. I began to see just what Year 7 pupils were capable of - much more than we expect of them - provided you lead them to the challenge by engaging them with the context. This idea of 'the challenge' became so important that I began to structure the lesson towards ensuring it, thinking carefully and experimenting with resulting reasoning progression. And the key is pupils' initial engagement.

I also realised that the range of ability is of little consequence in most cases! This was dramatically brought home to me when I was working within the same month in schools at both the 'top' and 'bottom' of the league table (one with <15% and another with a >75% A-C pass rate), in grammar, independent and EAZ schools, and in classes in England, Northern Ireland, Scotland and Wales.

With such a wide 'range' of pupils the concept, and language, of mixed ability and setting became meaningless. For example in one school I was told I had been given the 'top set' in Year 8 when there were only 50 pupils in the year! Soon I ceased to see 'ability', but just anonymous groups of pupils who were 11 or 14 or 9. With this in mind and with the erosion of my own 'ability expectations', and having no knowledge of the pupils as individuals, I began to further develop my model of how to challenge each particular group regardless of their school or ability. The main development of this, and the most relevant for the purpose of this activity, was the idea of telling stories as a means of engaging and involving the pupils right from the beginning of any lesson. It is probably best if I now simply relate a number of these ideas as I use them today. The reader need only glimpse at the rough idea of the intended mathematics lesson, and look at the way the children can be led slowly to it.

**Exploring average personal measurements through the eyes of a 5 year old girl**

'Best size desk' is a practical activity on spatial perception and data handling for pupils age 11.




The pupils have to decide upon and then roughly measure the main features of a desk (gradually concentrating on length, width and height) suited to them individually prior to collating and exploring the average measures for the class. I used to begin by telling them they each were going to be given a new desk as a Christmas present and asking them to think about the important features. Usually this worked well but I felt it was too dry and a desk was not really exciting to engage all pupils. But then I introduced a personal note about a 5-year old. It goes like this:

'At the weekend my daughter watched Mary Poppins again. She used to love it and as it was raining we all sat down to have a good sing along. The problem was that when it came to the part where Mr Banks tears up the letter for the new nanny, and put it in the grate, she realised that she had not written her letter to Santa yet. She thinks that is what happens with letters to Father Christmas – they float up in the air to Lapland! So she wrote her letter and asked for a dolly and some felt pens. She was thinking about what else she could ask when she remembered her house in the garden. We had bought her a wooden house for her birthday. So she said 'I wonder if Santa will bring me a desk for my house?'

At this point I ask the class 'what kind of desk a 5 year old girl would like?' Very quickly they mention that it would be a pink Barbie desk. I tell them that yes that is what she wanted. At this point I turn to the nearest boy and ask 'Do you want a pink desk?' To which he indignantly replies 'No!' I now ask them to think about and discuss what kind of desk they would ask for if they were in the same situation.' It would still lead to the different sizes, then to measurements. But they seem much more engaged. The personal note seems to humanise the relationship between them and myself. Now I am really a parent or an uncle. Of course, I could relay a story about any child that sounds plausible to them. And, of course, the story can be shorter, but then you want to draw them gradually from their various engagements into something common, and that needs time.

**Exploring awareness of change of mind with Mr Messy**

There is a well structured thinking lesson that contrasts area and perimeter, challenging pupils to explore the misconceptions involved. In the story-telling approach it needs two stories to set the scene, one merely about how familiar things can look different when viewed by a different eye, and the other to develop the mathematics. The activity itself leads the pupils to draw rectangles of area 12 and 24 units, aligning each group with a common corner, then switching attention to the shape of the curve that results from joining the opposite corner. But look at the start below:

'My daughter had been playing at Kirstie's house and came home with the Barbie Nutcracker video. As my wife was going out I said she could watch it while I fed and bathed her little sister. Half an hour later she switched off the telly and asked me if she could play in her room before bathtime. I gladly said yes and she disappeared into her room to play quietly which gave me time to play with my youngest girl. Some time later I ran the bath and called her to come and get changed. There was silence and so I walked into her room only to be faced with the biggest mess in the history of messes. Mr Messy had really been having a messy time. Piles of toys were scattered all over the floor and every other available surface. As my anger rose and I began to say 'Look at the mess. What have you done? Your Mum will kill me!' she simply looked up at me and said 'Daddy clam down, can't you see the dollies are going to the wedding?' I marched towards her very angry but then I stopped and looked. In front of me were 6 dolls sitting in a circle around my daughter with a pile of clothes neatly shared among them.

At this point in the story I now tell the class that I could not be angry with her as I saw the room differently and felt that she had been playing very constructively. I now tell the whole class that the aim of the lesson today is for them to tell me at the end of the lesson, what they have seen differently about the shapes we are going to work with.

I now move on to tell them about how

the next day we got some books down from the loft for my youngest to read. Once my eldest saw them she wanted to read them all over again. After looking through one book she turned to us and said 'Daddy, didn't I used to read a lot of shape books? I wonder how Ruby will like them?' I now ask the class to think about what shapes should go into a book for 2 – 3 year old children before asking them to think about the shapes in the room around them.'

The stories above show how far I have come since that incident 13 years ago with the Y9 class and the physics friction lesson. To me the use of stories provides a cognitive flow that forms a thinking thread that runs throughout the whole lesson. This thread serves to engage them on the initial part of the journey. Once the main activity has begun and the level of engagement has risen the story has been left behind and before they know it they have entered a very different and mathematical world. Managing learning in this way has a big advantage for me in that I am now able to work with and challenge a far greater number of pupils. For me the mathematics classroom is now no longer a world of quiet compliance and wrist ache!

Yes I know that the stories included above will date easily, not simply because my daughter is unable to join Peter Pan and stay 5 for ever. But I do feel they highlight how I am beginning to use the CAME materials to include and engage the whole range of pupils. Stories work, even for me without the constant reference to my children, as I found when I had to teach a lesson with a friend of my daughter and thought 'Hang on I better think of another story and quick!' After all Jesus taught in parables, and they have lasted for thousands of years, so why don't we?

*Sunderland*

1. (See *Equals* Vol. 9 no.1 - 'A Tale of Two Cultures')

# Maths in Art
# The Creative Side of Mathematics

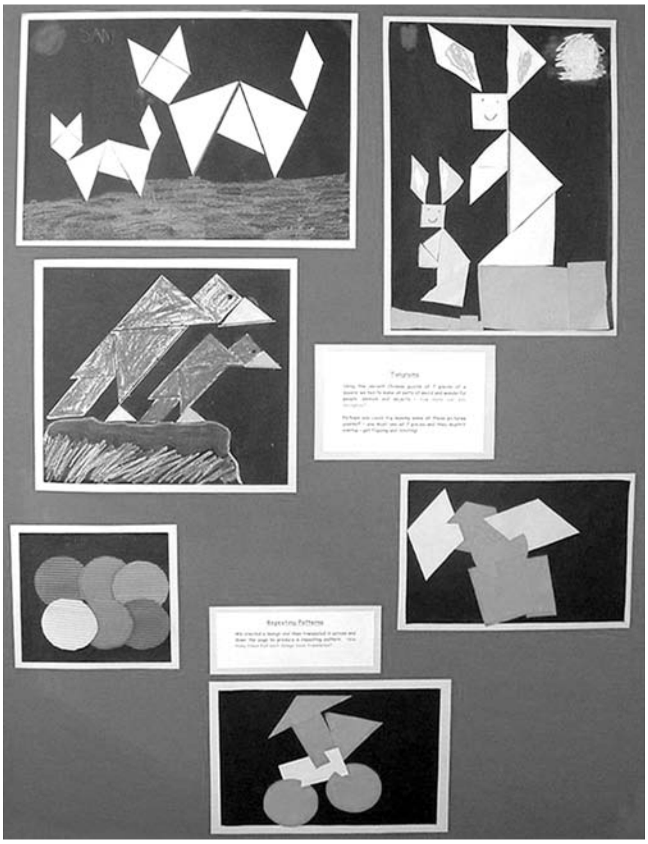
In July five teachers from Cookham Rise school near Maidenhead attended an afternoon's INSET on 'Maths in Art'. Three months later they held a maths day with the theme 'Maths in Art', which **Joanna Alexander** describes.

Having a maths day at Cookham Rise Primary School has become something of a tradition; this year it was held on Tuesday 12th October with the theme 'Maths in Art'. We mixed all the classes up so that each activity group had children from Year 1 to Year 6. Parents and governors joined us for some sessions too.

We had lots of fun and produced some very creative mathematical masterpieces along the way! Here are the activities we did and the subsequent questions we asked:

**• Tangrams**

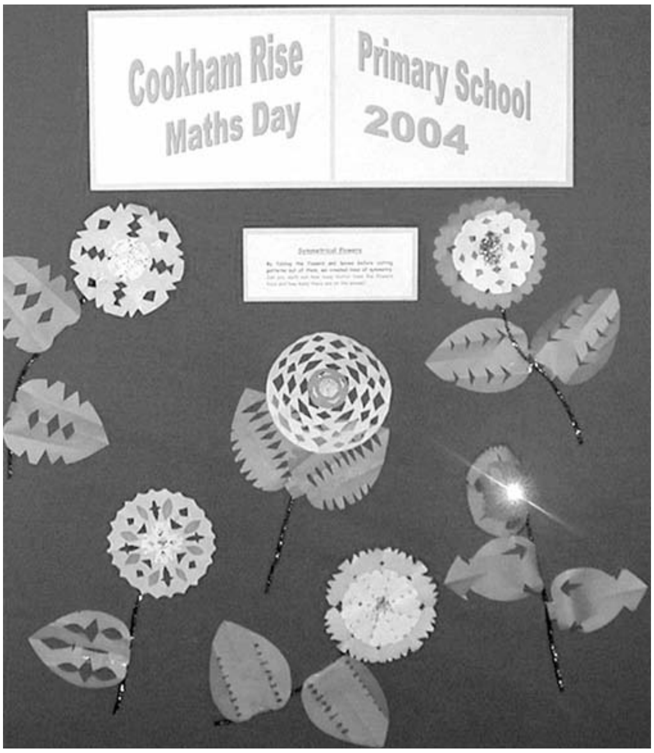
Using the ancient Chinese puzzle of 7 pieces of a square, we had to make all sorts of weird and wonderful people, animals and objects – how many can you recognise?



Perhaps you could try making some of these pictures yourself – you must use all 7 pieces and they mustn't overlap – get flipping and rotating!

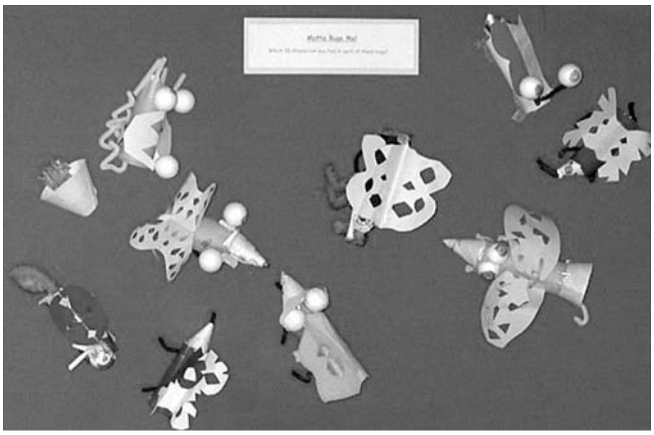
**• Symmetrical flowers**

By folding the flowers and leaves before cutting patterns out of them, we created lines of symmetry. Can you work out how many mirror lines the flowers have and how many there are on the leaves?




**• Maths Bugs Me!**

Which 3D shapes can you find in each of these bugs?



**• ICT**

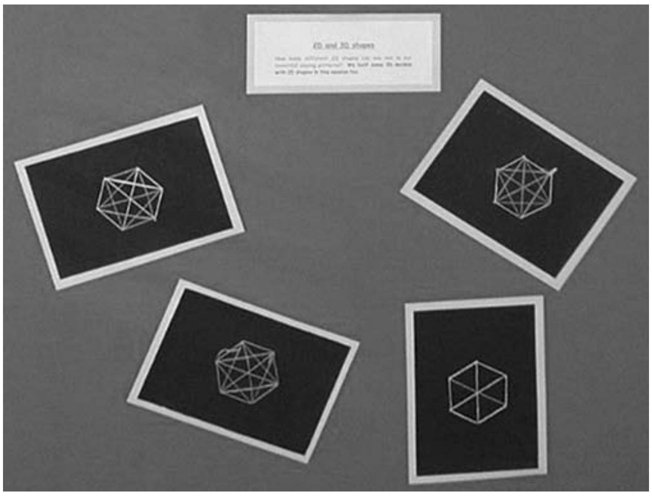
We used the program 'Revelation Natural Art' to create half a picture and then we had to copy, paste and flip it to create a mirror image for the other half. Can you see where the line of symmetry is?

**• Repeating Patterns**

We created a design and then translated it across and down the page to produce a repeating pattern. How many times had each design been translated?

**• 2D and 3D shapes**

How many different 2D shapes can you see in our beautiful sewing patterns? We built some 3D models with 2D shapes in this session too.



**• Tessellations**

The work of Escher inspired us to create pictures by tessellating (fitting together without any gaps) different shapes. Part of the work here was to work out which shapes will and which shapes won't tessellate.

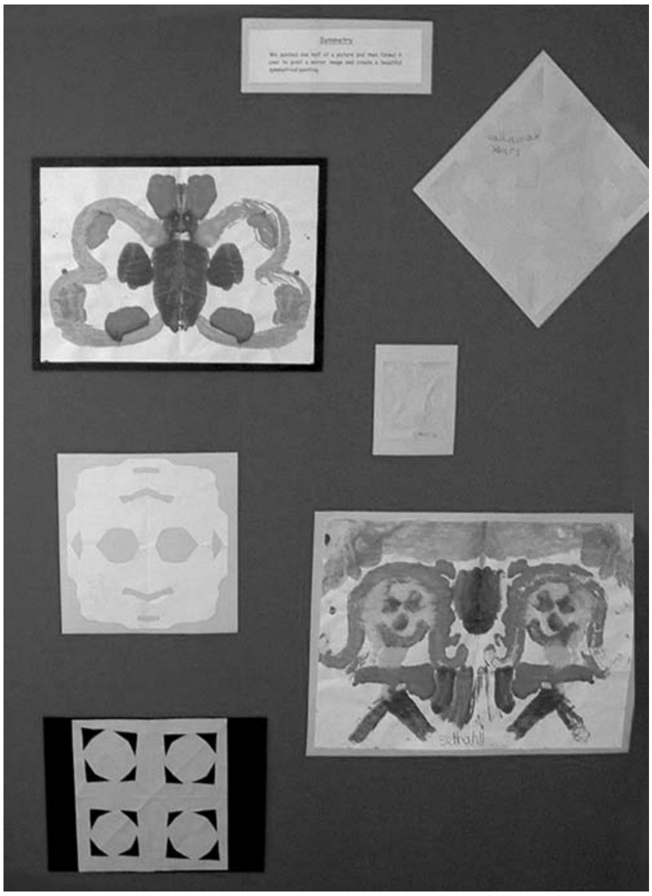
We cut a piece off one side of a square and stuck it on the other side to make a tessellating pattern just like Escher. This works with other shapes too.

**• Symmetry**

We painted one half of a picture and then folded it over to print a mirror image and create a beautiful symmetrical painting.

**• Finally**

We finished the day with an assembly in which the Year 6 leaders from each activity group told us about one of the activities (as each group only got to do 4 of the 8 sessions) and showed some samples of work



from throughout the day. We also talked about all the mathematical vocabulary that had been used during the day. One of the most valuable things for me about the way we organise these days, apart from the obvious raising the profile and enjoyment of maths for the children and the parents, is seeing children of all ages work together on the same activities, helping and learning from each other.

We then displayed our work in Maidenhead library for 2 weeks. The photographs are from that display.

*Cookham Rise Primary School*
*Royal Borough of Windsor and Maidenhead*

**Nobel Peace Prize for woman of 30m trees**
**First female African to win the award**

Professor Wangari Maathi created a women's movement which has planted more than 30 million trees in 20 countries. … In 1977 she walked into the ministry of Forests in Nairobi and asked for 15m tree seedlings to stop soil erosion, provide fuel and improve the lot of the poorest communities. … She encouraged the setting up of more than 5,000 tree nurseries which were run by women and disabled people. … In 1999 there were three days of rioting in Nairobi, and international outrage, after she and thousands of supporters were beaten and tear-gassed while trying to plant trees in Kaura forest near the city.

*Guardian* 09.10,04

# Counting Activities

Counting can be done as a whole class activity, explains **Jane Gabb**, provided those who are least skilled at it are included early.

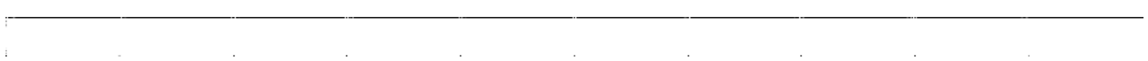
Counting can be done as a class in unison or with one pupil following on from another i.e. counting round the class. In the latter case the least able should be included early in the count - but not first - so that they have a chance to understand the pattern but before the numbers become too difficult.

Counting activities linked to Year 7 objectives

| Learning Objective | Counting tasks |
|---|---|
| Y7 understand and use decimal notation and place value | • Start from any single digit and count in 10s e.g. 4, 14, 24<br>• Start from e.g. 256 and count down in 10s<br>• Count up from 0.7 in steps of 0.1, or down from 8.7<br>• Start from any number and count up in 100s |
| Y7 understand negative numbers as positions on a number line | • Start from +15 and count down in 1s<br>• Start from –20 and count up in 1s<br>• Start from 25 and count down in 2s<br>• Start from –40 and count up in 5s |
| Y7 recognise and use multiples/ consolidate rapid recall of multiplication facts to 10 x 10 | • Count up or down in multiples of your choice<br>• Intersperse with questions to test out knowledge of multiplication and division facts out of the context of counting<br>• Ask questions like *Is 42 a multiple of 3?* |
| Y7 begin to add and subtract simple fractions | • Count up or down in halves, quarters, tenths, thirds, eighths<br>• Ask questions like *How many halves in* $5\frac{1}{2}$*?* |
| Y7 generate simple sequences | • Start a sequence by writing the first 3 terms on the board e.g. 2, 5, 8 or 75, 71, 67 Class continues<br>• Ask a pupil to start his/her own sequence, class continues |

## Using a Counting Stick

A counting stick can be made from a piece of doweling or plastic conduit approx. 1m. long. It needs to be marked into 10 equal sections and covered with tape in alternate sections so it looks like this:



Alternatively, many educational suppliers now produce them commercially.

It can be used for many different activities. Some examples are given below.

**For Early Number work:**

**• Counting forward and back**

Use numbers 0-10 on cards with blutak and attach to the stick in the appropriate places. Count up to 10 and count backwards. Remove some of the numbers and ask what's missing. Gradually remove all the numbers and get them to count up and down while you point at the places on the stick.

Ask questions like What's one more/less than …… ? Start counting up or down in the middle of the stick to establish counting on from other numbers than 0.

Then do the same with numbers 10 to 20. Or 0 to 20 with even numbers at the joins.

**• Number bonds to 10.**
Show how the stick can be 'cut' in different places. How many spaces this side/that side? What do they add up to? How many different combinations add up to 10?

**• Times tables work**
Using card numbers and blutak for a particular times table, first derive all the multiples, not necessarily in order, referring to the end of the stick (10 x a), the middle (half of 10 x a), other halves and doubles (4 x a is double 2 x a) etc. When they are all on the stick practice chanting the table forwards and backwards, then remove numbers and do the same until they are chanting the whole table fluently including backwards.

**For more advanced work:**

**• Work on reading different scales**
Choose an appropriate scale and explain what each end of the stick represents (or one end and the middle). Touch the stick in various places and invite pupils to say what number is represented by that place on the stick. Start with marked divisions and then move on to halfway between divisions and partway between divisions for estimating. You can also move your finger along and invite them to tell you when you reach a certain point.
e.g. Scale could be 0 – 10 (easy for whole numbers), then introduce 7.5 etc. Estimate 4.2.
0 – 1000 – start with hundreds, then move onto 50s and other 10s for estimation.
0 – 5 to start looking at different values for divisions.
Then 0 – 20, 0 – 50 etc.
-5 to +5 for negative numbers
0.5 to 1.5 for decimal quantities bridging 1

**• Looking at relationships between fractions, decimals and percentages**
Say that the ends of stick are 0 and 1
Ask:
- *What sort of numbers will be in between?*
- *Point to middle – what is this number? As a fraction, decimal? What would it be as a percentage of the whole stick?*
- *Where would $\frac{1}{4}$ be? What is that as a decimal? As a percentage?*
- *Point to 0.2 – What is that as a decimal? As a fraction? As a percentage? How do you know?*
- *Point to 7/10 – What is that as a decimal? As a fraction? As a percentage? How did you work that out?*
- *Point to 40% - What is that as a decimal? As a fraction? As a percentage? Is she/he right? Explain how you know.*
- *Put your hand up when you think I've got to 35%. 62%.*

**• Solving problems in number and time**
Point to the middle point:
*If this is 4.8, what could the end numbers be? What is each interval?*
Move to another point
*What if 4.8 were here?, What could the end numbers be now? What is each interval now?*
*If the middle number is 6.1 and this end is 0.6, what number goes at the other end? What is the interval? Can you count on from the highest number?*

The numbers can be changed depending on the ability of the class.

You could also do a similar activity with time intervals. Choose a time for the central point and either open it out for suggestions of end points, or give one end point, or give an interval for each segment to represent.

**• Solving problems in algebra:**
You can construct similar activities using algebraic expressions.

For instance, start with an expression at the lower end and specify the interval. E.g. *The end is a + b and the interval is a + 2b* – start by counting up the stick. Then point to places on the stick and ask what expression goes there. (Very good for proportional reasoning!)

Choose an expression for the midpoint, say 6a + 3b and ask students to select an interval, then count up from the midpoint and then down. Encourage the use of negative as well as positive expressions for the interval e.g.
a – 2b.

*Royal Borough of Windsor and Maidenhead*

**Oct 04**
Up to 4,000 asylum seekers drown at sea every year as they flee persecution or poverty. Three German aid workers were arrested recently when their ship docked in Sicily with 37 African refugees they had picked up form an inflatable dinghy. However fatality rates were probably higher during the 1970s when tens of thousands of Vietnamese boat people crossed the South China Sea. … "The International Maritime Organisation should encourage support for seafarers who adhere scrupulously to the norms of humanitarianism at sea."
Professor Michael Pugh, *The Guardian* 09.10.04

# The Earliest Calculating Machine – The Hand

As a result of a letter in the last issue, **Rachel Gibbons** has been exploring how the hands have been used down the ages as a calculating tool.

This is the title of a chapter in Georges Ifrah's Universal History of Number.[1] The book contains considerable information about how fingers were used as an aid to calculation in many different civilisations down through the ages. Amongst the Romans Ifrah quotes Cicero,

> "I well know your skill at calculating on your fingers"

and Seneca,

> "Greed was my teacher of arithmetic: I learned to make my fingers the servants of my desires."

Ifrah also describes in detail various methods of counting, indicating very large numbers by using the joints of the fingers which persisted almost to this day in some parts of Asia. He has an interesting reference to bargaining (perhaps reminiscent of the tic-tac of today's bookies?) from Carstein Niebuhr, a Danish traveller in the eighteenth century:

> The two parties indicate what price is asked and what they are willing to pay by touching fingers or knuckles. In doing so they conceal the hand in a corner of their dress, not in order to conceal the mystery of their art but simply in order to hide their dealings from onlookers.

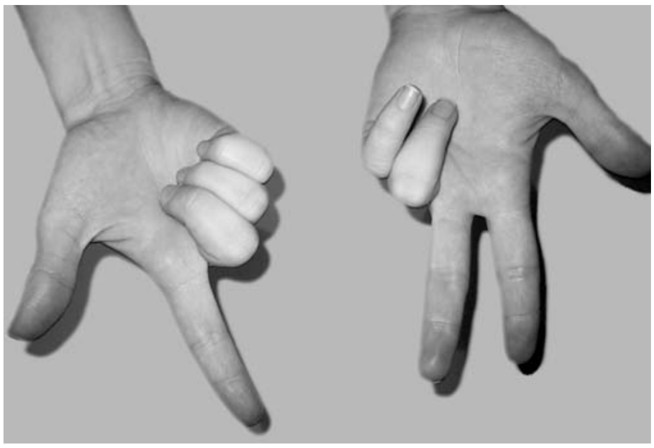
As light relief he describes the ancient game of Morra in which two players stand face to face each holding a closed fist. At the signal each players opens her fist and extends whatever number of fingers she chooses. At the same time each calls out a number from one to ten and if the number called is equal to the total number of fingers held up by both players a point is won. He has a quote from Cicero concerning this game too. Cicero described a man whom you could trust as one with whom you could play micatio (the name for the game in his time) in the dark.

Tobias Danzig in *Number: the Language of science* also has interesting information about finger counting and calculating.[2] He starts with the wider animal kingdom and describes how some species of wasps provide 24 live caterpillars for each egg that is laid. However, he writes that, in general, mammals do not possess such a number sense. My favourite example is Danzig's crow:

> A squire was determined to shoot a crow which made a nest in a watch tower of his estate. Repeatedly he had tried to surprise the bird, but in vain: at the approach of the man the crow would leave its nest. From a distant tree it would watchfully wait until the man had left the tower and return to its nest. One day the squire hit upon a ruse: two men entered the tower, one remained within, the other came out and went on. But the bird was not deceived: it kept away until the other man came out. The experiment was repeated on the succeeding days with two, three, then four men, yet without success. Finally, five men were sent: as before all entered the tower, and one remained while the other four came out and went away. Here the crow lost count. Unable to distinguish between four and five it promptly returned to its nest.

Danzig maintains that man has only evolved a greater number sense through the development of counting on his fingers. One example of using fingers as a multiplication machine is mentioned by Ifrah and Danzig.

Using the hands as a multiplication aid can remove the need to "know your tables" from six to ten. This method is what is sometimes termed "Gypsy Maths" and consists of positioning the fingers of the two hands to indicate the two numbers to be multiplied. Sometimes the positioning concerns finger tip touching, sometimes folding down fingers, but the principle is the same. Ifrah describes the version in which the fingers are folded down. We will illustrate his version by considering how to multiply by 7 by 8. All through we are interested in numbers above 5. Seven is 2 above 5 so fold down two fingers of one hand. Eight is 3 above 5 so fold down 3 fingers of the other hand.



The total number of closed fingers:
2 on first hand, 3 on second
gives you the tens figure – five tens 50
Upright fingers:
3 on first hand, 2 on second 3x2 = 6 six units 6
So 8x7=56

Can you work out why this works? (Solution will be given in the next issue)

1. George Ifrah, *The Universal History of Numbers from prehistory to the invention of the computer*. London: Harvill Press 1998
2. Tobias Danzig, *Number: the language of science*, New York: Doubleday (first published 1930).

# It's the set you're in that counts[1]

A summary of the conclusions reached by **Dylan Wiliam** and **Hannah Bartholomew** as a result of their research into schools' practices in grouping pupils for mathematics. It is interesting to note that both experienced mixed-ability grouping in mathematics personally - Hannah Bartholomew as a pupil and Dylan Wiliam as a teacher.

To obtain their data Wiliam and Bartholomew looked at a cohort of nearly 1,000 students in six London schools over a 4-year period, up to the time they took their GCSEs in summer 2000. All the schools had been judged by Ofsted to be providing a good standard of education. From their observations, they found that the progress made during key stage 4 varied greatly from set to set, top set students averaging nearly half a GCSE grade higher than those in the sets just below and the lowest set students averaging about 2/3 of a grade below them.

Wiliam and Bartholomew point out that because teachers' day to day practice varies considerably according to their personalities, they are difficult to change. Moreover, because of a lack of theorisation of classroom practices, attempts at change have concentrated on administrative aspects, especially on how groups of students are organised rather than the details of what happens to them in these groups. They further note that mixed age groups are shunned in English schools, whereas, in France and Germany for example, 25% of students are taught 'out of age'.

Traditionally, the primary aim in the formation for any learning group has been to reduce the range of attainment in a class because it is believed that this makes teaching easier. To deal with variations in the students' progress in any age cohort, most schools 'group by ability', although what ability means is not made clear. Wiliam and Bartholomew believe that the underlying notions of ability are neither well-founded nor valid predictors of potential. They note that every country that outperforms England in mathematics makes less use of ability grouping. They further confirm that in a 'setted' situation the lower sets are taught by teachers with the lowest qualifications in mathematics who use a much narrower range of teaching approaches than is used in higher sets.

In addition, Wiliam and Bartholomew note that from the early 1960s, after half a century of 'streaming' in primary schools and both streaming and 'setting' in secondary, there was increasing concern about the effects of these strategies. This concern still did not cause the proportion of secondary schools grouping students by ability in at least one subject (usually mathematics) to drop below 90%. Indeed, in 1997 the Department of Education and Employment proposed that setting should be the norm in secondary schools, although earlier research had found teachers overestimated the capability of students in top sets while underestimating that of bottom set students. Nor does this policy recognise the accumulating evidence that setting does not improve overall standards of achievement but that it contributes to social exclusion by polarising achievement - in particular by disadvantaging students from working-class backgrounds. They found that middle-class students outperformed working-class students by more than a whole grade at GCSE. They point out the irony that while government policy is to give parents more choice as to which schools their children attend, they assume at the same time that setting shall be the norm in secondary schools. This denies parents the choice that really matters – being able to send their children to a school that does not set for mathematics.

Finally they urge the present government to consider what might actually improve achievement in schools rather than what is politically expedient.

*ETS, USA & King's College, London*

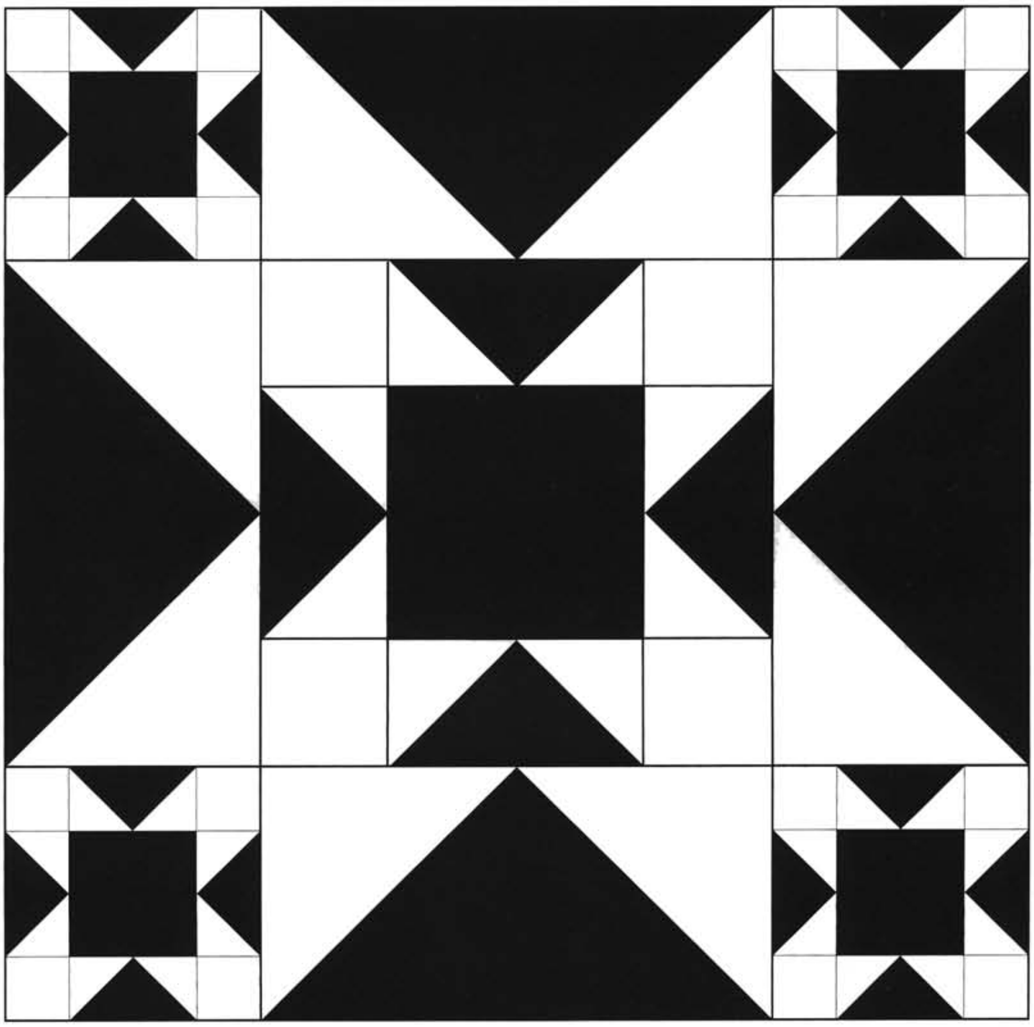
1. Dylan Wiliam & Hannah Bartholomew, "It's not which school but which set you're in that matters: the influence of ability grouping practices on student progress in mathematics", *British Educational Research Journal* Vol. 30, No. 2, April 2004

Shape and space | Using and applying mathematics

# ACTIVITY 9 Amish quilt design

The Amish people of North America maintain a simple way of life with few luxuries and strong community links. They use traditional farming and craft methods such as weaving. Amish quilts are an expression of frugality. They have a practical purpose, but the groups of Amish women who make them are also able to socialise and relax. Quilting is a community activity.

Here is a typical design used on an Amish quilt.



Describe the mathematical properties you can see in the Amish quilt design above.

- What fraction of the design is black?
- Does it have reflective symmetry?
- Does it have rotational symmetry?
- How many different shapes can you see?
- Create your own Amish type quilt design.

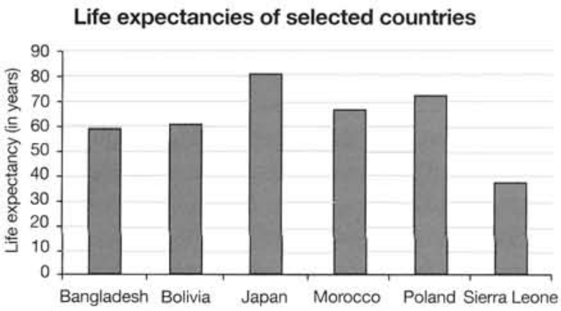
Photocopy original © Amnesty International UK

The following pages are from *Human Rights in the Curriculum - Mathematics* reprinted with permission from Amnesty International.

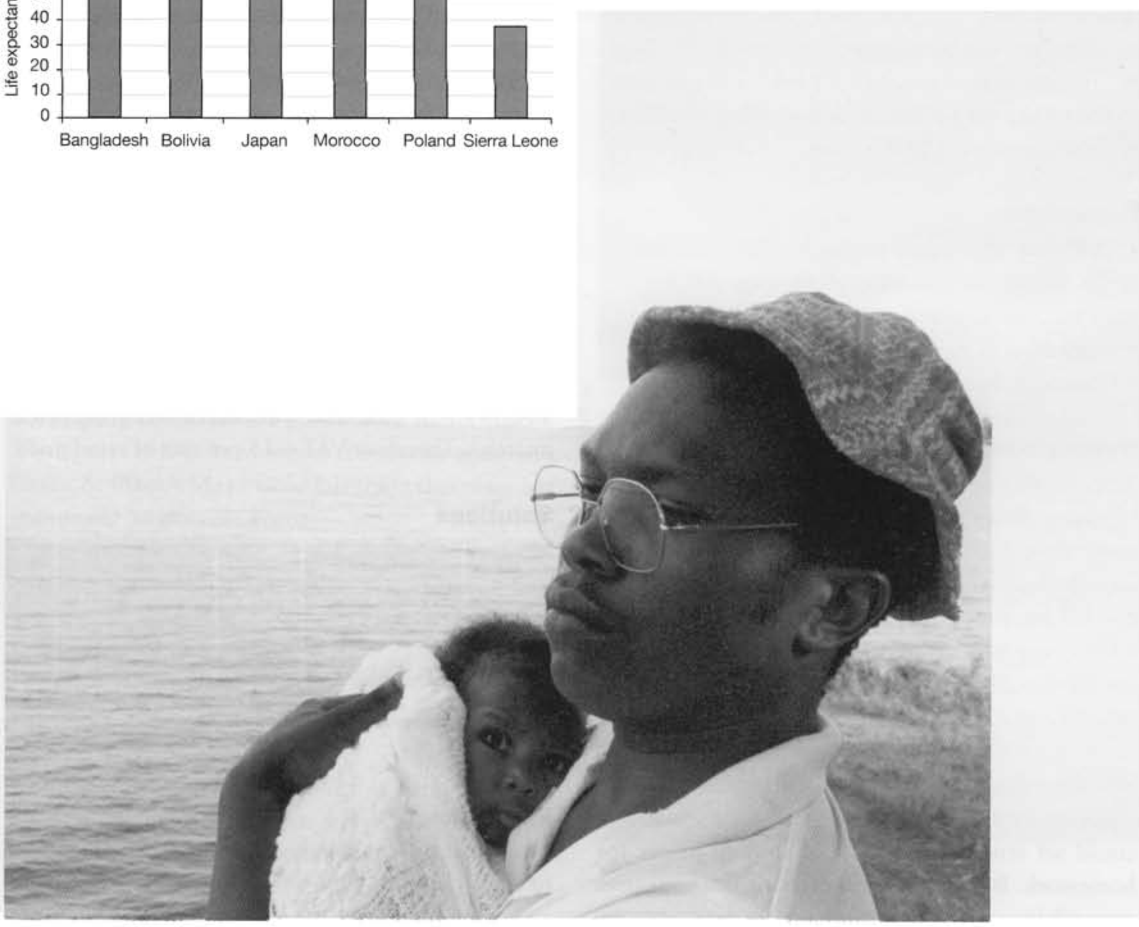
# ACTIVITY 18 Life expectancy

Life expectancy in a country is the average number of years a newborn child can expect to live, assuming that the living conditions in that country do not change.

The bar chart below shows average life expectancy in six countries from different parts of the world. Look at the chart, then answer the questions on the right.




- What does the bar chart tell you about life expectancy in the six countries?
- Choose some countries from different parts of the world.
- Find the life expectancy in each country.
- Represent this data in a bar chart.
- What does your bar chart show?
- What factors do you think might cause a country to have a high life expectancy or a low life expectancy?



© Media for Development International/Courtesy of Photoshare

Uganda 1990: Suna holding his baby, both infected with HIV. Video still from *It's Not Easy*, the first HIV/AIDS drama produced in Africa. Suna is a young business executive with several girlfriends, who ignores warnings about AIDS. When his wife and baby become ill, he learns that he has infected them with HIV. He must also face the prejudices of his co-workers while learning to deal with his illness. Suna turns his despair into hope and determination for those around him.



Photocopy original © Amnesty International UK

**Handling data** | Using and applying mathematics

# ACTIVITY 18 Life expectancy

**Attainment target and levels**

| | | |
|---|---|---|
| England | Handling Data | 3 - 5 |
| Northern Ireland | Handling Data | 4 - 5 |
| Scotland | Information Handling | C onwards |
| Wales | Handling Data | 3 - 5 |

**UDHR Article 25: We all have the right to enjoy a good life. Mothers, children, the elderly, the unemployed and the disabled have the right to be cared for.**

**UDHR Article 3: We all have the right to life, and to live in freedom and safety.**

Universal Declaration of Human Rights 1948

## Learning objectives

- Collecting data from a secondary source, drawing and interpreting a bar chart.
- Comparing life expectancies in various countries in different parts of the world.
- Target age range: 11-13 years.

## Resources

- One copy of the Life expectancy activity (page 13) and a spreadsheet or graph paper for each student or group of students.
- Copies of world development statistics (see Appendix 1, page 77) or access to data from an alternative source, such as the Internet.

## Description of activity

Students use bar charts to interpret and compare life expectancies in different countries. It is important that students are familiar with bar charts.

You may wish to discuss the initial question on the activity sheet with the whole class. Appropriate responses might include: 'Japan has the highest life expectancy'; 'Sierra Leone has the lowest life expectancy'; 'The range of the life expectancies is 43 years'.

Ask the students to compare the life expectancies of people living in different countries and continents. Suggest that they choose countries from the 'industrialised' world and the 'developing' world. They can use the Appendix or the Internet to find the life expectancies.

Encourage the students to use a spreadsheet to record their results and to draw their bar charts.

The final question on the resource sheet could provide a focus for a plenary discussion. Possible factors that might affect life expectancy are: war; natural disasters; nutrition; diseases; healthcare provision; access to safe drinking water; working conditions; housing and social welfare. All of these are directly or indirectly related to poverty.

## Solutions

The values used to produce the bar chart on the resource sheet are for 1999: Bangladesh (59 years), Bolivia (62 years), Japan (81 years), Morocco (67 years), Poland (73 years), Sierra Leone (38 years).

## Variations

Students could use bar charts to compare a different development indicator for countries of their choice. Indicators with integer values below 100 are easiest to use, for example, literacy rates, primary enrolment ratios and infant mortality rates.

Multiple bar charts can be used to compare factors such as male and female life expectancy or adult literacy.

Students will gain a better understanding of how different life is for people living in different countries if you ask them to use their spreadsheets to perform additional calculations, such as finding:

- Mean life expectancy for Europeans, Asians, Australasians etc
- Range of life expectancies across specific areas (e.g. continents)
- Modal life expectancy

These calculations can be performed on all the development indicators. A useful extension would be to use scatter graphs to compare development indicators, and look for link between e.g. infant mortality and life expectancy.

## Useful websites

- United Nations Development Programme at www.undp.org Navigate to the latest Human Development Report, then to Human Development Indicators. (It is useful to make a back-up copy of the relevant web wages.)

Photocopy original © Amnesty International UK

# ACTIVITY 9 Amish quilt design

**Attainment target and levels**

| | | |
|---|---|---|
| England | Shape and Space | 3 - 5 |
| Northern Ireland | Shape and Space | 4 - 6 |
| Scotland | Shape, Position and Movement (if using rotational symmetry otherwise different mixed levels) | E, F onwards |
| Wales | Shape, Space and Measures | 3 - 5 |

**UDHR Article 18: We all have the right to believe in whatever we wish, to have a faith and to change this if we wish.**
Universal Declaration of Human Rights 1948

## Learning objectives

- Consolidating understanding of fractions, reflective and rotational symmetry, congruency and similarity.
- Exploring the geometrical properties of a contemporary design from a different culture.
- Target age range: 11-13 years.

## Resources

- One copy of the Amish quilt design activity (page 12 ) for each student or group of students.
- Centimetre squared paper

## Description of activity

Before students analyse the quilt design, ensure that they understand the appropriate mathematical vocabulary, such as 'line of symmetry', 'order of rotational symmetry', 'congruent', 'similar'. You could do this by asking the whole class to describe simpler shapes and designs.

Encourage students to use the correct vocabulary when describing the symmetry of the design and when classifying the shapes they can see.

## Solutions

- Exactly half of the design is black. Justifying this could promote valuable class discussion during a plenary.
- The design has 4 lines of symmetry and rotational symmetry of order 4.
- There are 8 different sizes of square and 6 different sizes of right-angled isosceles triangles (all similar). There are 10 other sets of similar rectangles with ratios of sides 1:2, 1:3, 1:4, 2:3, 2:5, 2:7, 3:4, 4:5, 4:9, 4:11.

## Variations

- How many triangles are there altogether? (There are 72)
- How many squares? (There are 55)
- Explore the mathematical properties of Islamic designs and designs from other cultures.

Teachers' notes

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# What Makes Mathematics Congenial?

**Mark Pepper** gives some sources for stimulating mathematical experiences for children with special educational needs.

For imaginative activities within the mental maths/oral starter I find I need:

- Maths games
- User-friendly, stimulating resources
- Relevant computer software
- An awareness of the interests both of individuals and of the collective group.

The mental maths/oral starter provides an ideal opportunity for continuous informal assessment of each student; challenging questions can be posed according to the perceived attainment of each student and opportunities are presented to encourage discussion of calculation strategies and to correct any misconceptions. This is likely to stop any student feeling left behind or losing interest in the topic. One round of questions could be based on AT1 Using and Applying Maths with themes such as money or time. A question for a relatively able student could be:

*A can of cola costs 48p. You buy 2 cans and pay with a £1 coin. How much change should you get?*

An appropriate question for a less able student could be:

*One sweet costs 2p. You buy 3 sweets. How much will this cost? Which coins could you use to pay the exact amount?*

In my experience, questions such as these usually maintain the interest and motivation of a group of students with varying degrees of learning difficulty.

**Games allow differentiation, so that the more able can work with the less able, each working at their level. They also provide incentive to good behaviour.**

**Maths Games**

A wide range of maths games is usually of interest to students with special educational needs. Games that I have found to be popular include Shut The Box, Connect 4 and variations of Jody's Pegs (nominally a game for visually impaired students but also popular with sighted students).[1] Additionally, games with a long tradition such as Bagatelle, Snakes and Ladders, Ludo, Dominoes and Draughts continue to generate interest.

The use of construction material such as Clixi or Polydron[2] is also popular with most students. This apparatus consists of squares and triangles that interlock easily to facilitate the construction of 3D shapes. Activities can be differentiated such that a relatively able student could construct a cube whilst a less able student with poor fine motor skills could gain confidence and satisfaction by randomly attaching different shapes.

Some activities with a whole group can also provide enjoyable learning opportunities. I make extensive use of two activities suggested by Anita Straker in *Mental Maths ages 5-7*[3]. One is called Card Game, which I have modified as follows;

I have a pack of number cards ranging from 1-18. I put a specific card on the top of the pack and ask a student to turn it over. The card and difficulty of the question I ask must be appropriate to the level of attainment of the student. For a student of relatively low attainment, I might choose a 5 card and ask;

"How many more to make 6"?

For a relatively able student I would perhaps choose card 16 and ask;

"How many more to make 105?"

If a student gives a correct answer she/he keeps the card. Otherwise the card goes back into the pack. The winner is the player with most cards after 3 rounds.

A second game recommended by Anita Straker is 'Give Away' in which players start the game with 10 cubes each. Each players rolls a 1--6 die and gives the next player the number of cubes that has been scored on the die. After 3 rounds the students count their cubes and the one with the most cubes is the winner.

An indirect advantage of mathematical games is that they can be an incentive to good behaviour. When I have a new group of students I tell them that, provided the group has worked hard and behaved responsibly in the earlier mathematics lessons of that week, the final mathematics lesson of the week will consist of games (following the mental mathematics starter). This is a remarkably powerful sanction against disruptive behaviour or an unwillingness to work hard. I have never had to invoke this sanction with any group more than once and then all subsequent lessons have been free of disruption!

**Use of software**

Madge Maths, a piece of software I use regularly, is a series of games that cover addition, subtraction, multiplication and division.

The degree of difficulty of the questions can easily be differentiated as there is a gradation with the categories of very easy, easy and harder. There are 12 different speeds of response determined by the speed of a continual reduction of the length of a blue line that appears on the screen.

**Calendar**

A calendar can generate the interest of a group of students in both numeracy and literacy. It is particularly effective if it is visually attractive and has illustrations for each month on a theme that appeals to a specific group of students. It is essential that within each date there is a rectangular space in which short entries can be made. Students can then be encouraged to note special events such as a birthday, a forthcoming school trip or the last day of term. This provides an ideal opportunity to pose questions regarding past or future events such as;
"How many days is it until your birthday, Gemma?" or "How many weeks is it since we visited Lords Cricket Ground?"

**Data Handling**

If carrying out a survey and then using the data collected to construct a graph is to be a stimulating experience for students, it is essential to choose a theme that is of direct interest. I have always found that this can easily be achieved by initiating a group discussion on the various options for a theme and then encouraging them to reach a consensus. They are then likely to be motivated by their interest in the outcome of the survey.

*Linden Lodge School*

1. 'Shut the box', R.N.I.B. (see *Equals* Vol.6 no. 1). 'Jody's Pegs', R.N.I.B. (see *Equals* Vol.3 no. 3)
2. See *Equals* Vol. 10 no.1, Vol. 10 no.2)
3. Anita Straker. *Mental Maths for ages 5-7,* Cambridge University Press. ISBN 0-521-57764-0 Reviewed in *Equals* Vol.2 No. 3

# More to a game than meets the eye

Some games offer some sophisticated thinking if carefully developed. **Carla Finesilver** describes how a simple spinning game showed potential in breaking down and combining numbers, and being systematic. All of this took place in a convivial atmosphere, with a small group of pupils with special educational needs

"Are we going to play the Spinner Game today?" asks Perry. Daisy is already heading hopefully for the shelf where the boxes of Cuisenaire Rods live. "OK", I agree. "Which table do you want to practice?" We settle on the four times table, and set up the equipment needed: a box of Cuisenaire Rods, a pair of hundred-grids (where each of the squares is 1 $cm^2$), and a plastic spinner Blu-Tacked onto one of my laminated spinner sheets. They argue a little over who should start, then decide to use the spinner with the person who gets the highest number starting.

**How the Spinner Game came into being**

I began to use the Spinner Game soon after I started teaching at The Moat School, a specialist school for secondary pupils with dyslexia and other related SpLD. Children with dyslexia typically have great difficulty remembering maths facts, such as the times tables, and the pupils I was teaching that year were no exception. I was teaching them strategies for quick calculation of table facts they could not remember, but they still needed to practice these calculations.

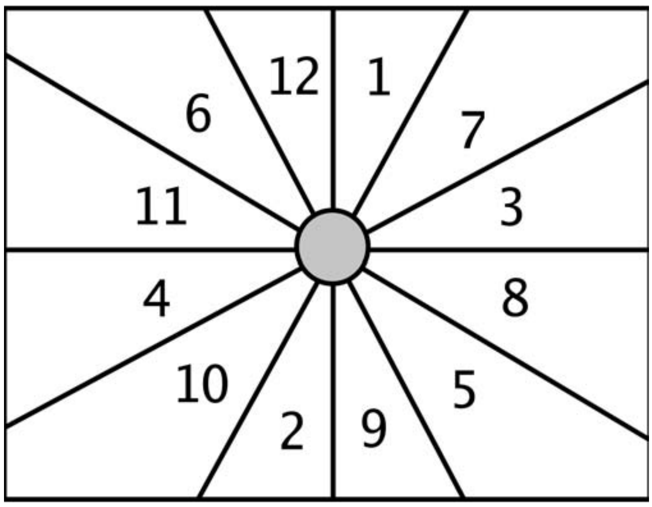
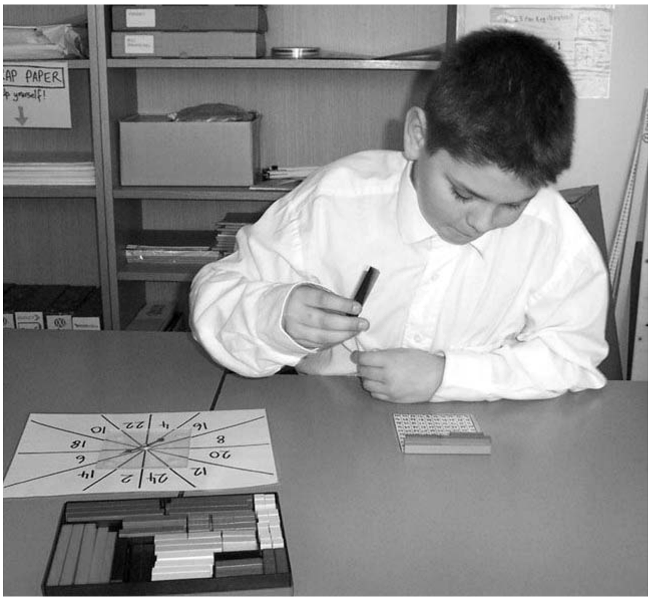



*Figure 1: A simple spinner with numbers 1-12*

I made a spinner sheet, numbered from 1 to 12, with the idea that they would play a game where each player took it in turns to spin, and then would multiply by the number of whichever table we were practising that day.

For example, I had shown Perry and Daisy that to multiply a number by four, they could double the number then double it again. When Daisy spun a six, she would double six to get twelve, then double twelve to get twenty-four. Another advantage of having the pupils generate their own questions was that there was no need for all the players to be practising the same calculations; one player could practise multiplying the number on the spinner by four while another player practised multiplying his numbers by five, for example.

My game needed a method for scoring. Many of my pupils had weak numeracy skills and found it difficult to imagine the size of different numbers when written down, so I needed a visual way of displaying how many points they had won. Children love the look and feel of Cuisenaire Rods, so I decided that they should win a rod of the size corresponding to the calculation they had just done; if they spun a six, and did the calculation correctly, they would win a 'six' rod. Each player would have a hundred-grid, and the winner would be the first person to cover every square on the grid with rods, i.e. to score 100 points.



The advantages to this were, apart from the fact that they could see their score physically growing as they did more questions, the amount of points they got in one turn would be to some extent proportional to the difficulty of the calculation, so for example, doing 4 x 8 would win them more points than doing 4 x 3. (Of course, they soon realised that to spin a ten was very lucky!). With teaching games, I always prefer to have some element of chance involved, as the pupil who loses can reassure themselves that they were unlucky that time, and so not become demoralised.

Now, when trying to cover all the squares on a hundred-grid with a random selection of Cuisenaire Rods, there comes a point when there are odd squares here and there left uncovered, but the rod that the player has just won is too big to fit in any of these gaps. At this point, it generally occurs to the pupils that they could take their eight points (for example) in the form of two 3-rods and a 2-rod, thus reinforcing the idea of it being possible to break up a number into different combinations of smaller numbers.

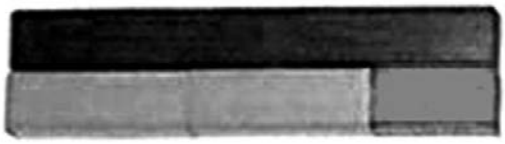


*Figure 2: One 8 rod is equivalent to two 3 rods and a 2 rods*

**Extending the game**

My next thought was to make a set of spinners numbered with the 'answers' to the times tables, as this would be a way to link multiplication and division. For example, if a pupil had been practising multiplying numbers by four, I would replace the basic 1-12 spinner sheet with one numbered 4, 8, 12, ...48. When they spun a 24, I could phrase it first as 'Four times what makes twenty-four?' then 'How many fours go into twenty-four?' then eventually, 'What is twenty-four divided by four?' and so on. The game was very popular among the children, and as they became older and learned more advanced mathematics, I made spinner sheets numbered with the square numbers, and finally the first twelve cube numbers, so they could in fact end up asking each other 'What is the cube root of 343?'

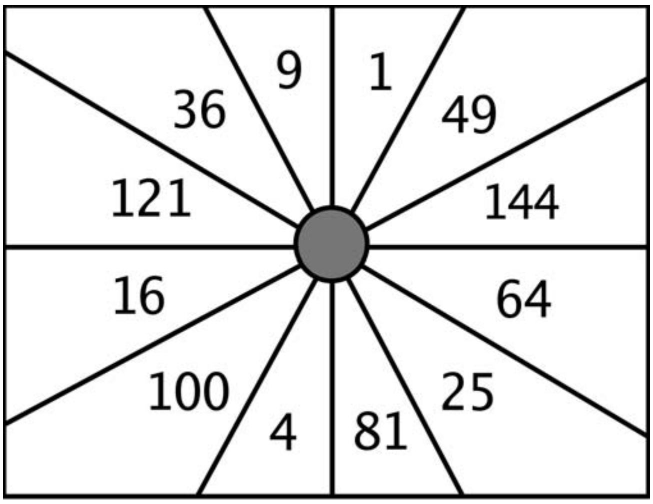



*Figure 3: A spinner sheet for square numbers*

I also began to introduce the Spinner Game to lower ability pupils, who perhaps had not yet encountered multiplication, as a way to practise their number bonds to ten. We would use a spinner sheet numbered from 1 to 10, and if, for example, they spun a three, I would ask something like 'Three and what make up ten?' Another option might be to use it to practise addition or subtraction, for example asking the child to add to whichever number they spun.

**Further variations**

One of my pupils, David, did not like there to be any gaps on his grid, which gave me the idea of putting an increased emphasis on the partitioning of numbers into smaller components. Once pupils are familiar with the basic working of the game, I insist that they fill up each row of the grid before starting to fill the next. Thus, if there are two squares left on their current row, and they win seven points, they cannot take a 7-rod, but must take a 2-rod to fill the gap, and then work out that they should also take a 5-rod to make up their seven points (see Fig.2). This reinforces not only the act of breaking up larger numbers into smaller ones, but also addition facts and strategies.

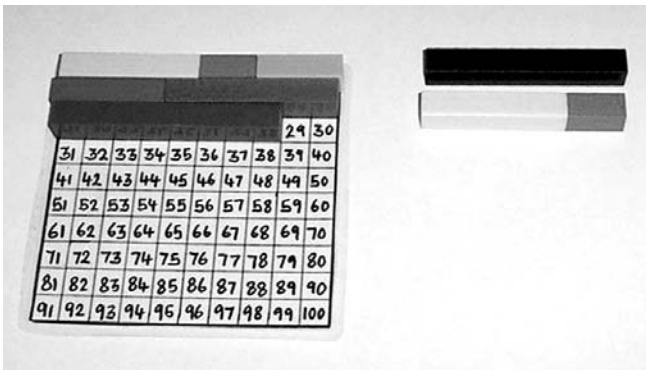


*Figure 4: The player is effectively performing 28 + 7*

Another pupil, Sam, had very strong opinions on different colours, and would only take rods of the colours he liked. He did not like orange, so when he spun a ten, would have to work out how to make that ten using rods that he liked, which were usually the 6-rod (dark green) and the 4-rod (dark pink). He would also willingly do many extra calculations in order to pick rods which would colour his grid symmetrically, or in a repeating pattern.

**Meanwhile...**

Back in my lesson, the situation is tense. After a series of high scores, Perry has been leading for most of the game, but he answered the last question wrongly, and scored only one point on his previous turn, and Daisy is closing in fast. She spins a twelve, and is momentarily concerned that this will be too difficult for her, before remembering that all she has to do is multiply by ten, multiply by two, and then put the answers together. She does a little victory dance as the bell goes, while Perry remarks that he will beat her tomorrow, if I let them play again.

**Summary**

**Teaching Aims:**
Practice of mental arithmetic strategies
Reinforcement of table facts
Breaking down and combining numbers

**Advantages as a method:**
- Works with whole class practice, in groups of two or three
- Variation used can be tailored exactly to suit a particular individual
- Pupils generate their own questions
- Pupils can check each other's answers with a calculator
- Element of chance involved in winning, as well as skill
- It's fun!

*The Moat School*

**The Cost of Christmas Spending**

| | |
|---|---|
| £4.42bn | the amount Britons spent on cosmetics this Christmas |
| £4.14bn | Britain's aid budget for the developing world for 2004 |
| £813 | average spending per adult on celebrating Xmas (£55 less than 2003) |
| £50 | the per capita annual income in Ethiopia |
| £20m | Amount made by Mark Tilden British robot expert who invented Robosapien, this year's hit toy |
| £20m | amount nations of sub-Saharan Africa are paying in debt to developed world every 16 hours. |

*The Independent*, 24 December 2004

# Correspondence:

## Dear Tracy...

wrote so many of you concerning 'Gypsy Maths'. Below we print the interesting extras.

**Saw your question in *Equals'*. Place hands together as if in prayer position.**
**Colin MacDonald**

6x7 doesn't work all that nicely because you have a "carrying problem".
Peter Hall

I must admit that I had never heard of "Gypsy maths" but as soon as you mentioned the placing of the finger tips together it reminded me of a method I had read about in one of Kjartan Poskitt's Murderous Maths books, *Numbers, the Key to the Universe*.
Heather Sims

I was first taught this method by my grandmother when I was in primary school. I was good at maths and was taught the method as a curiosity to share with other pupils. I was later reminded of the method whilst teaching at an inner London School where the method was used successfully with students with learning difficulties and with students with very weak English, as it can be taught just by example.

**Fist Tables**

Clench your hands into fists. The fist represents a five so now hold up fingers to represent numbers more than 5. So hold up one finger for 6, three fingers for 8 etc. The computation is now done in three steps:

- the raised fingers give the tens of the answer.
- Multiply the number of down fingers on one hand by the number of down fingers on the other. These are the units of the answer.
- Add the tens and the units, carrying if necessary.

Nigel Wills

**I use the method for the 9x table all the time for pupils with learning difficulties. Multiplying by 9 using the gypsy method: e.g. 4 x 9**
**Hold both hands out, palms downwards. Tuck away the 4th finger from the left.**
**The number of fingers to the left, 3, gives the tens. Therefore the result is 30 + ?. The number of fingers to the right, 6, is the number of units.**
**So 4x9 + 36**
**(See Joy Pollock Elisabeth Waller, Day to Day Dyslexia in the Classroom, Routledge, 1944)**
**I have not used the finger tables. I personally feel that those with learning difficulties confuse the two methods and cannot remember the rules.**

*A useful article which I think is from the TES Special Needs Special,"Ten times more fun" by Tandi Clausen May, from around 1997.*
*Jean Holderness*

I did not know the finger method was called gypsy maths
Terry Tuffnell

**I was reading my *Equals* in bed this morning when it arrived (it is Saturday!) I noticed your request for information about multiplication methods using your hands - 'gypsy multiplication'. I've never heard it called this before, but it's quite a well known method I think.**
**For those with an algebraic turn of mind it's quite a simple task to work out why it works - but I'll leave that to readers.**
**Thanks for the diversion this morning, now I'd better get on to the marking which was today's real job!**

(Ed's Note: We too had decided to leave the explanation till the next issue of Equals because some of you may like to work it out for yourselves.)

I was a fan of Martin Gardner's columns for *Scientific American* in my school days, and have since collected all of his books. He discusses the method and the maths behind it in an article called 'Finger Arithmetic', reprinted in the collection Mathematical Magic Show (see http://www.amazon.co.uk/exec/obidos/ASIN/0140165568/).
I was reminded of the article by a Year 2 student last year: her grandmother had shown her the finger method for multiplying two numbers in the half decade 6 to 10.
According to Gardner, the method was 'widely practiced in the Renaissance and is said to be used still by peasants in parts of Europe and Russia'. It is based on 'using the complements of the two numbers being multiplied with respect to 10'. Gardner's article is well worth tracking down and has a very clear explanation, there are also some versions on the 'net.
This version differs from Gardner's only in the way you hold and number your fingers; Gardner uses palms towards you, small fingers numbered 6 up to thumbs numbered 10 whereas this version uses palms outwards and fingers numbered the other way around. I find it much easier to hold my palms towards me so I stick with Mr. Gardner's method, I suspect because I learnt it first!

http://homepage.mac.com/pamsoroosh/iblog/math/C1498644337/E1527377677/

Gardner also explains how to multiply other half-decades - 11 - 16 is particularly simple. I recommend that you track down a copy of the book. The article also covers other uses of fingers in arithmetic - all fascinating material.
Exploring the finger patterns for different multiplication tables would make a good basis for some investigative work.
I hope that this helps.
Elizabeth Waggott

You can also tackle products from 10 x 10 to 15 x 15 is a similar way: for 13 x 14 hold up 3 fingers on one hand, and 4 on the other. The hundreds figure always starts as 1, the tens figure is the total number of raised fingers (7) and the units figure is the product of the numbers of raised fingers (12): 100 + 70 + 12 = 182. Here, of course, I've called it the units 'figure' for simplicity even though it equals 12.
Michael Fox

Dear Readers

It is exciting to have so many interesting ideas flowing in and we thank you all for these perceptive contributions.
**What else turns you on?** Please will you **all** consider writing to share your experience so that it can enrich the understanding of all *Equals* readers and help us to provide richer learning environments for all children.

The *Equals* Team

We happened to catch sight of the following correspondence and, although usually printing positive ideas and incidents, felt it might prove a useful cautionary tale. One question it poses is whether a lack of knowledge of English constitutes a special educational need as this school clearly considers it does. One might consider too that the deputy head's use of English could be improved. As you will no doubt realise all names and locations have been changed to preserve anonymity.

**Dotherkids Hall School**
**Elite Street**
**Bantown**
**Nosenshire**

4 March 2004 — Ref: OUT/all

Mrs Freeman

**MARIA CHANU (D.O.B 14.01.91)**

Thank you for attending the interview with regard to Maria's application for a place at Dotherkids Hall School.

As I explained, due to Maria's lack of formal education and the fact that we do not have sufficient EAL support that she would need, due to her not being able to speak much English, we do not feel that Dotherkids Hall School would be a suitable placement for her.

In light of these problems we are unable to proceed with Maria's admission to Dotherkids Hall School and so we cannot offer her a place.

Yours Sincerely

Sam Gradgrind

Sam Gradgrind
Deputy Head

Cc Mrs U Tripp, Senior Admissions Officer, Nosenshire Education Authority

**Pay women fairly**

Women, more than 30 years after the Equal ay Act came into force, still earn on average 20 per cent less than men For the millions of women whose family commitments require them to work part-time, the gender gap is even wider. The average part-time female worker receives an hourly rate 40 per cent lower than a full-time male worker. … According to the Equal Opportunities commission, the salary gap between men and women is 25 per cent, an average monthly loss to (or robbery from) women of £559; for weekly paid women, the loss is £129 a week.

*New Statesman* 04.10.04

1 Fair Terrace
Freetown

9 March 2004

Dear Mrs Chaucer

I enclose a copy of a letter received from Dotherkids Hall School and I was shocked by the contents. The school has rejected Maria's application for a school place on the grounds of her "lack of formal education" and "not being able to speak much English". Clearly the school has a selective policy based on attainment. Furthermore the attainment is judged by means of an impromptu test with no prior notice given to the student or the parent. Thus Dotherkids Hall School does not operate a comprehensive system nor does it practise an inclusive policy. I hope this school is not representative of schools in Nosenshire L.E.A. as I assumed that such schools were inclusive and upheld the principles of comprehensive education.

I do not accept the assertion that Maria is "not able to speak much English". She arrived in the U.K. in mid December 2003 and could then speak virtually no English. In a few months her English has improved to the extent that she can understand and reply to questions in English with the correct vocabulary and grammatical structure. Indeed my wife tells me that she replied to questions in English at the "interview". She can also read basic texts in English with fluency. This suggests that Dotherkids Hall School's assessment procedures are flawed. It was a great blow to Maria's confidence when she was told that she had been rejected by Dotherkids Hall School because her English was deemed to be inadequate. I have worked as a teacher for over 20 years including 5 years at Welcome School in East London. At that time over 80% of the school roll consisted of pupils from Bangladesh, the vast majority of whom spoke very little English when they joined the school. The school did not reject the application of a single pupil on the grounds of a "lack of formal education" or of "not being able to speak much English".

My wife and I do NOT wish to appeal against the rejection by Dotherkids Hall School as we do not want Maria to attend a school that operates a selective policy based on spurious ad hoc testing. We do, however, urgently need school places for both Maria and her brother Paulo as close as possible to where we live. The first application for school places was made over 2 months ago!

My wife fully supports all the contents of this letter.

Yours sincerely
A. Freeman (Stepfather of Maria)

Z. Freeman (Mother of Maria)

# Reviews

**Review Martin Marsh**

**Human Rights in the Curriculum: Mathematics (Published by *Amnesty International* ISBN 1 873328 49 4 Price £18.50) [First published in 1998 under the title *The Maths and Human Rights Resource Book* but extensively revised and updated]**

Citizenship has been part of the National Curriculum since September 2003. Asking most schools how the mathematics department contributes to the citizenship curriculum will probably result in some awkward shuffling and some rather blank looks.

[*Those of you who use our significant figures extracts in your classrooms would be able to give better answers than most!*] This book not only addresses many aspects of the citizenship curriculum but will also enrich the mathematics curriculum offered by all secondary schools.

The book contains 30 photocopiable activities with teachers' notes aimed at pupils working from Level 3 to Level 7. Each activity is linked to one of the 30 articles of the Universal Declaration of Human Rights (UDHR) which are listed in a helpful appendix at the back of the book. How many of us could name more than a few of these articles? My guess is very few, and yet the introduction to the Universal Declaration of Human Rights calls upon member countries of the United Nations to publicise the text of the declaration and 'cause it to be disseminated, displayed, read and expounded principally in schools and other institutions'. In all, this book cites over half of the 30 articles. This reviewer certainly feels he knows more about the articles of the UDHR having read this book.

Regardless of the benefits to the citizenship curriculum, the activities in this book provide stimulating starting points for mathematical activities. All areas of the mathematics curriculum are covered and each activity will also develop pupils' using and applying of mathematics skills. I particularly liked the activity entitled 'Gerrymander' (learning objective - to 'gain a critical understanding of the relative majority voting system with multiple constituencies'). Despite this objective (*before I looked at the activity I wouldn't have known what it meant either!*) it is accessible at some level to the vast majority of 13-15 year olds. With an election in the United Kingdom due sometime during 2005 this would seem an opportune time to discuss issues of proportional representation and other electoral systems and how they can be manipulated by unscrupulous politicians.

Each activity in the book is accompanied by extensive teachers' notes and solutions to the problems in the activities. The text is accompanied by an excellent selection of photographs, tables, charts and links to useful web sites.

I would have no hesitation in wholeheartedly recommending this book as an essential resource for any mathematics department.

*Slough*

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**Review Jane Gabb**

**the trouble with maths**
**A practical guide to helping learners with numeracy difficulties**
**Steve Chinn**
**Routledge-Falmer**
**ISBN 0-415-32498-X**

The first thing to say about this book is that it's very readable and contains a lot of material.
However, the back cover makes rather grandiose claims for the book, saying that it 'offers important insights', is a 'comprehensive text', 'considers every aspect of maths and learning' and 'provides a perfect balance of advice, guidance and practical activities'.

I tested the comprehensiveness by looking up certain topics in the index. I started with 'time' as I have found that many pupils find learning how to tell the time very difficult. While there is a very interesting article which illustrates the difficulty stemming from the use of language related to time (pp.117-8), there is very little of a practical nature to help teachers to address this problem. When I looked up 'co-ordinates' I found little beyond suggesting the age-old mnemonic 'along the corridor and up the stairs' and advice about dealing with negative co-ordinates. The biggest problem with both of these topics is the necessity of looking at 2 things at once (hours and minutes and 2 co-ordinates). Neither of these difficulties is mentioned, never mind addressed.

Another omission is the number line which can be a useful visual tool, especially for 'awkward' subtractions like 2004 – 1876.
You might say that it unfair to judge a book by what is omitted, and in fact I wouldn't if the extravagant claims above had not been made. The very claims push one in the direction of catching the author out, just as someone who sets themselves up as an expert must expect to be tested.

As far as insights go, I found much that was written here familiar, so much so that at times I felt I might have written it myself! Admittedly, I have a good deal of experience of pupils who find mathematics (and indeed other subjects) difficult, so perhaps the book was not written for people like me! On the other hand, I accept that I don't know everything about the subject and I am interested and willing to learn, so perhaps the book could be for people like me.

I found the information about 'no attempts' interesting. Dyslexic pupils in particular, and any pupil for whom maths is anxiety-making, won't attempt questions which they feel insecure in, preferring not to try out of a desire not to be wrong. These are as useful when diagnosing pupils' difficulties as correct and wrong answers.

There are some 'criterion referenced tests' at the back of the book. I found the layout came into the category of 'overwhelming' from the point of view of the way the numbers of the questions interfered with the actual calculations required. The presentation of addition and subtraction as vertical calculations also leads the pupil to feel that they need to be approached in this way. For instance presenting 9001 – 2049 as a vertical calculation means that decomposition (with lots of horrible zeros) is indicated; if presented horizontally then the pupil may be more inclined to use a number line, which might prove a more accessible method.

So what is useful in the book?

The section on language in maths has some useful links to help understanding of words or prefixes like 'milli', 'octagon' and 'quadrilateral', but you would come up with more examples if a group of teachers were asked to find as many linking words as possible.

I feel this book would have been better if a number of practitioners had collaborated and brought their collective experience to the book. Then the omissions mentioned above might have been filled and some more of the 'new' methods, which are undoubtedly helpful for children who find maths difficult, would also have been evident.

Teachers who are just beginning the fascinating journey of trying to find ways of supporting pupils who find mathematics difficult may well find a wealth of useful information in this book; for those of us with more experience I feel it has little to offer except perhaps confirmation that some of the things we try are recognised by another as useful.

*Royal Borough of Windsor and Maidenhead*

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**Review Roger Burton**

**Bring on the Maths!**
**Available as an interactive program or as a print out (which could be put on OHT or photocopied) from www.kangaroomaths.com**
**Cost: £60 per year group or £150 for all of years 7-9.**

This program is in demand! My pupils (throughout years 7 to 9, of all abilities) ask if there's an activity about the topic we're doing, and invariably there is. If I put it on the pupils' network I'm certain they would play every 'game' within a term but these are best used as teacher-driven activities that lend themselves to assessment for learning.

For each of the three year groups, there are at least 3 activities for every key objective. They cater for all abilities within that objective and challenge all the common misconceptions. If pupils choose a correct answer then a letter appears which leads to an anagram of a related keyword. Wrong answers just earn a red cross. The challenge therefore is to avoid all the wrong answers.

I use it either as a starter or as plenary – a quick game can take just 3 minutes or, with careful discussion of each answer as it is given, I can keep the whole class engaged for 20 minutes and by taking points away if they choose a wrong answer I avoid them guessing. They keep on asking for more!

There are too many activities to even start looking at any individual topics – suffice to say that there are about three 'types' of structures:

Which ones are correct?
Which ones have an answer of …?
Which ones have a pair on the board?
That means they have to read the question – another bit of literacy work for them.

There's so much variety that you can re-use an activity two weeks later – the pupils will notice, but generally can't remember the keyword or the correct answers (they stay in the same place each time you play it) – they do however explain their answers better – good for an end of topic plenary.

I could go on and on … it's brilliant – try it yourself at www.kangaroomaths.com and then look at the price again – around £1 per individual activity for a whole school licence (you are given a password to play it online or to download it. All the activities are available as worksheets too).

I am certain of three things.

1) Your pupils will love it
2) There will be more coming
3) I'll be buying them as soon as they appear

*William Parker Sports College, Hastings*

**Homelessness**
A survey of more than 400 homeless households in England found that the children in more than two thirds of families in temporary accommodation had problems at school. On average each child missed 55 school days a year because of the disruption caused by being homeless.
*CASE*, CASE notes, issue 3, 2004