Primary Magazine

Issue 14

National Centre for Excellence in the Teaching of Mathematics

Welcome to the 14th issue of the Primary Magazine – and the beginning of another school year!
In Maths to share – CPD for your school, we look at beginning the new school year by refreshing our approach to mental calculation.
Our Up2d8 Maths provides opportunities for work on measures, calculation and estimation within the context of landlocked, city-centre beaches.

Contents

From the editor

In this issue, we consider life without the Primary Strategy, flag up a great little series of video clips and give you some important dates for your diary.

Up2d8 maths

This issue of Up2d8 is based around landlocked town and city beaches. It provides opportunities to explore, among other concepts, measures, estimation and calculation. With some careful planning the suggestions given can be adapted for EYFS, KS1 and KS2.

The Art of Mathematics

This issue explores the art of the French artist Auguste Herbin. His work was initially influenced by Impressionism and Post-Impressionism but these influences gradually gave way to an involvement with Cubism, for which he is best known.

Focus on…

In this issue, as many begin to get back into the classroom, we consider the start of the new school year by looking back to see how, where and when it all began.

Starter of the month

Our starter suggestions are based around some fascinating facts relating to the population of the world and of the UK.

A little bit of history

For the next few issues, our series on a little bit of history looks at famous mathematicians of the past. In this issue, we look at a potted history of Carl Friedrich Gauss, a child prodigy and reputedly one of the greatest mathematical and scientific minds in history.

Maths to share – CPD for your school

The beginning of the new school year is a great time to think about those elements of our practice that underpin children's learning in mathematics. We are, of course, talking about mental calculation strategies. If you wish to follow the CPD idea in this issue, you will need to ask your colleagues to read Thompson, I. (1999) Mental Calculation Strategies for Addition and Subtraction, *Mathematics in School*, Vol. 28, Issue no.5.

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From the editor

Primary mathematics is under fire yet again in the press. According to the parliamentary Committee of Public Accounts' report issued in May, too many children are still leaving school with low attainment in mathematics, despite vast amounts of money being spent in the hope of reaching some high national targets in 2011. It reports that:

- £2.3 billion is spent each year on teaching mathematics in primary schools but improvements in attainment have recently levelled off.
- In 2007-08, the Primary National Strategy for mathematics cost £104 million to implement.
- More than one fifth of all primary school children reach the end of their primary education without a secure grasp of basic mathematical skills.
- There is a clear link between deprivation and underachievement in primary mathematics, with an 18% differential between those receiving school meals and those that do not.
- The Williams Review recommendation for 13 000 specialist mathematics teachers to be trained will not benefit some primary schools for another decade.
- In 2008, 1 648 schools were deemed to be underperforming in mathematics compared with 3 570 in 2003, a reduction of 54%.
- Pupils rate a good and enthusiastic teacher as the greatest influence in their enjoyment of mathematics. Recently, we heard of the demise of the national strategies.

The contract between the DCSF and the strategies has been extended for one more year until March 2011, and then that will be it – no more Primary National Strategy. Is this a good thing or not? We would love to hear what you think of this news – will it be a great loss to teachers, or will it enable them to be more flexible and creative in their approaches to teaching mathematics? Do you think standards will drop without this support, which undoubtedly was very much needed when it began nationally in 1999? Please comment in the Primary Forum.

In the last issue's Focus on article, we gave you some 'me' time ideas to explore in books, on the web and on TV. We saved one for this issue! *Donald in Mathmagic Land* is great fun to watch and share with your class. It comes in three parts and looks at the discoveries by Pythagoras. It can be viewed on YouTube:

- Part 1 includes the mathematics of music and an introduction of the golden rectangle;
- Part 2 includes real life examples of the golden rectangle, maths in nature and games;
- Part 3 continues to look at games and also the importance of the circle in real life. Enjoy!

And finally, here are a couple of dates for your diary:

Tuesday 1 December 2009, Nottingham
Engaging with Mathematics – A journey for teachers, learners and families
This free, one-day conference hosted by the National Centre will explore learners' attitudes to mathematics. It has a primary focus and will be well worth attending.

6–9 April 2010 is the date of the British Congress of Mathematics Education (BCME) conference Mathematical Progressions, where speakers include Marcus du Sautoy, Margaret Brown and Paul Cobb (Vanderbilt University).

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Up2d8 maths

This issue's Up2d8 investigates the idea of city beaches. Several landlocked cities in the UK and across Europe have created beaches with sand, paddling pools and palm trees. In the spread, the children are asked to help create one for the mayor of a fictional town. This provides some great mathematical opportunities for exploring, among other concepts, measures, estimation and calculation. This resource provides ideas that you can adapt to fit your classroom and your learners as appropriate.

In addition to the ideas in the resource, here are some more that you could adapt and try:

- You could ask the children to design a beach, planning where to place the palm trees, Punch and Judy show and the deckchairs.
- Depending on the age and ability of the children you could encourage them to draw their plan to a given scale.
- In the FS/KS1, you could use a sand tray or something similar and ask the children to make a beach and put play people in it. They could make the palm trees using coloured paper or plasticine and add anything else they think would be fun.
- You can find out from the Associated Content website how to create a beach of your own!
- You could plan a day trip to a real seaside town and beach – include finding the distance, ways to get there, length of journey, cost of travel, pocket money for 'treats', things to do, weather.
- Younger children could pack a bag for a day at the beach. Offer a selection of clothes, including beachwear and winter clothes as well as a range of both suitable and unsuitable items for the children to choose from. They could also draw or select appropriate items from a mixed sheet of pictures, cut them out and add to their own cut-out bag.
- You can't have a beach without ice cream. Children could choose which ice cream flavours to sell at their beach and how much to charge. Another opportunity for data handling. Explore the Ice Cream Van game to support this activity.

Download this Up2d8 maths resource - in PowerPoint format.

Download this Up2d8 maths resource - in PDF format.

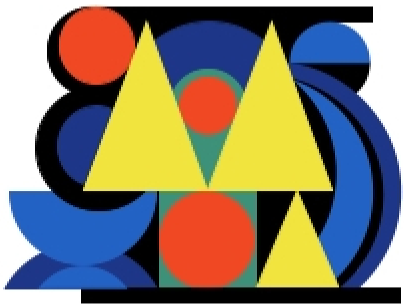
The Art of Mathematics
Auguste Herbin (1882 - 1960)

French artist Auguste Herbin, son of a weaver, was born in the small village of Quiévy, close to the border with Belgium, on 29 April 1882. He studied drawing at the Ecole des Beaux Arts in Lille, from 1898 to 1901, then moved to Paris where he worked in isolation for some years. His work was initially influenced by Impressionism and Post-Impressionism. These influences, visible in paintings that he sent to the Salon des Indépendants in 1906, gradually gave way to an involvement with Cubism after his move in 1909 to the Bateau-Lavoir studios. Herbin's studio was next to both Braque's and Picasso's, giving him the opportunity to study Cubism at first hand. He created his first Cubist paintings in 1913 and his first abstract paintings in 1917. He moved on to an abstract, geometric phase before gradually discovering Constructivism. His work forms a bridge between the Cubist movement and post-war geometrical abstract painting.

Herbin's reliefs of simple geometric forms in painted wood and related furniture designs were met with incomprehension and such harsh criticism, even from those critics most favourably disposed towards Cubism, that he briefly followed Léonce Rosenberg's advice to return to a representational style, including landscapes, portraits and still life. Herbin later disowned these works. He returned to abstraction in 1926 and was co-founder of the group Abstraction-Cr-23ation in 1931.

From 1938, his interest in the Italian, Trecento, led Herbin to a more concrete, two-dimensional painting style with simple geometric forms. He was one of the great pioneers of geometric constructivist art in France. His later work became highly abstract, but he always worked with geometric forms. Although these sometimes suggest people or objects, they are not representational. He discovered his own geometrically abstract language of forms in 1943. The pure geometric shapes and positive colours of his later abstract works had considerable influence on younger abstract painters.

In 1946, he developed the unique Alphabet Plastique, a compositional system based on the structure of letters. He assigned colours and shapes to each letter. This was not meant to be art alone, but a puzzle to unlock. His code reveals an unexpected depth and complexity which adds a particular attraction to his paintings. However, in spite of his strict adherence to his coding principles, Herbin also allowed himself a great deal of freedom in the conception of his pictures.



Herbin published this compositional system, as well as his colour theories, in his 'L'art non-figuratif non-objectif' in 1949. A lateral paralysis in 1953 forced him to learn to paint with his left hand. He was active in the 1950s as a designer of tapestries.

Herbin's typical architectural approach and his colour effects made his pre-war work widely known in the international art world – a success which continued after the war. Herbin died in Paris on 31 January 1960. One painting remained unfinished: it was called 'Fin'.

Alphabet Plastique 2, 1950

The Arithmeum opened in Bonn in 1999. It offers a rich mixture of science, technology, mathematics and art and aims to convince you of the fascination, excitement, beauty and fun that these disciplines offer.

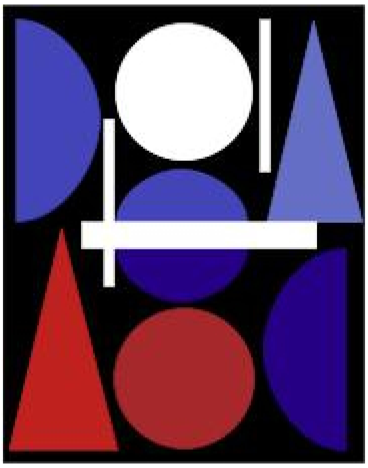
A recent children's TV programme asked, *What is constructivist art?* and focused on the work of Auguste Herbin and his Alphabet Plastique. Children studied several of his originals to develop an understanding of the Alphabet Plastique. They then encoded their own name and turned it into a work of art.

National Curriculum links

These activities will address aspects of the learning objectives in the Primary Framework Using and applying mathematics, Understanding Shape and Measuring strands. Pupils in Key Stage 1 and 2 can learn to recognise circles, semi-circles, ovals, triangles, squares and rectangles, as well as crescents. They will explore using 2D shapes, position and symmetry as they create pictures.
Although the following activities are suggested for a particular stage, most could be adapted for use in any key stage.

Foundation Stage

Activity using 'Nude'



You will need:

- pre-cut coloured circles, semicircles, triangles and thin rectangles
- black paper for the background
- glue.

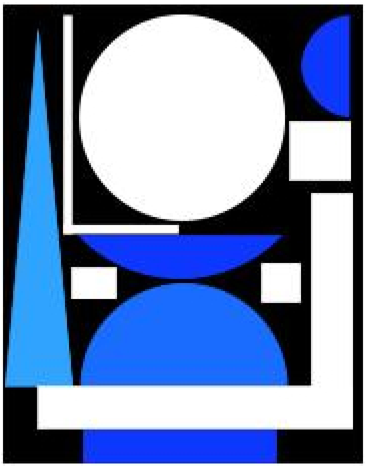
If the children are able to draw around a shape and cut out reasonably accurately, you may prefer to offer the children a range of shapes to draw around on different coloured papers.

Work in small groups of around four children. Show the children a copy of 'Nude'. Ask them what they notice – look for observations on shape, colour and the arrangement of the shapes. Observations may include suggestions such as 'the circles are like traffic lights' or 'there's a circle cut in half'.

Invite the children to create their own version of the picture. Encourage each child to move pieces around until they are happy with the final result, then stick in place. As they work, discuss the shape used and the position in which it has been placed.

Display the creations alongside a copy of the original picture.

Key Stage 1
Activity using 'Nu'



You will need:

- black paper for the background
- white paper and various shades of blue paper
- glue
- a range of shapes to draw around on different coloured papers.

You might like to provide some thick and thin strips of white paper for the children to use for rectangles and squares.

Show the class a copy of 'Nu'. Ask them what they notice – look for observations on shape, colour and the arrangement of the shapes. Children may 'see' scales – is the white circle being weighed? Is the thin blue triangle balancing the white square and darker blue small circle?

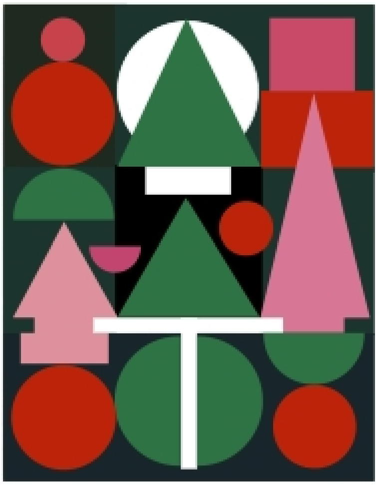
Ask the children to choose a piece of measuring equipment, such as weighing scales, ruler, trundle wheel, jug etc. Explain that you would like their picture to suggest that item, but not be a picture of it. Look at the equipment and ask the children to suggest which shapes might best represent it.

The children must limit themselves to only two colours, though they may use shades of those colours and any geometric shapes they wish. Encourage the children to move their pieces around until they are happy with the final result before sticking in place. As they work, discuss the shapes used and the positions they have been placed in. When complete, look at the children's work together. Can you see the piece of equipment each child was aiming to represent?

Display the pictures with the equipment used for inspiration.

Key Stage 2

Activity using 'Soleil' and 'Pape' initially, then any of the other pictures.



You will need:

- a copy of each painting
- access to a computer for each child
- black or grey background paper and a range of coloured papers.

Begin by showing the whole class 'Soleil' and 'Pape', complete with their titles. What is the same and different about each picture? Invite observations. Explain Herbin's Alphabet Plastique. Return to 'Soleil'. This is a six-letter word and the picture appears to split into six blocks. Could each block represent a letter? If so, which block represents which letter? Ask the children to explain their thinking. Move on to Pape. Could there be one or more colours and a group of shapes for each letter? Can the children use the same ideas to pick out parts of this picture?

Explain that they are going to create their own alphabet code, using colours and geometric shapes. They will need to set up a 5 x 5 grid on the computer and split the last cell. To avoid confusion, each cell should be labelled with the appropriate letter of the alphabet. Once their template is ready, the children can create their own alphabet, using the shapes provided by the particular computer programme. They will need to consider the size, orientation and colour of each shape as well as the combinations used for each letter. Once complete, preferably on one sheet of A4 for ease of handling, the alphabet should be saved and printed.

Using their own alphabet, children move on to create a picture of their own name or another word. It is useful to have a possible word in mind when designing the alphabet since the word may influence the colours, as in Soleil. Display the names or words with the relevant alphabet, inviting observers to 'read' each picture.

Round off the activity by inviting children to share their work with the rest of the class and explain their choices. You might also like to show the children one of the more complex constructions such as Composition with the word 'Vie', or 'Napoléon'. What does the title of the piece suggest? Can the children recognise possible representations for any of the letters used in the title?

And finally: take a look at John Dabell's blog I spy with my little maths eye... for some further ideas.

Follow these links to find the paintings referred to in this article:

- Composition with the word 'Vie' 2
- Nude
- Nu
- Dessert
- Alphabet Plastique II
- Jour (Day)
- Pape
- Matin
- Soleil
- Napoléon

Focus on…the start of the new school year

Will the new school term be the start of something special?
It always is!

As we start a new autumn term, it prompts us to think about the exciting things that lie ahead for our new intake of pupils. They, as well as many teachers, are likely to be feeling apprehensive, excited, full of questions. Will this year be the same as the last? What new things will we learn? Will there be special moments?

Teachers will have worked hard over the summer, preparing for their new classes, planning appropriate lessons and starting work on making their classrooms stimulating, inviting places to learn. Each year, new ideas come to light and the 'experience' of being educated improves.

But why do so many of us work so hard to ensure that just over 4 million primary aged pupils in England attend school for the required 195 days each year? The quick obligatory internet search doesn't really provide the answers; mainly a string of apathetic comments from disgruntled teenagers who didn't respond well to the recent 'exam season'. A more positive contribution on blurtit.com, discusses the need for groups of individuals, right from the earliest times, to keep together and to find ways of keeping the group going after individual members were gone. It was this need that drove older members to teach the young people so that they could survive and continue with the customs, knowledge and skills of the group. Thus 'education' was born. School became a necessity once a formal written script was introduced, as special learning was required to master the symbols.

It is not clear when the first schools appeared, although they were in existence in Ancient Egypt more than 5 000 years ago! It wasn't until the reign of Queen Victoria in the mid 19th century however, that the idea of an education for all became accepted as a way of improving society as a whole. In fact, it wasn't until 1870 that school became mandatory for all pupils up until the age of ten.

Find out how the children in your class are feeling about starting back at school. Do they see it as a privilege for which they are grateful? Discuss with them how schooling has changed over the years… school hours, expectations, lesson content etc. Use the facts below or some of the suggested websites for inspiration:

- A child attending full time school from their fifth birthday until their 16th will have 2 145 days of teaching.
- In Roman Britain (43AD – 410AD) only boys between the ages of six and 12 with rich parents could afford school fees or a private teacher.
- In Tudor times (1484 – 1603), if their families could afford it, boys started school at age four, for six days a week, for up to 10 hours each day! Girls were kept at home to help or sent out to work to support their brothers' school fees.
- In 1844, it became the law that children working in factories should have six half-days each week in school, with up to 80 children in a class.

These websites will give you more information on the history of education:

- Woodlands Junior School
- Learning Alive Explore Pathways
- The British Museum
- BBC History
- BBC Primary History (Ancient Greeks)
- BBC Primary History (Romans)
- BBC Primary History (Victorian Schools)

Starter of the Month

Key Stage 1/Lower Key Stage 2

Ask the children how old they were when they started school (full time – Reception). Show on a simple timeline/number line. Do they know how old they need to be to leave school? Look at the chart showing when children in other countries are required to start full-time school and the age at which they can leave. Discuss the format with them.

What do they think? Are they glad they start school earlier than children in many other countries or do they wish they could have longer at home?

Ask them to calculate how many years the children in each of the countries attend school for. In which country do children spend longest at school? Which spend the least amount of years at school?

Mimnimum School Leaving Age	School Starting Age (full time) 4	5	6	7
14			Turkey	
15			Austria Cyprus Czech Republic Iceland Luxembourg	Bulgaria Estonia Latvia
16	Northern Ireland	England Malta Scotland Wales	Denmark France Greece Hungary Ireland Norway Portugal Spain	Finland Lithuania Sweden
18		Netherlands	Belgium Germany Italy	Poland

Data from Wikipedia

Key Stage 2

Tell the children that there are, according to the estimate for July 2009, 6 790 062 216 (6 billion, 790 million, 62 thousand, 216) people in the world. Just under 6.8 billion. How many of these do they think are unable to read or write? Half of them? One quarter of them? In fact, just under one fifth of all the people in the world (18%) are illiterate. For many, they don't have, and never will have, access to suitable education to support them with their learning.

Explain that because the world population is so large and such a difficult number to comprehend, they should imagine that we have reduced it to a village of just 100 people. The proportions are still the same, so now there are 18 illiterate people in the village (still 18%).

Show them the table below giving facts about the people in the 'village'. Allow them some time to discuss the information. Can they compare any? E.g. there is the same number of cars in the village (the world) as there are illiterate people.

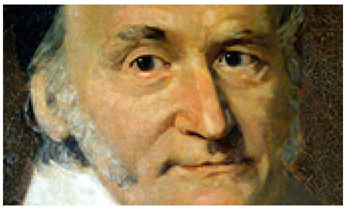
Villagers (where village represents the world population)	**Number** (%)
unable to read or write	18
under the age of 15	27
over the age of 64	7
unemployed	30
number of cars in the village	18
with inadequate sanitation	63
who are Christian	33
who are Muslim	20
who are Hindu	13
who smoke	26
considered severely undernourished	16
who are male	50
living on less than £1.18 a day	53

Data from If the world were a village by Matt Rosenberg.

Now ask them to consider just the United Kingdom. Do they think any of these percentages would be higher? Lower? Why? Show them the table below and allow time for discussion. How does it compare to the worldwide picture? Discuss how best to represent the data to others. Is a pie chart suitable? Why/not?

Villagers (where village represents the world population)	**Number** (%)
unable to read or write	1
under the age of 15	17
over the age of 65	16
unemployed	4
number of cars in the village	44
who watched Susan Boyle lose '*Britains got talent*'	32
who are Christian	72
who are Muslim	2
who are Hindu	1
who smoke	17
who are rich	49
The richest 10 villagers would earn more than the poorest 50 villagers combined	

Data from Simon Usborne's If the UK were a village of 100 people, published in The Independent, 21 July 2009.



A little bit of history – Carl Friedrich Gauss

Carl Friedrich Gauss was born into a poor, uneducated and very strict family on 30 April 1777, in Brunswick, Germany. His father had a number of jobs including as a mason, gardener, labourer, an assistant to a merchant, and the treasurer of a small insurance fund. Gauss described his father as 'worthy of esteem' but 'domineering, uncouth and unrefined'. He wanted Gauss to become a mason as he had been, so didn't really encourage his interest and education in mathematics and science. It was his mother who supported him. She was Gauss' father's second wife, a highly intelligent but only semiliterate woman who worked as a maid before beginning her reputedly unhappy marriage to him. She and Gauss' teacher persuaded his father to allow Gauss to attend a college preparatory school when he was eleven, and to study after school instead of spinning to help support the family. They both recognised him to be a child prodigy.

From a very early age he proved to be an incredibly gifted child. So much so that the Duke of Brunswick gave him a fellowship to a local college which he went to for three years, from the age of fourteen. The Duke also funded his studies at the University of Göttingen for a further three years.

It is said that Gauss was able to calculate without any help before he could talk! One of the stories of his early genius was when, at the age of three, he corrected, mentally, an error his father had made on paper while calculating some finances. He taught himself to read and astounded his teacher when he was eight years old by instantly solving a problem he had given the class. This is now a well-known mathematical problem, why not try it?!

Gauss' problem: find the sum of the first 100 integers. The solution is at the end of this article.

Find the sum of the first 100 integers ?

His teacher at the time saw the promise that he had and supplied him with books to encourage his intellectual development.

When he began college at fourteen, he had a scientific and classical mind far in advance of the rest of his peers. He knew about elementary geometry, algebra, and analysis and often 'discovered' important theorems before studying them in class. Among other things, he discovered Bode's law of planetary distances, found a square root in two different ways to the nearest 50 decimal places and formulated the principle of least squares while working on unequal approximations and the distribution of prime numbers!

While he was at university, Gauss independently rediscovered several important theorems. His first major achievement was when he was able to show that any regular polygon with any number of sides that is a Fermat Prime (near square prime numbers) can be constructed by compasses and a ruler. This was a major discovery in an important field of mathematics dating back to the Ancient Greeks. This led him to choose mathematics as a career. He was so pleased with his discovery that he asked for a regular heptadecagon (shape with 17 sides) to be inscribed on his tombstone. He didn't get one however, because the stonemason decided that it would be too difficult to construct and would end up looking more like a circle!

His passion for numbers and calculations extended to the theory of numbers, algebra, analysis, geometry, probability, and the theory of errors. He also researched many branches of science, including observational astronomy, celestial mechanics, geomagnetism and electromagnetism. His publications, correspondences, notes, and manuscripts show him to have been one of the greatest scientific minds of all time. In 1799 he earned his doctorate from the University of Helmstedt.

In January 1801, an astronomer named Piazzi briefly observed and then lost a new planet, which, for the rest of that year, astronomers tried in vain to relocate. Gauss decided to have a try. He applied some of his scientific and mathematical theories and found it again. Today this 'planet' is known as Ceres, the largest member of the asteroid belt. This established his reputation as a mathematical and scientific genius of the highest order and so began his transition from mathematician to astronomer and physical scientist. At this time, he was still being supported financially by the Duke of Brunswick but really wanted to become independent and be settled in an established post. The most obvious role for him would be to become a maths teacher, but he felt 'repelled by drilling ill-prepared and unmotivated students in the most elementary manipulations', so he decided on a career in astronomy.

In 1807, aged 30, he became the director of the observatory in Göttingen, where he worked for 47 years until his death on 23 February 1855 at 77.

His personal life wasn't quite so successful. In 1805 he married Johanna Osthoff and they had two children, but she died in 1809 soon after giving birth to a third child, who also died. He became very lonely and depressed, never really recovering from her death. Less than a year later, he married his wife's best friend. He had two sons and a daughter with her. This wife was seldom well and died in 1831 after a long illness. He didn't have a happy relationship with his children, dominating his daughters and quarrelling with his sons, two of whom emigrated to the US. His relationship with his youngest daughter was restored when she took over the household after her mother's death and looked after him for the last 24 years of his life.

More information about Gauss can be found at these websites:

- Wikipedia
- The GAP Group

Did you try the Gauss problem? There are a number of ways to work this out. Gauss' presumed method was to realise that totalling pairs of numbers from opposite ends of the list gave the same sum: 1 + 100 = 101, 2 + 99 = 101, 2 + 98 = 101 etc. He knew there were 50 pairs so he multiplied 101 by 50 to give 5 050. Why not give this problem to your class and see what they make of it? You never know, you might have a budding Gauss!! As a starting point, you could ask them to total the numbers to five, then 10 and 20 and to look for patterns to try for the numbers to 100.

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Maths to share – CPD for your school

Mental and oral calculation strategies

It is the beginning of the year, a very good time to think about those elements of our practice that underpin children's learning in mathematics.

Before the Professional Development Meeting ask your colleagues to read Thompson, I. (1999) Mental Calculation Strategies for Addition and Subtraction. *Mathematics in School*, Vol. 28, Issue no.5 (from the Mathematical Association website).

Discuss the article. You may want to focus the discussion around some key questions, for example:

- Have you seen children use strategies like these in your classroom?
- How do the models compare with what you are teaching/supporting in your classroom?

Reflection
Ask teachers to reflect and share with their peers:

- When asked to calculate what is your initial response? Do you begin to calculate mentally, reach for pencil and paper or a calculator?
- Were you taught mental methods at school or were you taught standard written algorithms?
- As a result of your learning of mathematics at school, do you think this has equipped you for adult life?

Share with your colleagues recommendation 10 of The Independent Review of Mathematics Teaching in Early Years Settings and Primary Schools (Williams, 2008):

> *This review recommends a renewed focus by practitioners on 'oral and mental mathematics. Providers of ITT and CPD should ensure that this practice receives careful attention, both during ITT and in CPD programmes (p60).*

Stress how important it is that we as teachers support children's ability to calculate mentally. The National Curriculum and the Primary National Strategy Framework for Mathematics make it clear that children should learn number facts by heart and be taught to develop a range of mental strategies for quickly finding, from known facts, a range of related facts that they cannot recall rapidly, and this needs to be taught explicitly.

Activity
Tell colleagues that any calculations must be done mentally, supported by jottings if necessary (this would be a good time to reinforce the fact that when children are calculating mentally they should be encouraged to use jottings).

Show the number board and ask the following:

- Which is the largest/smallest number?
- Can you predict which row/column has the highest/lowest total?
- Add together the numbers in third row. What strategy did you use?
- Tell me two numbers with a difference of 9/19?
- Tell me three numbers that total 37?
- What is the difference between the largest and the smallest number?
- Find me one number that is half of another?
- Increase each number in Column 1 by 9.
- Multiply each number in the top row by 10. What do you notice?
- Double each number in row four. What strategy did you use?
- Find a product where one factor is 6. What is the other? Find more.
- Multiply each number in the middle column by 7. What strategies did you use?
- Find two numbers that have a total between 65 and 75.
- Find two numbers with a difference that is a multiple of 10.

16	9	24	7	11
6	18	50	28	30
12	36	5	2	14
4	45	10	40	27

Take feedback and discuss strategies. Point out the use of the number board as a tool to pose open questions – some in terms of the methods pupils can use and some in terms of the answers presented.

Answers to possible strategies to find answers for the number board questions can be downloaded here.

Share with the group:
By the end of Key Stage 2 children should be able to:

- Add or subtract mentally, combinations of one-digit and two digit numbers and develop written methods to record and explain these calculations;
- Add or subtract mentally, pairs of two-digit whole numbers
  - Counting on or back from the largest number
  - Reordering numbers in addition
  - Partitioning
  - Bridging through 10 and multiples of 10
  - Adding, subtracting 9, 11 etc. by compensating

- o Doubling by partitioning and near doubles
- o Find differences by counting up

National Curriculum (1999)

Number boards can be downloaded from the National Strategies site.

Discuss:
How can we help children develop their mental calculation strategies?

- Be aware of the range of strategies that children may use, so that:
    - o when children are carrying out mental calculations you may be better able to recognise the strategies being used
    - o you can draw attention to and model a variety of strategies used by children in the class
    - o you can make suggestions to the children that will move them on to more efficient strategies (this links back to the reading)
- Provide opportunities throughout the day, not just in the starter activity or even in the mathematics lesson to rehearse number facts, for example, as children move about the room and clear away
- Encourage informal recording and the use of tools such as number lines and hundred number squares to develop understanding of number and help to develop competence and confidence for mental calculation at all stages. Take a look at the models and images that can be used to support mental calculation methods on the Primary National Strategy Framework.

Summarise the session with this quote from the Primary National Strategy Framework for Mathematics:

> *Oral and mental work in mathematics is essential, particularly so in calculation. Early practical, oral and mental work must lay the foundations by providing children with a good understanding of how the four operations build on efficient counting strategies and a secure knowledge of place value and number facts. Later work must ensure that children recognise how the operations relate to one another and how the rules and laws of arithmetic are to be used and applied. Ongoing oral and mental work provides practice and consolidation of these ideas. It must give children the opportunity to apply what they have learned to particular cases, exemplifying how the rules and laws work, and to general cases where children make decisions and choices for themselves.*

Some questions for further reflection:

- Does your mathematics teaching encourage/facilitate children to have a flexible approach to calculation strategies?
- What can you do to further develop your pedagogy in this area?

Further reading and resources to enhance your practice:
Read the guidance paper on oral and mental work in mathematics on the National Strategy.

These two booklets provide the rationale for the use of mental calculation strategies, show progression in learning and provide a range of examples that can be used effectively in the classroom to enhance children's learning in this area:

- QCDA's Teaching Mental Calculation Strategies Guidance for teachers in Key Stages 1 and 2 is an absolute 'must have' with activities and ideas for teaching mental calculation strategies.
- National Strategies' Teaching mental calculation strategies in mathematics to Level 5.