Primary Magazine

Issue 15

National Centre for Excellence in the Teaching of Mathematics

Welcome to the 15th issue of the Primary Magazine. Our famous historian is Lewis Carroll and we explore the art of the South African tribe, the Ndebele people. Up2d8 considers food wastage and the 'freegan' lifestyle.

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National Centre for Excellence in the Teaching of Mathematics

From the editor

Has your school been involved in the annual Mathematical Association's Primary Mathematics Challenge? If not, maybe it would be worth considering, as it is a great way to raise the profile of mathematics in your school and to have a lot of fun at the same time!

Comments from teachers include:

- Interesting and exciting topics
- Good test of logic, knowledge and strategy
- Smooth admin.
- Pupils were excited and enjoyed the challenge
- Definitely a yearly feature on our school calendar.

Comments from the children include:

- It stretched me - a long way!
- I'm sweaty after that!
- It made you think!
- Probably the best test I've ever done
- It pushes you to your limit.

The challenge next takes place during November 2009. You can get more details and information about applying and registering on the MA website (follow the links to PMC).

How often do you gesture when you talk to your children? You may be interested to know that your gesturing can bring out learners' implicit knowledge and help in teaching and learning! Apparently, when we routinely gesture with our hands as we talk, we often convey additional information not found in our speech. A recent study investigated the impact on teaching and learning when eight- to nine-year-olds used hand gestures to solve maths problems. Have a read, you may learn something new!

Mathematics Knowledge Networks

Last chance to apply for Mathematics Knowledge Network funding!

The current 'application window' closes at noon on Friday 2nd October. More information is available on the portal until the deadline, with links to further information and an application form with guidance notes.

Lesson study is becoming an increasingly popular form of CPD. You can find news of a new NCETM lesson study project on the portal, as well as more information about lesson study and professional learning.

National Centre for Excellence in the Teaching of Mathematics

INSPIRING MATHEMATICS CHAMPIONS

Inspiring Mathematics Champions is an NCETM project supporting achievement in primary mathematics. Trainee teachers from Leeds Metropolitan University and York St John University were offered the opportunity to engage with the programme and its network of education professionals, through a series of workshops, as an extension to their course. The main aim was to support trainees in building teaching skills in using and applying mathematics through the development of problem solving and cross-curricular approaches.

In a future issue of the Primary Magazine we will be reporting on the inspirational work of two students who developed an IMC maths trail at the stately home Brodsworth House. It was so successful that English Heritage, who administer the house, have decided to use the trail in the future for school visits.

Finally, in case you missed them in the last issue, some dates for your diary:

Tuesday 1 December, 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.

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

Another conference worth considering is at the Institute of Education on 25 November, New Curriculum New Opportunities, with Mike Askew and Lynne McClure as keynote speakers.

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Up2d8 maths

In this issue of Up2d8 we consider food wastage and the 'freegan' lifestyle and also discuss how we can encourage supermarkets to help us stop wasting food. It provides some great mathematical opportunities for exploring percentages, big numbers and data. 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:

- Make up a problem, eg the local supermarket wants to sell its most popular foods at half price instead of using 'bogof' offers. The manager would like to know what your favourite foods are so that he can offer these. Use this as an opportunity to make up a data handling session: Ask the children to draw one of their favourite foods on a post-it note. In groups, ask them to place their pictures on the board – how do they do this? Do they place them randomly or group them. Together make a bar chart or pictogram. Discuss the importance of labels and add these. They should then use this to help them create a bar graph or pictogram so that the manager can see clearly which foods to sell at half price.
- Younger children could:
  Set up a class shop.
  Introduce a new offer every few days or each week: Buy one get one free, Buy one get one half price, three for two etc. Ask the children to look out for them in the supermarket. That would probably be enough in FS, but in KS1, these could easily be introduced in an oral and mental starter, as part of a money topic. Using an IWB, teachers could build up a comparative list each day, asking, 'Is this better value than yesterday?' rather than, 'Is this cheaper/more expensive?' Teachers could work with a group to calculate the best offer for buying (say) tins of beans, or any other familiar food. Would the same offer be useful for food which spoils, for example, fruit or vegetables?
- FS children could make some packets of food (package plastic fruit or vegetables, bake salt dough biscuits or cakes until hard etc.) and label with 'Sell by Friday' or 'Use by Wednesday', then check their shop daily for items which must be removed.
- FS and KS1 children receive fruit from the school fruit scheme. They could monitor the fruit order, eg children check deliveries, sort for a variety each day, check how much needs to be thrown away – keep a record and try to reduce the amount etc.
- Older children could look at Freecycle.

Download this Up2d8 maths resource - in PowerPoint format.

Download this Up2d8 maths resource - in PDF format.

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The Art of Mathematics
The Ndebele

A Brief History of the Ndebele

The Ndebele are descended from the Nguni settlers who, it is believed, arrived in Southern Africa around 200 AD. In the early 1600s, King Msi settled among the low hills around which present day Pretoria is built. After his death, his two sons Manala and Ndzundza fought over the chieftainship and the Ndebele split into two main factions. Manala and his followers went northwards, towards present day Pietersburg. Ndzundza and his followers, who today are known as the Southern Ndebele, went east and south and they have remained distinctly Ndebele and culturally independent of their neighbours.

In 1849 and 1863, the Ndebele successfully warded off attacks by the white Boer invaders and settlers. However, in 1883 they were defeated and the tribal structure of the Ndzundza Ndebele was broken up and all of their tribal lands confiscated and divided among the Boers.

From the early to mid-20th century, the Ndebele were in the wilderness, and as a result, maintained a strong tribal identity in the face of the government forces that sought to destroy them. Their mural art and beadwork and their strict adherence to culturally based rules of personal adornment maintained their cultural unity and reinforced their distinctive Ndebele identity. These expressive symbols were used as a type of communication between sub groups of the Ndebele people. They stood for their continuity and cultural resistance to their current circumstances. The Boer farmers did not understand the meaning and only viewed it as cultural art that was not harmful, so it was allowed to continue. Ndebele artwork is impressive because of the designs and colours used.

Wall-painting traditions

In the early days, clay, ash, plant pigments, and cow dung were used to create earthy colours. Today however, bright colours adorn the modern home. The married women are responsible for the decoration used in both the beadwork and mural art.

The photograph shows the painted wall of a home. Parallel lines create horizontal strips in which designs can be created. Each of the panels contains a design that reveals a high level of symmetry. Each design has both horizontal and vertical symmetry.

A Department for Children, Schools and Families initiative to enhance professional development across mathematics teaching

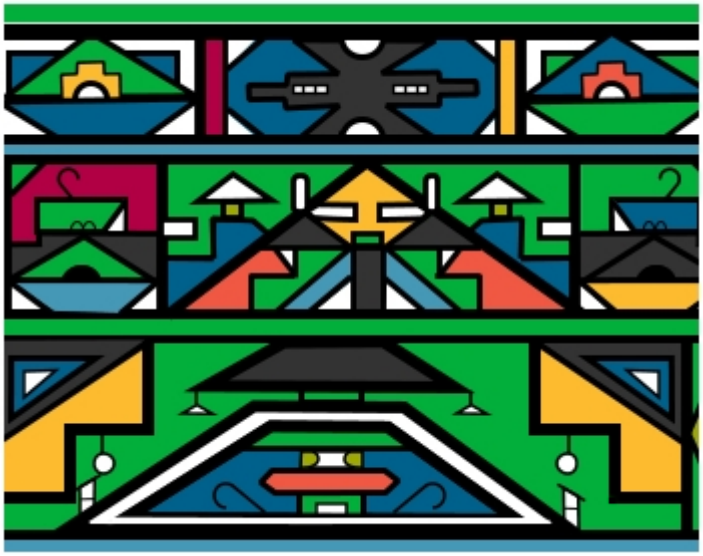
Techniques
To begin a wall-painting, the artist divides the wall into sections and then chalks lines diagonally across each section.

Next, the artist paints the black outline of the design for each section. Painting is done freehand, without the use rulers or set-squares. Somehow symmetry, proportion and straight edges are exactly maintained.

Then, the black outline is filled in with colour, and white spaces offset painted areas.

Classroom activities
The obvious stating point for examining Ndebele art is to ask the children to describe what they see. This activity and the language used can be matched to their age and stage of development. This is a really good opportunity to develop the use of mathematical language.

National Curriculum attainment targets addressed
NC AT3 – Pupils classify 3-D and 2-D shapes in various ways using mathematical properties such as reflective symmetry for 2-D shapes.



- What shapes can they see?
- What are the properties of these shapes?
- Can you find any shapes that are not polygons? How do you know?
- Are they regular/irregular shapes?
- Can you find any shapes with right angles?
- Can you find any shapes with angles smaller/greater than a right angle?
- Can they find any shapes that have reflective symmetry?
- Can they identify lines of symmetry?
- Can they find any examples where shapes have been translated or rotated?
- Can they see any patterns?

The Ndebele image is available as a downloadable worksheet.

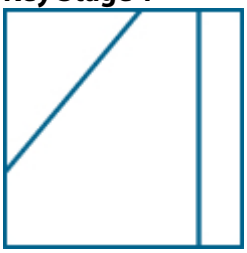
This activity could also be extended so that children devise their own design on squared paper satisfying NC AT3 – Pupils draw common 2-D shapes in different orientations on grids. They reflect simple shapes in a mirror line. They find perimeters of simple shapes and find areas by counting squares.

This could be made more or less difficult by opening out or closing down the criteria for the design. The more criteria, the more challenging the activity, eg:

- Devise a design that:
  - has a repeating pattern
  - includes an irregular pentagon
  - has two lines of reflective symmetry (horizontal/vertical)
  - has a shape that has been rotated
  - has a shape that has been translated horizontally/vertically
- Can you find the area of the…?

Cross-curricular opportunity
This activity could also be carried out using Microsoft Paint or, for a real challenge, writing instructions for Logo:

Key Stage 1

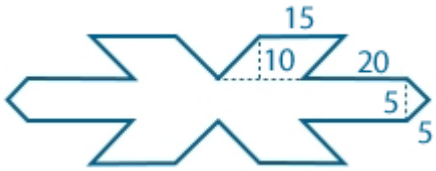


Using the Ndebele method, children in KS1 children can describe and identify properties of 2D shape.

- Using a ruler draw eight lines across the square – each line must go from one side of the square to one of the other sides
- When you have finished you will have made a number of polygons (straight-sided shapes)
- Use a different colour for each shape
- How many triangles did you find?
- Can you describe them?
- How many rectangles?
- How many are squares?
- What other quadrilaterals did you find? Can you find their names?
- How many pentagons did you find? Are they regular or irregular?
- How many of the shapes have lines of symmetry?

This idea can also be developed using Paint for children in KS2.
The children could create a display of their work. They could develop their thinking and language by posing their own questions for their designs.

Upper Key Stage 2



Select one of the symmetrical designs and ask children to measure the area and perimeter of the irregular polygon/compound shape. An example of one such design is shown below. By providing dimensions, the students can use the formulas they are familiar with to measure the area of the whole shape.

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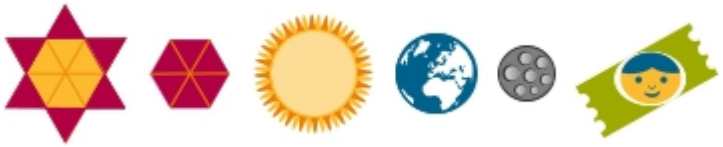
Focus on…Space

Space is a popular theme in primary schools today. Some teachers focus on the Earth, Sun and Moon system, others on the Solar System. Some begin with Earth and move on out into space, while others might start with galaxies and home in on the Earth, extending the study to include solids, liquids and gases, materials, magnets, rocks and soils, habitats, adaptations and more. Exploration, transport, monsters and aliens can easily be added into the mix. However you tackle the topic, there are many ways to include mathematics.

Take a look at some of the ideas below. Most of them can be adapted for any primary year group.

Foundation Stage

- When children think of space, they usually think about stars and rockets. Use the star starter and have fun counting down to zero and shouting, 'Blast off!'
- Sing *Five Little Men in a Flying Saucer*. Download visual aids from Sparklebox.



Key Stage 1

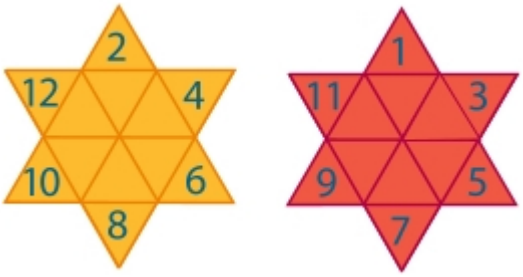
- Remind the children of the six-pointed star they used in the starter activities. Together, examine how the points fold in and match the interior triangles. What shape can you see when all the points are folded in? Challenge the children to make stars with 3, 4, and 5 points. You could give the children triangles, square and pentagons to draw around to get them started.
- Put the planets in our Solar System in order. Use ordinal language to describe the correct order.
- Light from the sun takes about eight minutes to reach Earth. What else takes eight minutes? Set some eight-minute challenges – can you complete a snakes and ladders game (or dominoes or a card game) in eight minutes?
- Visit your local supermarket to look at food for your journey to the Moon or stars. Allocate one display stand and one 3D shape to each child. Use tally marks to help count the different packaging shapes. Collate the results in a chart back at school. Which is the most popular shape for packaging? Which is the least popular? Were there any shapes you could not find? Why? Make wanted posters for the missing or rare shapes. List the properties of the shape and what it might be needed for. Which shapes stack without leaving any spaces? You must use space wisely on your spaceship.
- Look at Captain Invincible's control panel, found in *Captain Invincible and the Space Shapes* by Stuart J. Murphy (HarperCollins, ISBN: 0064467317). Why are the shapes grouped into two rows? Which properties does each row of shapes have in common? Can you find more shapes to extend each row? What would each shape do?

A Department for Children, Schools and Families initiative to enhance professional development across mathematics teaching

- For a great 3D shape exploration, ask the children to design tickets to fly on a rocket to Planet Vij. Adult single tickets 'cost' 24 faces, children's tickets,12 faces. Draw, stamp or stick printed shapes on the ticket to the required number of faces. Every member of a family must have a different ticket. Can the children make enough tickets to take their whole family and return home, or will they be stuck there?
- Read this article in the April 2008 issue of *Child Education* for some space-themed ideas on 3D shapes.

Key Stage 2

- Remind the children of the six-pointed star they used in the number activities. Together, examine how the points fold in and match the interior triangles. What shape can you see when all the points are folded in? Challenge the children to make stars with 3, 4, and 5, 7 and 8 points. Provide regular shapes to draw around if necessary to get started.
- Make a scale model of the Hubble Space Telescope.
- Draw the planets to scale. The diameter of the Moon is 3 500 km, the Earth 13 000 km and the sun 1 400 000 km. Draw the Earth with a diameter of 13mm. What should the diameter of the moon and sun be? Use the internet to find the diameter of the planets in the solar system and draw to the same scale. The information the children are likely to find will give you the opportunity to revise rounding. They could also find the distance of each planet from the sun and draw to scale. Model the sizes and distances using The Thousand-Yard Model or The Earth as a Peppercorn from the National Optical Astronomy Observatory.
- Light from the sun takes about eight minutes to reach Earth. If it takes three minutes for light to reach Mercury, five hours and 18 minutes to reach Pluto and the speed of light is 299 792 458 metres per second, how could you find out how long light from the sun takes to reach each of the planets?
- Use EarthTools to find the sunrise and sunset times of a chosen place. Use the data for the first of the month only to draw a bar chart or graph of daylight hours. When was the longest/shortest day? What is the average length of a day? Alternatively, allocate a month to a pair of children to work out the length of each day. Pool the information and identify days with identical lengths. What do you notice?
- Become an 'Inbetweener'. Ask each child to choose two next-door planets and find out as much about them as possible. Use this information to design a planet that would sit 'inbetween' the two chosen planets. How big is it? How far from the sun is it? What other information about your planet can you provide?
- Write a travel guide to a planet – describe its position in the solar system, its weather, distance from Earth and time taken to get there, what to expect and so on.



Further star number activities

- Number the points 1 to 6. Fold the triangles in. Explore how many different totals can be made by adding 2, 3, 4, 5 or 6 numbers. Look for systematic working.
- Number the points with the even numbers 2 to 12 only. Number a second star with only odd numbers 1 to 11. Ask the children to work in pairs to explore patterns of addition: add + add = ? even + even = ? odd + even = ?
- Number the points and the interior triangles. Make the interior numbers smaller than those on the points and challenge the children to find as many different totals as they can by subtracting an interior number from a point number. Alternatively, which totals can be made by multiplying a point and an interior number? Look for patterns in the totals. Again, look for systematic working.
- Number the points and triangles as appropriate for the children. Challenge them to make a particular total in as many different ways as they can, using as many of the numbers on a particular star as they wish and any of the four operations.
- You can probably think of several more!

Useful sources of information

- Science at School
- The Children's University of Manchester
- BBC Science and Nature
- BBC Bitesize
- National Geographic Kids
- National Geographic Space
- KidsAstronomy
- Science Year
- StarChild
- MESSENGER

Some space-themed online games

- Play Kids Games - Shuttle Launch
- Birmingham Grid for Learning - Booster Space Mission
- Count On - Shape Invaders
- ict games - space jumps
- MathsIsFun - Invaders
- Public Broadcasting Service - Mission Magnetite
- Primary Resources - Moonmaths
- Crickweb - Alien Weigh In
- Hyperstaffs - Cosmic Numbers

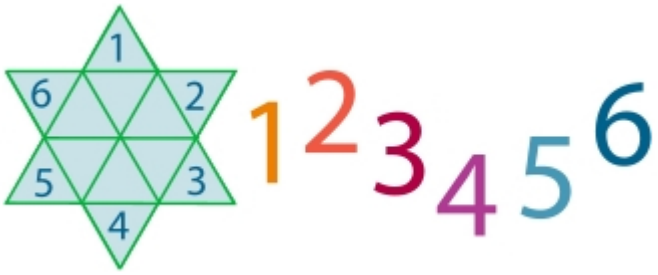
Resources

Download lots of space-themed resources from Sparklebox. There are play dough mats, role-play materials, bookmarks and themed borders. In the numbers section you can download numeral and number word rockets, stars and planets, as well as a matching game. Check out the literacy section too. For around £2 per set, but with some free resources too, go to Instant Display.

Mathematical stories to support a space theme

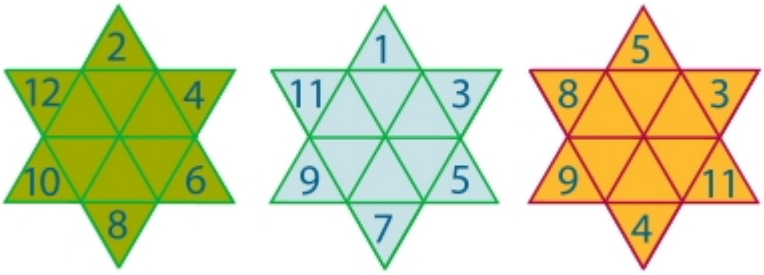
- *Captain Invincible and the Space Shapes* by Stuart J. Murphy (ISBN: 0064467317)
- *Eric and the Red Planet* by Caroline Glicksman (ISBN: 0099456400)
- *Galaxy Getaway (Mathematics for Martians)* by Jane Tassie (ISBN: 0753404443)
- *How Big is a Million?* By Anna Milbourne and Serena Riglietti (ISBN: 0794519245)
- *How Much is a Million?* By David M Schwartz (ISBN: 0688099335)
- *Planet Omicron (Mathematics for Martians)* by Julie Ferris (ISBN: 0753404451)
- *Space Rescue* by Graham White (ISBN: 0689836546)
- *Zachary Zormer Shape Transformer: A Math Adventure* by Joanne A. Reisberg (ISBN: 1570918767).

Starter of the Month



Foundation Stage
Print out a large copy of the star on yellow paper and enough smaller stars for one each. Write the numbers 1 to 6 in the points, in order. Count around the star in order, forwards and back together. Invite one or two children to have a go by themselves. Fold the points of the large star inwards. Reveal one point and ask the children to name the number and show you the matching number of fingers. Finish with all the points folded in and the children showing you zero as two closed fists.

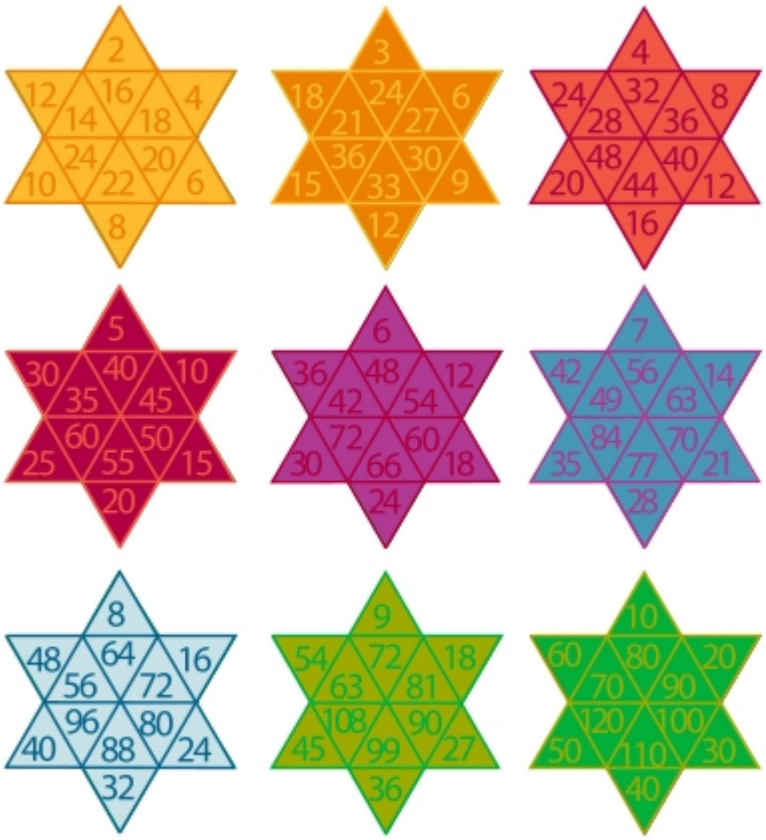
Follow up by working with a small group. Recap counting forwards and back. Ask the children to carefully fold in the points, then take it in turns to fold out a point, say the number and match with the appropriate number of objects. If the children are ready, ask them to fold out two points and add them, using objects for support if necessary.



Key Stage 1
Print six stars on different coloured paper. Number each point, as appropriate for the children and your current focus and cut out the stars. For example, one star could be numbered with the odd numbers from 1 to 11, another with even numbers from 2 to 12, another with random numbers and so on. Display the stars on a large board where everyone can see them. Ask a series of questions such as:

- *What do you notice about the green/blue/yellow etc. star?*
- *Which star has the highest/lowest number?...the largest/smallest total?*
- *Which star has the number that I get when I take 5 away from 9?...when I add 3 to 8?*

See Focus on for more ideas.



Key Stage 2
The Key Stage 1 activities may be useful in Years 3 and 4.
Print out nine stars and number each with the first 12 multiples of one of the numbers from 2 to 10. Ask questions such as:

- *What do you notice about each star?*
- *Which star has the largest/smallest total? How can you tell without adding?*
- *Which numbers are not on any stars?*
- *Which types of numbers appear on every star (square numbers)?*
- *Which two stars have a total of 624 (multiples of 3 and 5)?*

Alternatively, print six stars and number both points and triangles with random numbers, as appropriate for the children. Ask questions along the lines of those in the Key Stage 1 activity. Invite children to ask questions for the rest of the class to answer.

See Focus on for more ideas.

A little bit of history – Lewis Carroll

We all know that Lewis Carroll was a famous author who wrote such stories as *Alice in Wonderland*, but did you know that he was also the man who gave us the Carroll diagram that we use in mathematics to sort or group objects or numbers against given criteria? The Carroll diagram was also known as 'Lewis Carroll's square'. In it, numbers or objects are either categorised as 'x' (having a characteristic x) or 'not x' (not having that characteristic).
His were more complicated than those you will see in a primary classroom! To find out more about them visit the Cut the Knot website.

Here's an example of the Carroll diagrams we teach our children to use.
Sort these numbers according to whether they are even multiples of 3:
5, 6, 8, 12, 15, 18, 20, 21, 29, 35, 39, 40.

Criteria	Even numbers	Not even numbers
Multiples of 3	6 12 18	15 21 39
Not multiples of 3	8 20 40	5 29 35

You might like to use the interactive Carroll diagram found on the Nrich website with your children and then ask them to make some of their own with criteria of their choosing.

Now, about the man himself…
Lewis Carroll was born on 27 January 1832 as Charles Lutwidge Dodgson. As we all know, he was an English author whose most famous books were *Through the Looking Glass*, *The Hunting of the Snark* and *Jabberwocky*, as well as the previously mentioned *Alice in Wonderland*. As well as an accomplished author, he was also an exceptionally gifted mathematician.

Most of Carroll's ancestors were either army officers or Church of England clergymen. His father, also called Charles, was mathematically gifted, winning a double first degree at Oxford University. This could have led the way to a brilliant academic career, but he chose to marry his first cousin and become a country parson – and have 11 children! Lewis was the third child and eldest boy of this marriage. He was born in Daresbury, Cheshire. When he was 11, he and his family moved to Croft-on-Tees in North Yorkshire and this was where he spent the next 25 years of his life. He was a very intelligent child and for the first part of his schooling he was educated at home. At 12 he was sent away to boarding school, which wasn't a particularly happy experience for him. However, academically he excelled. He went on to Oxford and his talent as a mathematician won him the Christ Church Mathematical Lectureship, which he held for 26 years, mostly because the money was good – the work bored him. After those 26 years he continued there, in various capacities until he died on 14 January 1898.

When he was young, he suffered from a fever which left him deaf in one ear and when he was 17, he had a severe attack of whooping cough which was probably responsible for his chronic chest condition in later life. He also suffered from a stammer throughout his life. However, it didn't stop him from doing well socially. At the time when people mostly made up their own entertainment, Lewis Carroll was a

success. He was an entertaining man, who could sing, was adept at mimicry, a great story teller and also good at charades.

His ambition was to make a mark on the world as a writer or artist. From a young age he wrote poetry and short stories which were published in national publications. Up until 1856 he wrote under his real name of Dodgson. Lewis Carroll is actually a play on his real name: Lewis is the English form of

Ludovicus, the Latin for *Lutwidge*, and Carroll is an Irish surname similar to the Latin name *Carolus* from which Charles comes.

As well as changing his name in 1856, he took up photography and soon excelled, becoming a well-known gentleman-photographer. He also made studies of such things as landscapes, skeletons, dolls, dogs and nudes. It wasn't long before he was making portraits of people in higher society circles. For some reason, he stopped photography completely in 1880. This could be linked to the fact that he started having attacks of micropsia and macropsia (a brain condition affecting the way objects are perceived by the mind e.g. a sufferer may look at a larger object, like a football, and see it as if it were the size of a mouse). It is also thought he suffered from epilepsy.

Another area where he showed talent was inventions. He invented the first stamp case, a writing tablet that allowed for note-taking in the dark and several games made up from the logical rules of croquet, billiards and chess. Apparently he invented an early version of Scrabble and also the game, Word Ladder – changing a word into another by changing one letter at a time e.g. word to cool: word, wood, wool, cool.

For more information about Lewis Carroll visit these websites:

- Lewis Carroll Society of North America
- Wikipedia

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National Centre for Excellence in the Teaching of Mathematics

Maths to share – CPD for your school

Mathematics Subject Knowledge – Length

Before the session, ask colleagues to read the article by Douglas H. Clements, Teaching length measurement: Research Challenges. It explores the difficult nature of teaching and learning the concept of length, suggesting the difficulty might be due to the fact that it bridges both spatial awareness and real numbers. It also challenges the conventional progression of skills related to the teaching of length.

Ask teachers to discuss the following question…

> What are the most important aspects of teaching length?

Share the outcomes of the discussions. Are there common aspects that are shared by all? Do any of the teachers suggest an order for teaching particular concepts?

Provide the teachers with a copy of Length: Key Concepts. Ask them to consider the order in which the statements might be taught or used confidently by pupils. Are there any that are taught throughout? Which, if any, of the concepts is the hardest to teach? Why?

Allow time for discussion and feedback. What do they think are the common misconceptions with the concept of length? Some points for discussion might include:

- When comparing two objects directly, side by side, where no measuring or counting is required, children can fail to 'line up' one end of each object. Pupils' understanding can be challenged by an adult moving one object as shown below.
- Pupils will be moved on by comparing more than two objects, using each as a baseline for comparison, ordering from greatest to least. It is important for them to focus on the relevant criterion, ie length, as they can be sidetracked or confused by the width.
- If pupils use lots of the same uniform unit, for example, placing centimetre cubes carefully along a given line, they can make mistakes counting each unit. Once they progress to using one unit repeatedly (the skill of iteration) they may have difficulty keeping count. It is important that we recognise constraints set by pupils' counting abilities when setting tasks relating to length. Clements suggests that even when equipment marked in standard units (eg rulers) is introduced, pupils continue to use non-standard units, eg centimetre cubes, alongside.
- When using standard units children do not always have a 'feel' for the size of the standard unit. It is only once this is developed that they can use it as a benchmark to estimate.
- When using equipment calibrated in standard units (eg ruler, tape measure, trundle wheel) children need to be explicitly taught appropriate handling techniques. Often children measure from the end of a ruler or from '1' rather than from zero, or count the markings on a ruler rather than the units themselves (or the spaces).

The use of standard measuring equipment is discussed in detail by Clements (1999), alongside an equally strong argument for the development of *'mental rulers'*. In order to be able to develop a *'measurement sense'* pupils need a great deal of experience estimating lengths, visualising their own 'mental ruler'. This can then support them when judging and comparing lengths and measurements, or drawing lines of a given length.

The Early Numeracy Research Project (ENRP) describes the development of the concept of length as involving firstly an awareness of length, followed by comparing lengths, quantifying lengths, and finally measuring lengths. Clements (1999) claims that even pre-schoolers can compare two objects directly, and so we, as teachers, must try to assess exactly what level of understanding the pupils have when they arrive in our classrooms.

A common stumbling block for pupils is the language associated with certain areas of mathematics, and 'length' is no different. ENRP refers to the need to explicitly teach children to move from multi-dimensional words to *uni-dimensional* words. An example for length is the early use of the word 'big' and the need to give pupils "a wide variety of uni-dimensional words that describe 'bigness' more precisely - 'tall', 'long', 'high', 'wide', etc." This mirrors work carried out in literacy, exploring alternatives to words such as 'nice'.

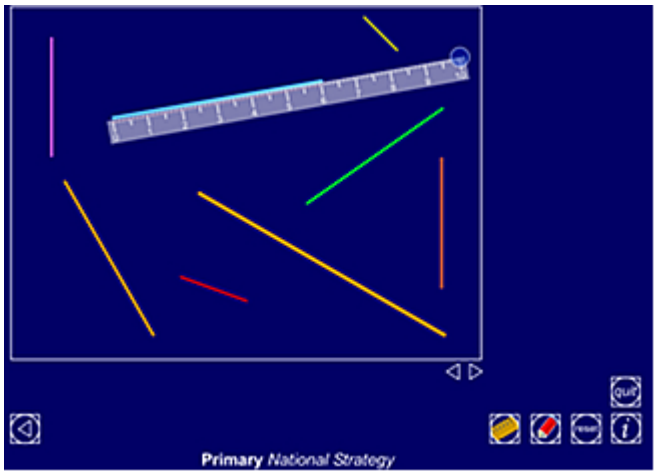
Ask staff to consider, for each of the following, an estimate, a suggested unit of measurement, and appropriate equipment.

The length of your little finger.
The height of the door.
The distance from here to the local shop.
The distance from London to Glasgow.

What did they use to make their estimates? How accurate does an estimate need to be, in order to be considered acceptable? How often do they ask pupils to carry out similar activities? It is vital that we allow pupils the opportunity to estimate lengths at all stages of their development, even early on when only working with non-standard units.

As for most areas of mathematics, there are numerous ICT programmes and pieces of animated software available to demonstrate measuring skills at all stages of a pupils' development. Despite the often eye-catching nature of many of these, they simply cannot replace practical activities where the pupils are required to estimate then measure objects and distances in 'real-life'.

- Ruler is an Interactive Teaching Programme developed by the National Strategies, designed to support the exploration of measuring length. It allows the user to draw lines or shapes that can then be measured using an on-screen ruler. Excellent for demonstrating the accurate use and lining-up of a ruler, which can be difficult to show practically to a whole class. There are no units attached to the ruler and it is important not to refer to the divisions as cm or mm because the magnified effect of the projector would interfere with the pupils' 'mental ruler'. Pre-saved screens allow users to practice their skills measuring shapes and lines already available.



- The use of a floor turtle followed by an on-screen turtle can really challenge some pupils' thinking and understanding of the concept of length. Floor turtles can be used as a measuring tool themselves, children trying to find out 'how many turtles wide the classroom is' for example. They can use their estimation skills to plan for and program the turtle to move around a particular course. You will find more information regarding the availability of on-screen turtle programmes, including some available as free downloads on the Mathsnet website.
- Primary Games has a very child-friendly site focusing on the teaching of measures. It includes resources for whiteboard/large display as well as related worksheets and follow-up ideas. Various units of measure are included.
- The BBC Skillswise site offers some suggestions of activities and includes useful factsheets, quizzes and games relating to teaching length.
- With the development of web-based mapping and location programmes such as Google Earth, a whole host of activities can be developed making use of the tools available. Adam Boddison led a live video conferencing session though Motivate aimed at upper Key Stage 2 pupils. It taught pupils how to use the line and path tools to measure straight line distances on Google Earth. Work then focused around the US Pentagon, the lengths of international airport runways and supermarket car parks, estimating, measuring and converting units of length. Further Motivate conferences can be found on their website.
- The book *Length* by Henry Arthur Pluckrose, (part of the *Math Counts* series) shows some wonderful photographic images aimed at encouraging young pupils to talk about the concept of length.
- *The Crocodile's Coat* by Cal Irons (also available as a Big Book) is a wonderful way to introduce children to the concept of repeatedly using a non-standard measure. A crocodile goes to the lizard tailor shop to be measured for a new coat, only to find that all of the clothes they make are measured in 'lizards'. The crocodile is measured by the lizards lying nose-to-tail along his body. The fabric is then measured in the same way, and a beautiful coat is made!