Primary Magazine
Issue 19

National Centre
for Excellence in the
Teaching of Mathematics

Welcome to the 19th issue of the Primary Magazine. In this issue we look at the life and achievements of the famous historian Ada Lovelace, the artist Andy Warhol, and our Focus is on water.

Contents

From the editor

In our last issue, we heard from Helena, the Primary Mathematics consultant in Merton. In this one we hear from Lee, the mathematics AST from Richmond upon Thames.

The first issue of the Early Years Magazine was launched in December. Like the Primary Magazine, it has a wealth of information and great ideas to develop classroom practice. Take a look, even if you are a primary practitioner. The research article by Ian Thomson is particularly relevant and might make you consider whether the way you expect children to record their work in Years 1 to 6 is really the right way to develop their mathematical thinking.

Now for a quick reminder of things you might have missed in Issue 18 due the hectic Christmas period in (and out of) school:

If you are a teacher in a school, an LA consultant or have any influence at all in education and have an idea that you think will make a difference, you might like to consider bidding for an NCETM Regional Project. Contact your NCETM Regional Coordinator and they can advise you on the best way to submit a bid.

At the end of November the NCETM launched Excellence in Mathematics Leadership, a really useful tool to assist mathematics subject leaders in their roles in school. We would love to hear from mathematics subject leaders who would be interested in applying for funding to take part in a project related to this. Contact your NCETM Regional Coordinator for more details.

If you are enrolled on the Mathematics Specialist Teacher (MaST) programme or would be interested in joining the second cohort in September, take a look at the MaST microsite which, as well as other useful information, includes a self-assessment tool to help you to decide whether it is something you are able and would like to do.

And finally, a couple of dates for your diary…
Are you in a position to support others in developing their teaching of mathematics? Are you interested in working with a group of like-minded teachers who can exchange ideas to develop teaching skills? Our free Influence and Impact Conferences are just for you!

Here are the dates for the Conferences:

- Newcastle 25/26 January 2010
- Manchester 28/29 January 2010
- Birmingham 1/2 February 2010
- Exeter 4/5 February 2010
- Peterborough 8/9 February 2010
- London 11/12 February 2010

Have you booked your place at the BCME7 conference, 6-9 April 2010, University Place, University of Manchester?

The Art of Mathematics
Andy Warhol (1928 - 1987)

Andrew Warhola was born in Pittsburgh, Pennsylvania, in the United States and is best known for his exploration of Pop Art, an art movement that emerged in the 1950s, characterised by themes drawn from popular culture, advertising images, those of comic books and mundane ‘everyday’ objects that people knew, were the foci of his work.

Warhol studied fine art at college, after which he moved to New York where he began illustrating for magazines and advertisements. He loved pop culture, and so began painting pictures of everything he loved: Coca-Cola bottles, Campbell’s Soup, and his favourite celebrities. He used a screen-printing technique to mass produce his work, while still retaining each piece as an ‘original’ Warhol painting.

In 1962, Warhol established ‘The Factory’ in New York. This is where much of his now well recognised artwork was created, with a whole host of people who became known as the ‘Warhol Superstars’ employed to help him. Here they starred in nearly 650 Andy Warhol films, made and used the silk screens and created the paintings for which he became known worldwide.

For further information on the life and works of Andy Warhol:

- Art Smarts 4 Kids is a good place to gain additional information, written in a child-friendly way
- Warhol's World Online is a fantastic interactive cartoon-style quiz game teaching pupils all about Andy Warhol’s early home life, his commercial art career, the Silver Factory and his later life
- Andy Warhol Poster 'n' Pop gives a useful overview of Warhol's life, along with a detailed image library with information about his pieces.

All Key Stages

Introduce Andy Warhol as a famous artist, who produced much of his work in the 1960s. Use information from the websites above to ensure the children have sufficient information appropriate to their age.

Show them a selection of his work, including a repeated celebrity image such as that of Mickey Mouse and some of his 'advertising' work, such as that for Coca-Cola.

Finding all possibilities...
Ask them how the pictures make them feel – do they like them? Do they think Andy Warhol was a good artist? Explain the screen-printing process to the pupils and discuss whether they think this makes Warhol's work less 'real' or 'unique'.

Show them a range of Warhol's Marilyn Monroe screen print images and then the one produced here 'in the style of' Warhol. How many different images are there? What are the differences? How else could the images be arranged? If we focus on the background colour only, then there are three different images. How many different ways can these be arranged? What if they were arranged in a line?

The children could use other images such as those provided here to investigate the number of permutations with different numbers of images. As a class, produce a table of results, showing the number of permutations or possibilities with different numbers of images. Are there any patterns in the results? Children could produce their own digital images using a digital camera, and then create their own Pop Art using features available in freely available graphics packages such as Irfanview.

Ideas for using work arrays...
Ask the pupils to close their eyes. Explain that when they open them they will see a photograph in front of them for a few seconds. They need to count or estimate the number of tins of Campbell's soup they can see. Briefly display the photograph of the Royal Scottish Academy, marking the 20th anniversary of Warhol's death in 2007. How many tins of Campbell's soup did they see? Did they estimate, count them one at a time, or have a different method for finding the total?

Discuss the use of arranging items in rows and columns to find a total. Show the photograph again and establish together that there are eight columns with three tins in each, giving a total of 24 tins (8 x 3). Look at other examples of Warhol's work where images are organised in a similar way. What multiplication sentences can they write to match the images?

Warhol's image 100 cans shows 10 columns of 10 Campbell's Soup cans, thus arranged like a typical 1-100 grid. Mask off sections of the image to show specific numbers of rows and columns of cans. Ask the pupils to calculate how many cans are visible using multiplication facts.

Let us know about any other ideas you have – and we can help you share them with others!

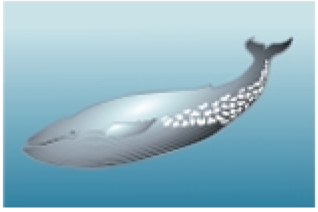
Focus on…Water

If water is one of your topic areas you might find this article useful. There are numerous activities and opportunities to explore in this topic and in this article we give a few of them.

Here are some of the many interesting facts about the oceans that cover most of our world to start you off, with links to enable further investigation.

- Earth has five major oceans
- the largest of these is the Pacific, located between the Southern Ocean, Asia, Australia and the Western Hemisphere, covering an area about 15 times the size of the USA
- the oceans cover nearly three-quarters of the planet's surface
- the Challenger Deep is the lowest spot in all the world's oceans, located in the Pacific. To put its depth into perspective, if you dropped Mount Everest (8 850m high) into it, there'd still be more than a mile of ocean above it
- Australia's Great Barrier Reef covers an area bigger than Great Britain, and can even be seen from space. The Reef is a collection of islands which are home to over 400 types of coral, and among which live more than 2 000 species of fish. The National Geographic website is a fun, child-friendly website worth exploring
- every teaspoon of seawater contains many thousands - even millions - of mostly-unnamed microscopic organisms
- the oceans provide half the world's oxygen, and absorb a quarter of the carbon dioxide we produce
- ocean circulation cools the tropics and warms the poles
- around 125 000 years ago, sea level was four metres higher than today; 20 000 years ago, it was 120 metres lower. Today, the rate of sea level rise is accelerating
- every year, the Arctic Ocean produces up to 50 000 icebergs, large chunks of ice that break away from glaciers and float in open sea
- 90% of all icebergs are hidden under water
- one giant iceberg from the Antarctic could supply enough water for millions of people for as long as five years
- the Blue Whale, the largest animal ever on Earth, exceeding the size of the greatest dinosaurs, still lives in the ocean; its heart if the size of a Volkswagen car
- 97.5% of the Earth's water is saltwater. If the world's water fitted into a bucket, only one teaspoonful would be drinkable (HDR, 2006).

Facts sourced from: Sailing over Changing Seas *and* Eden (UKTV)

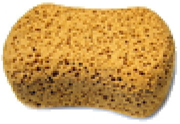




Teaching ideas could include:

All ages

Pirates
Why not link with a pirate theme - eg, Pirates of the Caribbean or Treasure Island! If you missed it before, Up2d8 in Issue 6 of the Primary Magazine, focuses on pirates, where you'll find lots more ideas for pirate links.

EYFS



Sponges
Make a collection of sponges of various sizes, colours and textures. Which sponge holds the most water? You could use this as an opportunity to discuss fair testing.

Key Stage 1

The Blue Whale
There is a fabulous activity on the Pearson Education website that will enable children to make predictions and measurements of the largest animal on Earth. This activity will lead children to discuss the sheer size of the Blue Whale, in relation to objects they are familiar with.

Lower Key Stage 2

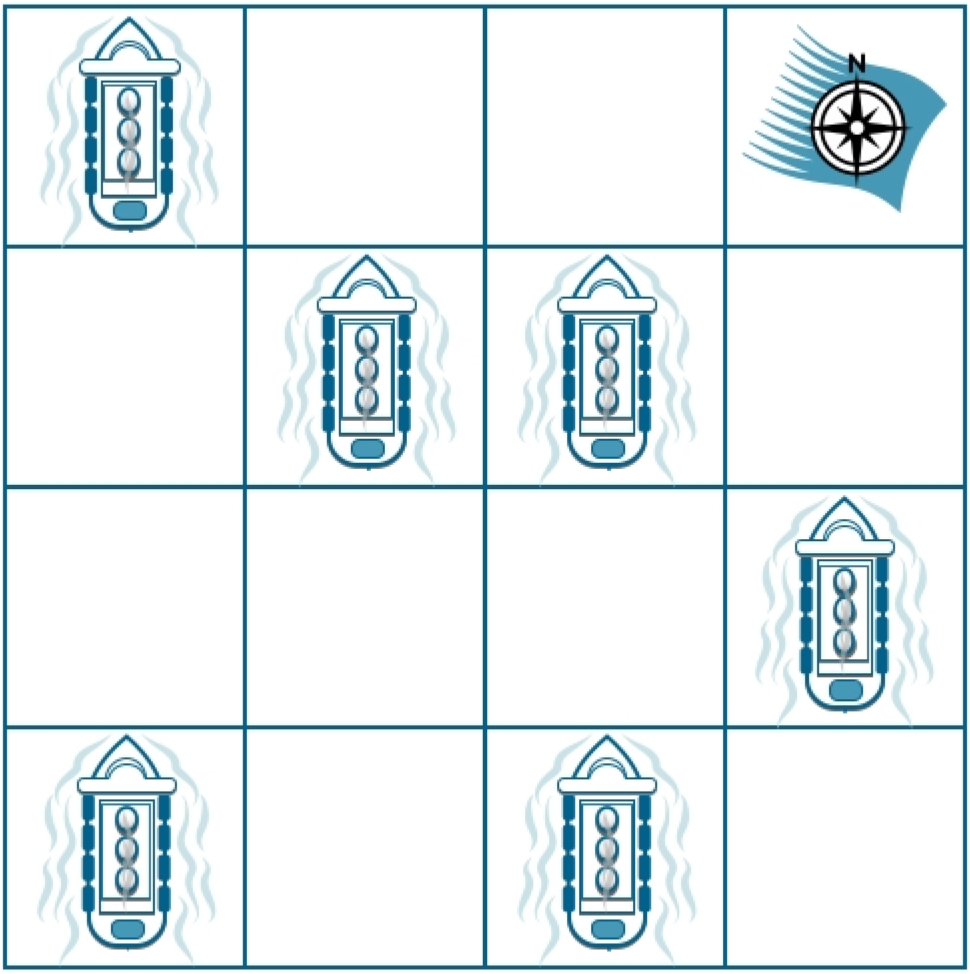
Crossing the Ocean
Two men and two boys want to sail to an island. None of them can swim and they only have one dinghy. The dinghy will only hold one man or two boys. How can they all get across? This has been adapted from Challenges for Able Pupils Years 3 and 4 problem 46, where the solution can also be found.

Upper Key Stage 2

Ships in the harbour
This is a group problem-solving activity which will draw on the knowledge skills and understanding of angles and direction.

Tell the children there are six unnamed boats in the harbour (see grid below). They are to use the clues to name each boat. You may want to provide the children with a grid and the names of the boats on card so that they can move them around as they read the clues.

- when the captain of Hercules turns 45˚ clockwise from north he sees Icarus
- Aphrodite is the furthest north
- when the captain of Aphrodite turns 180˚ anti-clockwise from north she sees Poseidon
- Zeus is to the east of Apollo.



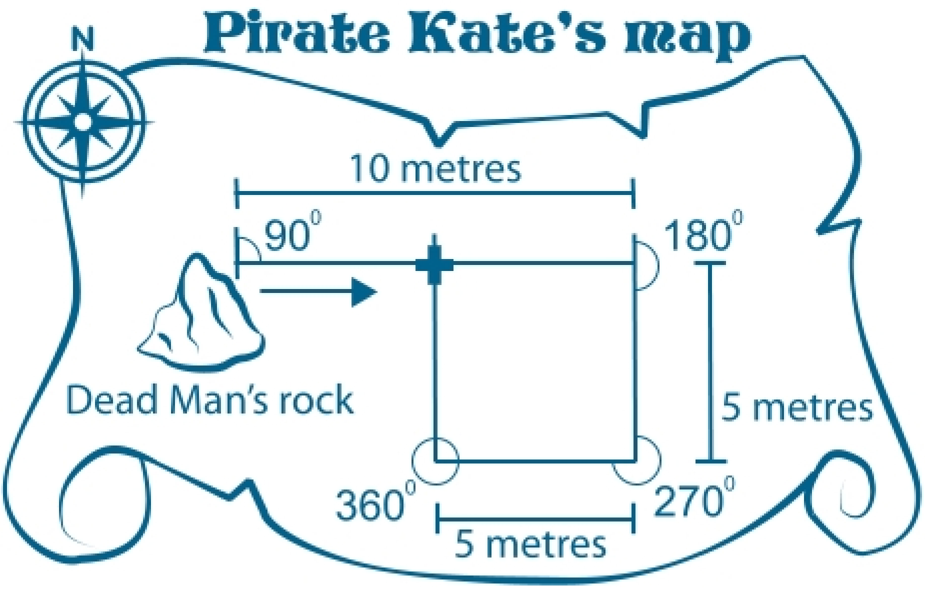
All years in Key Stage 2

Pirate Kate's Problem

There is a series of short clips on division, volume and other problems on teachers.tv. All are worth a look, but the fourth is the Pirate's Problem which provides a short scenario of Pirate Kate who has lost her treasure map. All she has left are the instructions she wrote down to help her find her way to the treasure from Dead Man's Rock. The aim of the task is to draw a map from the instructions given. The directions relate to angles on her compass. Every angle starts with her facing north at zero degrees

- start at Dead Man's Rock, facing north at 0°
- turn 90° and walk forward 10m
- now face north at 0°, turn 180° and walk forward 5m
- face north again at 0°, turn 270° and walk forward 5m
- face north once again at 0°, turn 360° and walk forward until you cross your original path - X marks the spot!

Draw Pirate Kate's map and find the buried treasure.



Extension
Plan a route 15m long and write instructions to get back to Dead Man's Rock

Liners and Oceans

The children could investigate some of the more significant ships that cruise the oceans:

- Royal Caribbean Liberty of the Seas
- SS Canberra
- Cunard Queen Mary II
- and perhaps the most famous liner of all time, Cunard QE2.

Ask children to prepare a presentation to the rest of the class about the ships. In addition to size, they could compare

- how fast they travel over the same distance
- how many passengers and crew
- what facilities there are on board.

They could also compare modern ships with famous ships in history, for example: the Mary Rose or the Cutty Sark.

Perhaps they could even make their own 'Top Trumps' cards if a wider range of ships were included.

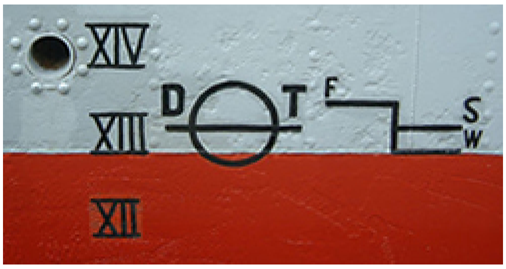
Ask the pupils if they think their chosen liner would fit in their school/supermarket/cinema or what else they think might be as big. They could mark out the length/width and height of their chosen cruiser on the playground (if it is big enough!). Think about how many school halls would fit in, how many children, etc.

Higher-attaining children could draw scale representations of the liner and go on to make scale models.

Alternatively the children could use the statistics below (one or all) or the weblinks provided to stimulate an enquiry into the world's oceans:

- the largest is the Pacific, located between the Southern Ocean, Asia, Australia and the Western Hemisphere, over an area about 15 times the size of the USA
- the ocean covers nearly three quarters of the planet's surface
- 97.5% of the earth's water is saltwater. If the world's water fitted into a bucket, only one teaspoonful would be drinkable. (HDR, 2006)
- BBC Nature
- Council of Monterey Bay Marine Libraries
- See the Sea.

Ask children to prepare a presentation to the rest of the class about the oceans. Their data should be represented in graph form using a range of formats, perhaps using data handling software (such as Excel). Children should be able to discuss the benefits and disadvantages of each format. Higher attaining pupils could consider the use of fractions, decimal, percentages, ration and proportion. This could also provide cross-curricular links with geography, science and citizenship.



Links with Science

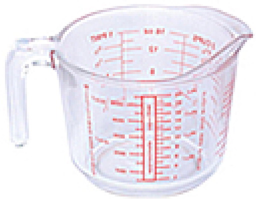
Children could find out about the Plimsoll Line – background information is available on the National Maritime Museum website. This could then be linked with work on forces - in particular Archimedes' principle. The law of buoyancy, discovered by Archimedes, states that any object that is completely or partially submerged in a fluid at rest is acted on by an upward, or buoyant, force. The magnitude of this force is equal to the weight of the fluid displaced by the object. The volume of fluid displaced is equal to the volume of the portion of the object submerged. Have a look at the Bathtime with Archimedes activity for some work on handling data.

For more about Archimedes, take a look at A little bit of history in Issue 16 of the Primary Magazine.

Children could also examine the impact of the size and shape of sails. Perhaps they could craft model boats and examine the impact of different size and shape of sails. A length of gutter pipe could be used to keep the 'ships' on track. Children could be asked to measure/calculate the size of the sails and measure and compare the speed of their vessels.

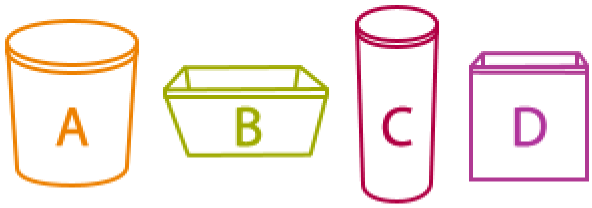
Children could use their knowledge of shapes to examine the bow of the craft and how different shaped bows reduce/increase friction. This could be linked with angles. Again, children could measure and compare the speed of their vessels.

Happy Sailing!



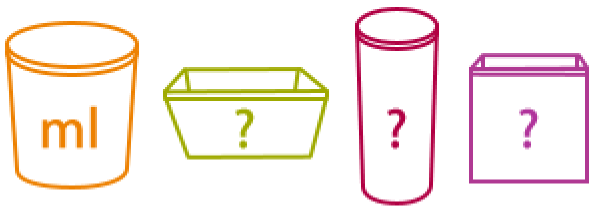
Starter of the Month

To link with our Focus on oceans and water, here are some suggestions for links with the measurement of liquid capacity.



Early Years Foundation Stage/Key Stage 1

Set up a small group activity in which there are four containers of different capacity with labels removed, if necessary, and relabelled A, B, C, D. Encourage the children to think about which container holds the most/least. Then give the children an opportunity to look at the containers, fill them with water and pour the water from one container to the other. Discuss how we know whether something is full or not.



Key Stage 2

For groups of 3 or 4: you will need a number of containers of different capacity with labels removed and relabelled A, B, C, D. Give each group one container and ask them to work together to guess the capacity of the container in millilitres. Give them a time limit to do this. When each group has agreed an answer, ask them to pass their containers to the next group on the right, who repeat the process. When the capacity of all the containers has been estimated by all the groups, one person in each group measures the capacity of the container they started with. Find out which group was the closest for each container and ask the children how they estimated.

Children work in pairs: ask each child to write a measure of liquid volume between 0 and 2 litres. Each pair should then have two cards between them. Sharing the cards like this will encourage mathematical dialogue. Ask all the children to stand.

Call out the following instructions one by one.

Stay standing if the capacity on your card is:

- greater than 0.4 litres
- less than 1 500ml
- greater than ¾ litre
- less than 1.2 litres
- greater than 900ml
- less than 0.95 litres.

When only a few children are left, ask for their values and check with the group whether they should be standing. How can they justify why they are standing?

Solution – children standing will have between 900 and 950 ml on their cards.

Simplifications

- rephrase the question 'sit down if...'
- limit the values to between 0 - 1 litre
- ask questions that specify an amount
- give children a list of amounts for liquid volume - eg 250ml - and ask questions like 'sit down if you have 250ml or equivalent on your card'.

Challenges

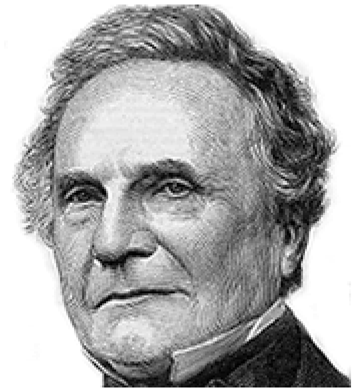
- ask children to write imperial and metric measures.

A little bit of history
Famous Mathematicians – Ada Lovelace

Ada Lovelace was born on 10 December 1815. She was the only child of the poet Lord Byron and his wife Anne Isabella, known as Annabella. When he knew she was expecting a child, Byron hoped that Annabella would give birth to a boy and when she didn't he was really disappointed. His daughter was named after his half sister Augusta Leigh, but Byron called her Ada.

When Ada was one month old, his wife asked Byron for a separation, moved out of the family home and went back to her parents' house, taking Ada with her. In those days, English law gave fathers full custody of their children in cases of separation, but Byron made no attempt to claim these rights. With some sadness, he left the country for good and headed to Switzerland when Ada was about four months old. He played no part in her upbringing and had no relationship with her at all: her mother was the only significant parent in her life. Byron died when she was nine.

Ada was often ill. At eight she suffered from headaches that affected her vision, when she was 14 she became paralysed after a bout of measles and was bedridden for nearly a year. Throughout her illnesses, she continued her education. Her mother insisted on it and arranged for her to be privately home-schooled in mathematics and science. At the age of 17, her mathematical abilities began to show themselves and one of her later tutors suggested that Ada's skills could lead her to become "an original mathematical investigator, perhaps of first rate eminence". He was right!



Ada met and worked with Charles Babbage, who was known as the 'father of computers'. He had worked on plans for his new computer and reported on its development at a seminar in Turin, Italy, in the autumn of 1841. An Italian wrote a summary of what Babbage described and published an article abobut it in French. Ada translated the article: Babbage saw this and suggested she add her own notes, which turned out to be three times the length of the original article. She went on to say in an article she had published in 1843, that a machine like the one Babbage was proposing might be used to compose complex music, to produce graphics, and for both practical and scientific use. She was spot on – the birth of the computer!

Ada suggested that Babbage wrote a plan for how his machine might calculate a special sequence of numbers known as Bernoulli numbers. This plan is now thought of as the first computer program, and she is thought of as the first computer programmer and software designer. In 1953, over 100 years after her death, this plan was republished. A software language developed by the U.S. Department of Defense was named 'Ada' in her honour in 1979.

She was quite a well-known lady in her time, with wide ranging interests from music to horses to calculators. She had a few famous friends such as Charles Dickens. She married William King in July 1835, who was later to become the 1st Earl of Lovelace. Ada's full title for most of her married life was The Right Honourable the Countess of Lovelace. She and her husband lived on a large estate in Ockham

Park, Surrey; they also had another estate and a home in London. They had three children, two boys and a girl: after the birth of the girl, Ada became quite ill and it took months for her to get better.

Sadly, Ada died at the age of thirty-six, on 27 November 1852. She suffered from cancer of the uterus. While she was ill her doctors used a common method at the time of withdrawing considerable quantities of blood in order to cure her, known as bloodletting. It didn't work and was another factor that caused her death. She was buried, next to the father she never knew, at a church in Hucknall, Nottingham.

Her name continues to be associated with computers: her image can be seen on the Microsoft product authenticity hologram stickers, and since 1998 the British Computer Society has awarded a medal in her name and initiated an annual competition for women students of computer science.

You could ask the children to research the history of computers and ask them to find out in child-speak how they work.

0 0 1 0 0 1 0 0

You could have some fun exploring binary numbers, which are how a modern computer exchanges and processes information. It uses ones and zeros rather that the more cumbersome ten-digit decimal system we use.
The binary system works in base two, so instead of 10s, 100s, 1 000s etc. the place value of these numbers works in doubles: 1, 2, 4, 8, 16, 32, 64, 128 etc.
If you placed these in columns as we might in our number system, it would look something like this:

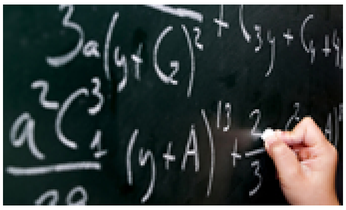
(128)	(64)	(32)	(16)	(8)	(4)	(2)	(1)
1	1	1	1	1	1	1	1

If you take the number 36, that can be made from one lot of 32 and 4, so in binary it would appear as this: 0 0 1 0 0 1 0 0.

You could ask the children to make up similar numbers in both binary and our number systems. You could even try adding and taking away or multiplying and dividing for the more adventurous!
Try playing the Cisco Binary Game: it's great fun for you and the children!

Information for this article has come from these websites:

- Wikipedia
- Agnes Scott College
- Swanson Technologies



Maths to share – CPD for your school

Mathematics Subject Knowledge – Algebra

Continuing our series on mathematics subject knowledge, we now explore algebra.

Before the meeting

Before the meeting, print enough copies of the following Mathemapedia articles for teachers to discuss during the meeting: Expressing Generality, Algebra, and Acknowledging Ignorance.

At the meeting

Introduction

Begin the session by asking whether people can tell you what algebra is. Record everyone's comments on a flip chart or whiteboard. It is likely that someone will comment that algebra is scary. Ask people to share experiences of algebra and how it makes them feel.

Explain that arithmetic uses numbers and the four operations, addition, subtraction, multiplication and division. Elementary algebra uses words or symbols to represent variables. A variable may be a number not yet identified or a generalisation. Algebra allows you to use the rules of arithmetic such as commutatively and associatively to play with numbers. Algebra is about finding an unknown. It is also about putting real life problems into equations and solving them.

We all use algebra every day, subconsciously. When we compare prices, work out how much paint we need to decorate a wall, how many plants we'll need for a particular bed, or work out how long it will take to get somewhere, we are using algebra. When you work out what you can buy with the change in your pocket, you are using algebra, you just don't realise it. Algebra is NOT incomprehensible!

Activity 1

Give everyone a copy of the Mathemapedia entry, Expressing Generality. Towards the end of the piece, the author comments "If letters and other icons such as clouds (for what someone is thinking) have been used repeatedly through primary years in order to express generalities for themselves, the use of letters is no mystery, and learners are content to learn to master the rules of algebra. Indeed the rules of algebra are actually the expression of generalities concerning the operations of arithmetic. [see Mason et al 2005]." The probes and prompts section asks "How often do you invite learners to rehearse, perhaps just for themselves, perhaps out loud to others, methods for doing calculations or resolving types of problems or constructing objects that exemplify a concept?"

Invite comments. Allow a few minutes for discussion, then ask a colleague to suggest a simple addition calculation, for example, 12 + 7 = 19.

Now ask colleagues to write the rest of the calculations in the family, which means they can only use 12, 7 and 19: 7 + 12 = 19, 19 – 12 = 7, 19 – 7 = 12. Ask how they know that these are correct. Which rules of arithmetic have they used? Move on to using three symbols. Avoid using letters if possible, since those who are uncomfortable with the word algebra will probably have a negative reaction.
So, if ***** + **§** = **#** what else do you know? Support colleagues to find the other three calculations in the family. What is *? Does it matter that we do not know which number * represents? If we specify *****, **§** and **#** are unknown. It is only when we fix two of the numbers that the third becomes fixed.

Ask colleagues to think of activities they have planned for this week or next. How can those activities be extended to consider and express generalities? Should we tell the children that this type of mathematical activity is known as algebra, to help ensure that the word does not acquire a fear factor in future?

Activity 2

Ask colleagues to break into key stage groups. Each group will need access to a computer. They will need to log in to the NCETM portal then go to **Personal Learning** > **Mathematics Teaching Self-evaluation Tools** and select **Mathematics Content Knowledge**. After selecting the appropriate key stage, choose **Using and Applying Mathematics**. Work through question 1 as a group. Look at the examples and discuss. Agree a group response to each part of the question. Scroll down to **Save and Results**, click on this and then on **Next Steps**. Either make some notes or print the next steps.

Share the recommended next steps with the other key stages. Which actions are common to all?

Activity 3

Give colleagues a copy of the Mathemapedia entries Algebra and Acknowledging Ignorance to read. Focus on both of the *Taking Action* sections. How can you ensure that you create opportunities for experiencing and expressing generality and emphasise acknowledging ignorance?

Conclusion

Summarise the actions to be taken, and book part of a future CPD session for reporting back.