Primary Magazine

Issue 39

National Centre for Excellence in the Teaching of Mathematics

Welcome to the 39th Issue of the Primary Magazine. Our history article focuses on the Vikings, we look at the art of Josef Albers, and focus on marine mammals. Our CPD opportunity considers role play in KS1 and KS2, and our ICT article explores computer programming. *It's in the News!* features space junk.

Contents

Editor's extras

We are very pleased to tell you that we have a new microsite on the portal, ICT and digital technology used in mathematics teaching. Many teachers are discovering that using ICT and digital technology within a mathematics lesson can enhance both teaching and learning. Many of the available resources are free or inexpensive, both in terms of time and money. This microsite aims to encourage teachers working in primary or secondary schools or in colleges, to think about how they can use digital technology within their department or institution. There are several examples showing the technology that primary teachers have used successfully. Why not take a look? We hope that you will find the microsite helpful.

Did you know that this year is the Year of Communication? Speaking and listening are now recognised as important skills that need to be developed in the primary school curriculum, including in mathematics! Poor communication skills have a huge impact on educational achievement, behaviour/vulnerability, mental health, employability and criminality. Hello: talk, listen, take part has some great resources to support speaking and listening in the classroom.

You might like to check out How Big Really?, a brilliant website from the BBC. Here you can explore how big things really are. You can type in your postcode and something that interests you, maybe an event such as last year's floods in Pakistan, a fact like the size of the moon or the length of the Great Wall of China, or a period of history such as the Ancient Egyptians. The website will overlay what you have typed onto the area where you live. Then you can see how big the area that the subject concerns really is, or was, compared with your local area. Your children might find this fascinating.

If you are able to access YouTube, you might like to share this video clip with your colleagues. It shows young children having a conversation with their teacher about the amount of water in a container, the number of coins in a row and sharing biscuits equally. It clearly shows that young children judge an amount simply from what they see. Conservation, in terms of quantity, is an understanding that needs to be developed through practical experiences in the EYFS. Some children take longer than others to achieve this understanding. It is worth asking your colleagues to bear this in mind when they work on number, length, weight and capacity in KS1. As can be seen from the video clip, young children will think, for example, that the volume of liquid will change if a container is a different shape, or the number of coins increases if the length of the line they make is longer. This also applies to other measures, for example, they may believe that a piece of string presented in a straight line will change length if it is then scrunched up; a sphere of plasticine will be a different weight if it is flattened out. It is worth bearing in mind that older children might have the concept of conservation cracked in number, length, weight and capacity, but have they when it comes to such concepts such as perimeter, area and volume? Many assume that perimeter and area have a relationship. They may think that if the perimeter increases the area will too; likewise, that if the area increases so will the perimeter. They may think the volume of a cube made from interlocking cubes will change if presented as an alternative cuboid. It therefore remains important for older children to explore these concepts practically.

Times tables – do your children struggle to be able to recall these quickly? If so, you might be interested in reading about what one school did. The mathematics subject leader and assistant head at Red Oak

Primary School, in Swindon, wanted to research the best ways to help children learn their times tables and involved all staff in trialling a range of methods:

> *"Improving times tables and maths results in general featured highly on our SIP. The project and, of course the finance, gave us a clear focus and the funding to do this in a way that otherwise wouldn't have been possible on a tight school budget."*

You can read about their project in the Teacher Enquiry section of the portal.

Have you found the key to helping children learn and recall their tables? We would love to hear of any successful ideas you have implemented in your school. Please let us know!

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It's in the News!

Following the news about the satellite that crashed to Earth last month, this issue of *It's in the News!* focuses on space. On 24 September 2011 an old US communications satellite crashed in the Pacific Ocean. Another satellite has also just landed in the Bay of Bengal! This one is German.

In the slides there are links to geography and science. If you do a topic on space, you might find these slides helpful. If not, why not do it anyway? The slides give opportunities for work on a variety of mathematical concepts such as number and measurement, including time.

Before you use the slides you might find the following websites useful for information on the satellite and also space in general:

- NASA
- The Telegraph - this includes a video of a possible sighting of the satellite in the sky
- The Telegraph - this has several related stories, including the one about the German satellite, whose landing was covered by the BBC.

This resource provides ideas that you can adapt to fit your classroom and your learners as appropriate. As always, we would be extremely grateful if you could give us some feedback on how you have used it, if it has worked well and how it can be improved.

Download this *It's in the News!* resource - in PowerPoint format.

Download this *It's in the News!* resource - in PDF format.

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The Art of Mathematics
Josef Albers

Josef Albers
photograph by Certo Xornal

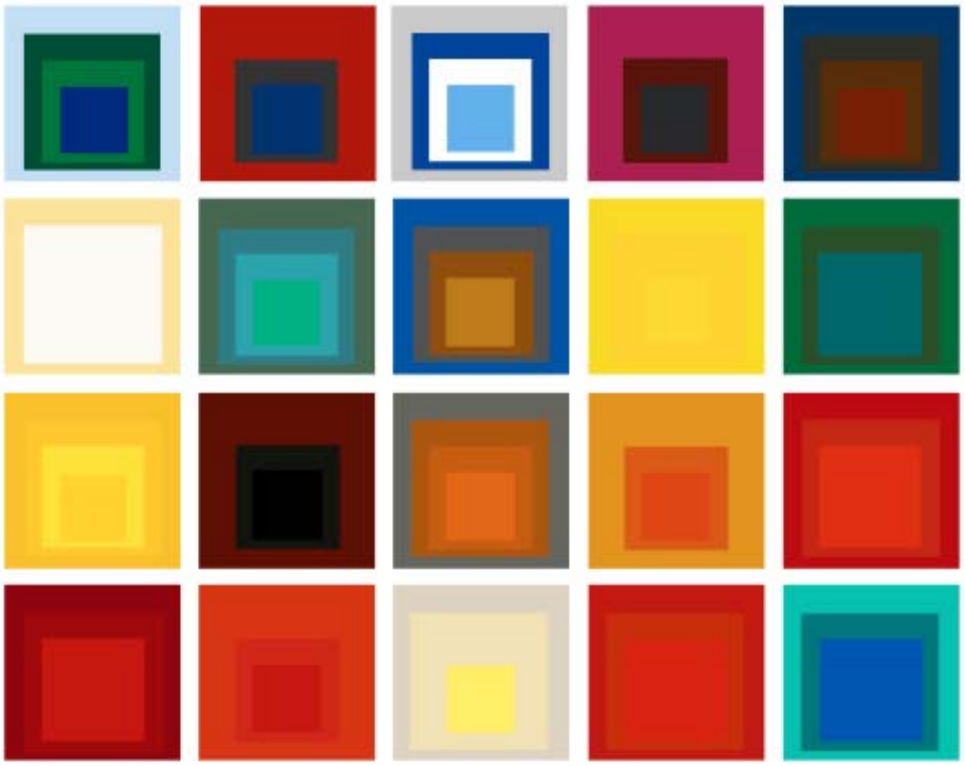
Josef Albers was born in Bottrop, in the province of Westphalia, Germany, on 19 March 1888. He trained to become a teacher and taught a general elementary course in local primary schools from 1908 to 1913. He attended the Königliche Kunstschule, the Academy of the Arts, (today the University of the Arts) in Berlin from 1913 to 1915, where he became a certified art teacher. He then studied art in Essen and Munich before entering the Bauhaus School of Art, Design and Architecture in Weimar in 1920, where he initially concentrated on glass painting. At first, Josef made glass creations from rubbish he found at the Weimar town dump, but later moved on to sandblasting glass and designing large stained glass windows for buildings.

Albers was one of the best-known artists and teachers at the Bauhaus in pre-WW2 German. When the Bauhaus was forced to close by the Nazis in 1933, Albers and his wife, Anni, emigrated to the United States where they became American citizens in 1939. The same year that he arrived in America, Albers became head of the art department at the newly established, experimental Black Mountain College, near Asheville, North Carolina. He continued to teach at Black Mountain until 1949. In 1936 he had his first solo show in New York at J. B. Neumann's New Art Circle.

In 1949, Josef began his best known works, his *Homage to the Square* series, which he continued until his death in 1976. His work had moved on from a figurative style of picture-making to geometrically-based ideas. The Homage to the Square series is disarmingly simple. It consists of hundreds of paintings and prints all focused on layered squares. Josef layers three or four superimposed squares of different colours in the same orientation, using oil colour applied with a palette knife directly from the tube onto a white panel. The arrangement of the squares is intended to optically alter the sizes, colour tone and special relationship to the other squares. On the back of each panel, he carefully recorded the technical details. His research into colour theory was published in his influential book *Interaction of Color* in 1963.

Josef taught at various colleges and universities across America. From 1950 to 1958 he was head of the design department at Yale University, New Haven. In addition to painting, printmaking, murals and architectural commissions, Albers published poetry, articles, and books on art while continuing as a captivating teacher and writer. He was a very important influence on generations of young artists and trained a whole new generation of art teachers. A major exhibition of his work, organised by the Museum of Modern Art, New York, travelled to South America, Mexico, and the United States from 1965 to 1967. His wife Anni also taught, while continuing to weave, design and write essays on design reflecting her independent and passionate vision. Josef and Anni Albers were both pioneers of 20th century modernism.

In 1971, Josef was the first living artist ever to be honoured with a solo retrospective exhibition of his work at the Metropolitan Museum of Art, New York. He lived and worked in New Haven, Connecticut, until his death there on 26 March 1976. Anni died in 1994.



Activities

Show the children the gallery of Homage to the Square at the Albers Foundation. Click on the first of the 20 pictures and then move steadily through page 1 of the gallery. Ask the children what they notice. Some of the pictures have extensions to the general name, *Homage to the Square*. For example, one is call *Guarded*, another *Equilibrant* and another *Tap Root*. Why do the children think some are named and not others?

The image on the Guggenheim's Josef Albers page is slightly different. Can the children spot what is different and how it has been achieved?

Discuss how the children could make their own *Homage to*.... Here are a few options, but the children will probably come up with several more. For each variation, children will have to decide whether or not to make the outer one or two shapes look like a frame.

- paint a *Homage to*... any chosen geometric shape, titled appropriately.
- create a *Homage to*... any chosen geometric shape using layered paper cut to the appropriate shape. This is particularly useful for younger children. You could pre-cut squares (and perhaps triangles) of a range of different colours and invite the children to choose their colours and how many squares to use.
- create a *Homage to*... using layered fabric, cut to the appropriate shape and size. There could be some interesting interactions between the fabric patterns and the chosen shape.
- 'the image on the Guggenheim site looks as though the…' ask the children to complete this sentence.
- challenge older children to create their own *Homage to*... using one of the four sets of measurements Albers made. These can be found on the website An Anecdotal History of Sound and Light
- challenge older children to make or use discarded boxes to create a 3D version, such as *Homage to a cube*, *cuboid*, *cylinder* or ... Use fishing line to suspend the boxes at the correct depth within the nest. Could these also be done using Albers' measurements? You could ask older children to compare the areas of the different shades or colour and different shapes within a shape. This would give them the opportunity to explore ratio and fractions. The children could investigate different combinations of colours/shapes, for example, how many different paintings could be made using three colours in three squares?

And finally, invite the children to record (or scribe for them) on the back of their creation the technical details of what they did. Display the creations with their names.

For more information:

- The Albers Foundation
- Guggenheim New York
- Wikipedia.

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Focus on…marine mammals

After humans, dolphins have the biggest brains for their body size. But are those big brains any good at mathematics? The scientists, alongside dolphin trainers, at the Dolphin Research Center in Florida, worked together to create a basic mathematics test for dolphins. The research initially looked at the first things that a young child might learn and focused on the difference between less and more. In the wild, dolphins might need these basic mathematics skills in foraging situations where it would be good to know which area has more fish versus an area with less fish. They may also need them in a competition situation, 'Does my group outnumber your group?' The research indicated that dolphins do indeed have a grasp of this concept.

So, these wonderful marine mammals may be good mathematicians but how can they, and their relatives, help stimulate further mathematical discussion?

Did you know that…

- the sperm whale has the largest brain on the planet: it may weigh up to 20 pounds
- the length of an average blue whale is about 30 metres
- each mouthful of krill eaten by a whale is 40 000 litres
- a blue whale is equivalent in weight to 25 elephants and weighs 170 000 kilograms
- blue whales speak to each other using low-frequency moaning sounds which can be heard for more than 100 miles in deep water.

This video clip provides interesting facts about whales which can be used as great starting points to explore size in different ways. Children are often faced with measurements which are too large to imagine but these occasions allow for opportunities to explore "How big is big?"

Very young children can discuss the biggest numbers they can think of. Ask them questions such as:

- what do we see ten, a hundred, a thousand, a million of?
- what is the biggest number of objects they can count?

Ask the children if they can find a number on a number line and give numbers which are more or less than their number.

Children can search for the longest objects and the heaviest objects. Can they decide on a means of finding ways to quantify their measurements using non-standard units? This will provide an opportunity to see the need for standard units. If the same object is measured using a range of non-standard units, different results will be calculated.

Older children may like to investigate the question, How many children/cars/ buses are as long as a blue whale? This will provide wonderful opportunities for application and selection of appropriate mathematics.

- does it matter if we use children of different heights or cars of different lengths?
- should children lie down head to toe or consider the spacing of children if they are standing up?
- would measurements be accurate if some children were squashed together while others were more widely spaced?
- what do we need to understand about the units of measurement and conversions between measurements?

Similar investigations can be followed up focusing on:

- how many children weigh the same as a blue whale?
- how many buckets will we need to hold the krill that a whale eats each day?
- how far does your voice travel - how does that compare to the whale?

Ask children to pose their own questions to explore using the whale facts.

Did you know…

- scientists use different estimation methods to count dolphin populations. One way of doing this is to count the number of dolphins in a certain area and then use this count to calculate the population for the whole ocean.

The NRICH article Counting Dolphins explores and compares two estimation methods used by scientists to count dolphins.

Explore with the children what other items appear in such large numbers or across a vast expanse that might require counting - for example, people in a football crowd, stars in the sky or leaves on a tree. What methods could be used to estimate the number of these items? Encourage children to look at a small area, such as one row at a football stadium, and then use this small count to estimate the total crowd by working out how many people in ten rows, one stand, one side of the stadium, the whole stadium. This would provide an excellent opportunity to explore scaling up and down. Focus on…trees in Issue 36 of the Primary Magazine also explores further estimation activities.

Younger children can start to develop estimation skills using Estimation, a National Strategies spreadsheet activity, which allows a random display of stars to estimate and count.

Other practical resources such as sweets or marbles in a jar or a box of conkers can also be used, allowing opportunities for children to amend or refine suggestions based on other children's suggestions or reasons, or by comparing the unknown quantities to benchmark quantities given i.e. if

children know how much space ten conkers fill, can they use this benchmark to determine whether their unknown group is smaller or larger, and by how much, in order to determine a sensible estimate.

Children's development of range based estimation skills: Far more than guesswork is an article written by L Adams from the Esso Family Math team at the University of Western Ontario. It discusses ways to refine estimation skills with children and offers activities for classroom use including *'In the Zone'*. This activity encourages children to look at an amount and then, on a 100 grid, cross out all the amounts that are not relevant. They stop when they reach a 'maybe' number and then work backwards from one hundred using the same technique. From the numbers that remain they can suggest their estimate.

Did you know…

- eleven countries hunt whales. Most countries, with the exception of Japan and Norway, allow only the native population to hunt. About 7 400 whales are killed each year, that's about 20 whales a day!

In 1986, the International Whaling Commission (IWC) banned commercial whaling, but since this ban, scientific whaling has been on the increase. Iceland and Norway also lodged official objections to the moratorium and have continued to hunt commercially. The World Wide Fund for Nature (WWF) has gathered data showing the total number of whales killed since the moratorium, and the rise in scientific rating.

Can older pupils use this data to work out:

- how many whales have been killed each year through scientific or objection whaling
- the effect of the moratorium
- what the two graphs show about the attitudes towards whaling
- why one set of data is represented as bars and the other set as a line.

This pie chart from the Whaling Library also shows the total catch of Antarctic blue whales of ten of the countries.

Did you know…

- millions of tonnes of plastic debris dumped each year in the world's oceans could pose a lethal threat to whales?
- a review of research literature from the last two decades reveals hundreds of cases in which whales, dolphins and porpoises have been made sick or killed by marine litter?
- for large ocean-dwelling mammals, ingestion of refuse is emerging as a serious cause of disability and death?
    - in 2008, two sperm whales were stranded on the California coast. They were found to have fish nets and other synthetic debris in their guts. A total of 205 kilograms was found in one alone
    - in 2002, a dead minke whale washed up on the Normandy coast of France had nearly a tonne of plastic in its stomach, including bags from two British supermarkets.

Young children might be interested to look at the effects of pollution and litter.

- do we have the same types of litter on land as is found in the sea?
- what problems does this litter cause?
- what kinds of litter do we have in our local environment? Can it be reduced?

This last question can be explored further using the data handling cycle as discussed in Issue 10 of the Primary Magazine. Ask children to consider:

- what data should be collected?
- will the data consist of measurement or opinions?
- how should we collect the data?
- how should the data be analysed?
- how should results be presented? Does this influence how we should collect the data?

A follow-up survey might consider how litter could be reduced. This survey would consist of gathering opinions rather than a count. The different data types should be made explicit to children as they need to ensure that the sample surveyed can make informed decisions, thus making results more accurate and representative. Bias and opinion can be discussed along with discussing:

- whose opinion should we ask – everyone with an interest or just a sample?
- how do we ensure that our samples are representative?
- should the opinions of some groups have a weighting, or should all opinions have the same value?
- what else needs to be considered?

For a few fun whale- and dolphin-linked ICT resources, you may also like to take a look at:

- Save the Whale which focuses on bonds to ten
- Shark Numbers which shows a number represented by Dienes' Apparatus, children have to select the matching written number. If they are correct, a dolphin jumps over their boat, if not a shark takes a bite out of their boat.

Other interesting resources

- *How Big is a Million* (Usborne, ISBN-10: 0746077696) by Anna Milbourne: this picture book helps children understand the concept of big numbers. Pipkin, the smallest penguin, is always asking questions, but what he wants to know most of all is how big is a million? So he sets off to find out, and along the way meets 100 penguins, sees 1 000 snowflakes and meets one new friend, before being amazed to finally find out how big a million really is. A special fold-out poster at the end of the book shows Pipkin looking at the sky, which is printed with exactly one million stars.
- *How Deep is the Sea?* (Usborne, ISBN-10: 0746096089) by Anna Milbourne: Pipkin, the inquisitive penguin, wants to know just how deep the sea is. With the help of a friendly seal, a big blue whale and a salty sea dog in a yellow submarine, Pipkin learns that the sea is very deep indeed! A VERY long poster at the back of the book shows just how deep the sea is – and how far Pipkin would have to travel to get so deep.

A little bit of history
The Vikings

In this article, we are being cross-curricular once again, and looking at some of the ways that you can link mathematics to a topic on the Vikings.

However, due to the large amount of ideas and resources, this feature can only be read directly on the portal, otherwise the interactive nature of the way they are presented will be lost.

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Maths to share – CPD for your school

Developing mathematics through role play

Walk into any nursery or reception classroom and among the many fun and practical activities on offer, you are more than likely to see a role play area – a shop, a restaurant or Post Office for children to develop their familiarity with the language of money, counting or measurement. These role play areas provide opportunities for children to explore mathematics in context, in reconstructed environments from outside the classroom.

In the Independent Review of Mathematics Teaching in Early Years Settings and Primary Schools, Sir Peter Williams highlighted that:
"The challenge in planning learning for children is to provide the interlinked 'bigger picture' as well as the detail, to enable children to recognise how their learning fits together rather than appearing to be piecemeal."
(DCSF, 2008)

Teachers are looking for creative ways in which to teach their children mathematics in a context or through real life situations, making links between the areas of mathematics and across a range of other subjects. Could the role play area provide these opportunities for KS1 and KS2 classrooms?

Setting the context

Before the staff meeting, ask colleagues to read through the NCETM case study, Investigating How Children's Play Can Enrich The Early Mathematical Experience by Helen Williams (2010). The aim of this project was to investigate the potential for teaching and learning mathematics through role or 'context' play in the early and primary school years, and its impact on children's and teachers' attitude to mathematics. Ask teachers to consider a point in the report that interested them and to be prepared to share this with colleagues at the meeting. Alternatively, this activity could be done at the start of the meeting.

Share with colleagues the above quote from the Independent Review of Mathematics Teaching in Early Years Settings and Primary Schools and discuss the challenge that teachers face in providing the bigger picture rather than a piecemeal curriculum:

- how do they currently make links between different areas of the mathematics curriculum?
- how do they currently make links with mathematics and other subjects?
- can they share examples of lessons where they have taught mathematics in context or using real life situations?

Ask colleagues to share the points that interested them from the above case study by Helen Williams and explain that during this session you will explore the following further:

- what is role play?'
- what areas can be created to support the primary curriculum?
- how can lessons be organised to make the most of the role play area?

What is role play?

To ensure that all teachers have a common understanding of terms to be used in discussion, in small groups, ask teachers to discuss and define the following terms:

- role play
- role play area
- contextualised play

- real-life mathematics.

During feedback, draw out that:

- role playing involves changing ones behaviour to assume a new role which enables exploration of situations from different perspectives. This could be re-enacting an already known scenario or a 'make believe' situation
- the role play area provides an environment rich in props and resources which will enhance the role playing
- contextualised play could be defined as occasions where children are able to explore mathematics in simulated, possible 'real life' situations. In contextualised play, children could explore the mathematics as themselves or in an assumed role
- real-life mathematics could be defined as occasions where exploration may relate more to situations that are directly meaningful to the child in their day-to-day life.

Ask colleagues to discuss how child- and teacher-initiated play could be developed in each of these situations and the difference between free play and structured play.

Working with teachers in similar year groups, ask colleagues to discuss the benefits of having a role play area and any issues they feel they may encounter and to record their response in this table. Remind colleagues of the case study article as this may also have highlighted benefits and issues.

Draw out the following points during feedback. Benefits might include the following:

- having a role play area in a Year 1 classroom will support transition from FKS to KS1 as this will provide a familiar style of classroom setting. In the Independent Review of Mathematics Teaching in Early Years Settings and Primary Schools, Sir Peter Williams talks about the "…abrupt nature of the transition from this [play-based learning] to a more formal approach in KS1, at a time when many children may not be ready."
- role play areas enable exploration of mathematics in a context that could show links between different areas of mathematics and mathematics across the curriculum – big picture, not piecemeal.
- the role play area could also provide a fun, motivating and creative context for children to practise and discuss their mathematics.

"Children will remember the innovative and interesting ways in which a subject is presented. If it is interesting they are more likely to understand it. Look at ways in which maths can be shown to be useful rather than just an abstract subject that has to be covered each day. Children are more willing to learn if the material is presented in a relevant fashion."
(Angela Youngman, Teaching Expertise)

However, downsides may be as follows:

- even though the role play area is set up to explore particular areas of mathematics, children's use of the area may take different directions of learning and the intended learning may be lost.
- role play areas can be difficult to resource and change on a regular basis. Time may be an issue.
- in many primary classrooms, making effective use of this area may cause problems with classroom organisation and lesson structure.
- there may not be enough room in the classroom.

Having discussed the many benefits, can teachers look through the issues raised and discuss possible ways of overcoming any of the difficulties they feel they may encounter.

What areas can be created to support the primary curriculum?
Share with colleagues a list of commonly created areas that enable mathematics to be explored and used. These might include: various shops, an estate agents', a restaurant/café, theatre, cinema box office, building site, home e.g. kitchen, post office, hospital/health centre, travel agent. However, other creative areas will provide stimulation for mathematical learning.

Share these working examples:

***Example 1: A KS1 class focusing learning around the story of* The Three Little Pigs**
This class at Park Primary School in Lincolnshire, set up their role play area as a construction site. In this role play area, children could:

- count bricks/ sticks in bundles of tens and ones
- decide on measurements for the houses, measuring out materials (length of sticks, amount of sand required for cement mixing)
- become more familiar with money when paying for materials
- use 2D and 3D shapes to design houses – creating houses to fit given criteria.

Example 2: A lower KS2 class focusing learning around their 'Egyptians' topic
In Helen Williams' (2010) report she discusses how a Year 4 class requested a role play area based on their topic on the Egyptians. Here the children:

- explored measurement when making Egyptian clothes and in measuring lengths of linen when mummifying
- measured out specific amounts of water when collecting water from the Nile to make 'beer' to drink
- made containers to hold the drink.

Share other mathematical opportunities highlighted in Primary Magazine Issue 34, A Little Bit of History – the Egyptians.

Example 3: An upper KS2 class focusing learning around a travel agent's
These photos show a working travel agents in the role play area of a Year 5 classroom. Here the children could look at:

- interpreting tables to extract information
- pricing up a holiday for various groups of people
- using percentages to calculate group discounts, sale prices etc.
- collecting, interpreting and using data to find out which are the most popular holiday destinations in order to inform the selection of brochures on display
- exploring time differences in different parts of the world and flight durations.

Ask colleagues to consider their mathematics curriculum and the other subject topics they are teaching this year. Can they now add to this list and begin to see opportunities relevant to their own classroom?

How can role play areas be managed in the primary classroom?
The way that role play is organised throughout the school may differ from year to year, teacher to teacher or from one key stage to the next. The Birth to Five Service suggests that an effective role play area would:

- be planned to encompass a variety of types of role play. This could include domestic play, transactional play and imaginary worlds
- contain real objects of good quality. For example, fruit, money and packaging for a range of products

- be based on first-hand experiences from which the children can draw. For example, carefully consider an airport or travel agent if the majority of your children have not experienced these locations
- change and be enhanced
- be organised in a manner in which children and staff know where to store resources
- have involved the children in developing the area. For example, the children choose the focus for the area and make/collect resources for this
- promote opportunities for many skills. These could include, problem-solving, negotiating, mark-making including writing, expressing ideas and reading.

Depending upon the space available and lesson organisation, some role play areas may be permanent over a period of time, used daily or when appropriate, whist others may be temporarily constructed for a specific time period.

It may be the case in some primary schools that the organisation of the Foundation Key Stage is continued through KS1 and 2. However, if this is not the case, teachers can be creative in how they plan and organise their lessons to take full advantage of their role play area.

Ask staff to discuss the following scenarios in relation to their classroom:

- a mathematics lesson where groups of children are focusing on similar mathematical objectives which are being developed through different activities. One of these activities would be set in the role play area. This is rotated with similar activities set at appropriate levels through the course of the week.
- a particular cross-curricular topic that may enable the planning of different activities from across the curriculum with specific maths activities set in the role play area.

The above suggestions may also include having free play in the role play area rather than structured activities. Ask colleagues for other suggestions that they feel would work in their classroom.

You could suggest they refer to the book by Sue Gifford, *Teaching Mathematics 3-5*. This has plenty of ideas for role play.

Conclusion

However colleagues decide to organise their role play areas, they need to remain true to the reasons and benefits of having role plays, as discussed at the start of the meeting. Encourage them to consider child-initiated learning and teacher-initiated learning as well as free and structured play.

Explain to colleagues, that once children have encountered working in role play areas and are clear about the mathematics they are learning, they will then be able to suggest ideas for other appropriate role play settings and discuss how they could be used to support future teaching and learning.

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ICT in the Classroom – Computer Programming

In Issue 33, we explored the mathematical possibilities of using programmable toys. These included engaging contexts such as storybooks and sports. In this issue, we take these ideas into the more abstract world of onscreen programming. To be able to do this, children will benefit from a reminder of the practical activities that support the beginnings of programming before launching into the abstract. It is therefore important to provide opportunities for them to work together on giving both verbal and written instructions to each other and also to programmable toys. They will need to be able to use the computer keyboard efficiently to enter the text for programs, so it is important that they have these skills. In addition, they will need an understanding of 'left' and 'right' and be able to measure angles using degrees. To consolidate or reinforce this you could consider using a physical obstacle course for either pupils themselves to be directed around or, for a robot.

LOGO is the mostly commonly used programming language in primary schools. It is used to control a turtle (an on-screen cursor) on a blank screen. There are many versions of LOGO available, they all have similar features but there are some differences in the commands. The commands used here will work in most versions of LOGO, but are written using MSW LOGO which can be freely downloaded from Softronix.

For an engaging activity that reinforces the concept of right angles, you could use this idea. Try making clear plastic mazes that stick over the computer screen. The children can then easily create their own mazes to challenge each other. They should draw the maze first on 1 cm squared paper by marking a pathway from the centre of the paper to one of the edges going through the middle of squares without diagonals. The walls of the maze can then be completed using some of the lines on the squared paper. The maze, not including the solution, should then be copied onto the clear plastic film using a marker pen and this is attached to the screen.

As an alternative, you could introduce the 'penup' (pu) and 'pendown' (pd) commands. The children could draw a show jumping or obstacle course onto the clear plastic film. The jumps are numbered so that the turtle, on the LOGO programme, can reach them in order and 'jump' over them.

Creating procedures involves generalisation of patterns – and real programming. Children will often discover the need for more efficient instructions as they find themselves writing the same instructions repeatedly. A discussion about a pattern such as this provides the opportunity to reveal the 'repeat' command. This pattern is made using *'repeat 5 [fd 20 rt 90 fd 20 lt 90]'*.

This is a more efficient solution than typing in each line individually. More elegant programming involves teaching the turtle a new word. For example, the pattern above can be recreated any time using the command stairs if the computer is programmed to understand the new word. This new word is called a procedure. Every new procedure the turtle is taught opens with 'to' and is closed with 'end'.

```
to stairs
repeat 5 [fd 20 rt 90 fd 20 lt 90]
end
```

Once pupils have mastered the repeat command they can use circle commands to create spirograph-style patterns.

This pattern is created using *'repeat **9** [circle2 **50** rt **45**]'*. *'Circle2'* is a procedure already written into MSW LOGO that draws a circle with the turtle at the edge. The number after 'circle2' refers to the size of the circle's radius.

Ask pupils to predict and investigate what happens when they change the blue numbers in the instruction.

Experimenting with changing the values in a command leads us nicely to exploring variables. A procedure with variables could, for example, allow children to quickly draw rectangles with any size length and width. For example, a rectangle could be created by programming this procedure:
to rectangle :length :width
repeat 2 [fd :length rt 90 fd :width rt 90]
end

If you then enter the command *'rectangle 60 20'* a rectangle with a 60-unit length and a 20-unit width would be created. This procedure is useful for reflection and discussion about the perimeter of rectangles, and how they can be calculated by doubling the sum of the length and width. Challenge pupils to use this procedure to create a set of rectangles that all have the same perimeter.

To provide a context for investigating number patterns try exploring the 'sound' command to create a tune. Start with something familiar such as the first three notes of 'Three Blind Mice'. Can the pupils use trial and improvement to make those three notes by changing the values in the instruction *'sound [1000 1000]'*? Once they have identified the difference in the numbers that changes the pitch by one tone, children can continue the pattern to create a whole scale of notes and use them to make their own music.

Children with more experience can make a simple 'programming language' for younger, less experienced pupils by using procedures. The children designing the commands can create a poster to be displayed near the work station that communicates what each command does:

'F' will make the turtle go forwards 10 units
to f
fd 10
end

'B' will make the turtle go backwards 10 units
to b
bk 10
end

'J' will make the turtle jump forwards 10 units
to j
pu
fd 10
pd
end

'L' will make the turtle turn 90 degrees to the left
to l
lt 90
end

'R' will make the turtle turn 90 degrees to the right
to r
rt 90
end

These one-letter commands can make controlling the screen turtle accessible to the youngest children in school if they are familiar with symbolic stickers that go over the appropriate letters on the computer keyboard when they are using the program. Interest can be added to the activity by putting a simple pictorial map on a clear plastic sheet over the display. Encourage children to use positional language to describe how the turtle can get from one place to another on the map.