



Outdoors maths

Where can you teach maths in your school grounds?

Why teach maths outdoors?

Evidence is growing that outdoor lessons help pupil motivation and understanding and encourage an atmosphere of collaboration between pupils and teachers, which helps children develop their interpersonal skills. Moving outside the confines of the classroom requires that pupils are given responsibility, this increases levels of trust and pupils' sense of ownership.

Lessons outdoors also offer more opportunities to use different teaching and learning styles, particularly problem solving and group work, which enhance pupils' self-esteem and self-confidence. Children report that outdoor lessons are generally more interesting, varied and relaxed, that practical lessons are easier to understand, and that teachers are friendlier outdoors. Even a simple blast of fresh air, compared to a hot and stuffy classroom, can make a welcome difference.

While any outdoor environment can promote learning, use of the school grounds offers specific benefits. Because they are on your doorstep school grounds can make outdoor learning a daily event. Staff new to outdoor learning can take their first outdoor lessons alongside more experienced colleagues in a familiar environment, building confidence in their abilities to assess and manage risk outside the classroom. In this way, you can lay the foundations for learning beyond the school site and ensure that off site educational visits run smoothly.

The way that learning outside the classroom can motivate children and help them apply their knowledge has particular importance for a subject which many children find difficult. By providing real examples of how mathematical concepts can be developed and applied, teaching maths outdoors can prevent the subject being seen as too abstract.

Every part of your school grounds can be used as a learning resource but in this Groundnotes we will look at some specific, common features. The suggested activities are most relevant for the primary curriculum, but hopefully will provide some ideas for extending them for older or more able pupils. The challenge provided by each activity can be varied according to how detailed your instructions are. For more able pupils set them a challenge of answering a question, but let them work out how.

Boundaries

Boundaries offer an ideal opportunity for practising the *estimation* and *measurement of distance*, whether they are walls, fences or hedges.

Choose a section with a clear start and finish mark that pupils can walk alongside safely. Mark a set distance, perhaps 100 metres, and ask children to walk the distance, counting their paces. It is easier to count double paces (i.e. always on the same foot) particularly once you reach



above twenty. Set children off individually at intervals of about 20 seconds to avoid them falling into step with each other, though they may need some practise to walk at a steady, comfortable rate. Get the children to repeat the exercise until they are sure they have a consistent number of paces.

Once pupils have practised measuring one length, ask them to estimate different distances – e.g. 5 metres or 20 metres – either by eye or by pacing, standing where they think that distance reaches. Use a long measure to find out who's closest to the right distance. Pupils can then try measuring the whole grounds by pacing.

Paces are one ancient way of measuring distances, but you might be able to think up more, for example lying on the ground to see how many body lengths a path is. You can link this into old methods of measuring such as those used by the Romans, which included *pes* (foot = 29.6 cm), *digitus* (thumbnail = 1.85 cm) or *palms* (palm = 7.4 cm).



Brick walls provide an opportunity for estimating *quantities* which can be checked by counting. Measure the area of an individual brick then multiply by the number of bricks, to estimate the area of the whole wall. Compare your answer to the area you get by multiplying the width and length of the wall – you might need to estimate the height if the wall is very tall.

If your boundaries are old hedgerows you can estimate their *age* by counting how many species of trees and shrubs there are in a 30 metre length. Large stumps in the hedge will prove that it is old and not recently planted with lots of different species. As a rough guide, there is one species of hedgerow plant for every 100 years of a hedge's life.

Spaces

School grounds provide large spaces for applying calculations such as *areas* and *perimeters* on a giant scale. Choose a clearly defined hard surface area, such as a games court, and measure the length and width with a long measuring tape, a trundle wheel or by pacing. Calculate the area and perimeter of the space – you could chalk your calculations onto the ground. If you have two suitable areas, pupils could estimate which is larger before they measure, or calculate how many times one space would fit into the other.

More challenge is provided by an irregularly shaped field. From a central point, use a compass to measure the *bearing* (angle of turn away from north) to various points around the edge of the field.

Then measure the distance to each point by pacing. A *scale map* can be drawn up by using a protractor to mark the bearings, and marking the distance along each bearing to the edges of the field using a suitable scale. The area of an irregular field can be estimated by dividing it into rectangles and triangles whose areas can be more easily calculated, or by drawing it onto squared paper and counting the squares.

Hard surfaced areas can be enhanced with mathematical playground *markings* or *mazes*. Even a simple game of hopscotch involves counting skills, but you could invent your own games that practise more complex mathematical skills. Paving stones offer a ready-made grid for chalking in number patterns or for creating giant versions of board games, such as snakes and ladders (you'll need to buy some giant dice). You also have more opportunities for practising area calculations, as well as demonstrations of *tessellations*.

If you have a large area of grass, link science and maths by carrying out a daisy survey. A good tip for keeping track of daisies is to use counting cubes, as well as a quadrat or hoop to define an area. Throw the quadrat onto the grass, and then cover each daisy with a counting cube. Once all the daisies are covered, the cubes can be taken away and built into columns of ten to help with the counting. Test hypotheses about where daisies grow best by comparing the numbers in different areas of the field: shady or sunny, where they are trampled or where they are not.



Play and sport areas

Apply maths to sports to practise *timings*, draw *graphs* and calculate *averages* or *percentages*. Time how long each child takes to complete a set challenge on a trim trail or time races across the playground. Who is the fastest and who the slowest? What is the average time? Create a graph to show different times. If you have football or netball goals, ask each child to take 5 shots, and then calculate their percentage success rate, which can be also be shown on a graph.



measurements all round the pond can create an accurate scale drawing.

Times tables can be illustrated with natural features. Easy ones include legs on insects for the 6x table or wings on birds for the 2x table. Different flowers have different numbers of petals, use a buttercup for the 5x table. Woodlice have 7 segments to their bodies. How many other times tables can pupils find in the grounds?

Creatures

As with many mathematical investigations, activities involving living creatures can *link with other subjects* such as ICT, geography, environmental studies and science.

A minibeast hunt will uncover creatures with different numbers of legs, with or without wings, and with other physical differences. Putting minibeasts into sets according to these differences helps with identification. Children could create their own identification charts according to these sets, drawing pictures of each minibeast. Got a vegetable garden plagued with snails? Look upon them as an easy-to-handle minibeast for your lessons. Close observation of the shells provides opportunities for sorting according to differences, comparative language, and looking at spirals.



Feeding birds can help your maths lessons as well as the local feathered population. There are lots of observations and experiments that can be carried out, as part of *hypothesis testing* or learning about graphical presentation of data. Carry out observations of your bird feeders at set times to see how the numbers of visitors vary across the day, week or year? Place feeders in different parts of the grounds to find out if some are more popular than others? Experiment with different types of food on different tables and work out what food attracts which birds? Observing birds across your grounds can also reveal interesting patterns like those schools with a peak in gull numbers after lunchtime, as they come to scavenge.

Trim trail equipment includes interesting *shapes* and *angles* for naming and measurement. Ask children to search for triangles, squares or circles, or measure angles between different parts of the equipment.

Natural areas

Trees, gardens, ponds or wildlife areas offer a wealth of opportunities for applying maths to real contexts. Different leaves and flowers can provide exercises in *counting, multiplying, sorting, comparative language* (more / fewer petals) and *symmetry*.

A famous numerical phenomenon occurring in plants is the *Fibonacci Series*, named after an Italian mathematician born in 1175. The series begins: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233 . . . and so on, forever. Each number is the sum of the preceding two. Look closely at seed and flower heads (sunflowers or daisies are good examples) and you can see spirals, curving both to the left and to the right. The number of spirals will nearly always be consecutive numbers in the Fibonacci series. This arrangement seems to form an optimal packing of the seeds so that, no matter how large the seed head, they are uniformly packed at any stage, all the seeds being the same size, no crowding in the centre and not too sparse at the edges.

Pine cones also show Fibonacci spirals clearly, and many plants show the Fibonacci series in the arrangements of the leaves around their stems. Look down on

a plant and see that the leaves are often arranged so that those above do not hide the leaves below. This means that each gets a good share of the sunlight and catches the most rain to channel down to the roots as it runs down the leaf to the stem. How many spirals and Fibonacci sequences can be found in your school grounds?

If you have several trees in your grounds you could set the challenge of finding which is tallest or which has the biggest girth or widest canopy, perhaps first by estimation and then by measuring. Children could also measure angles between two twigs. See the Groundnotes* *Teaching with Trees* for more ideas.

Ponds of different shapes provide differing levels of difficulty in calculating *surface areas*. Rectangular ponds are simple but irregular natural ponds offer a challenging task to work out how to sketch a *scale diagram* and estimate the area. One method is: choose two fixed points near the pond or put two sticks in the ground; mark the two fixed points on squared paper, making sure that they are the right distance apart according to your scale; measure to different points of the pond's perimeter from each fixed point (e.g. one point might be 2 metres from one stick and 3.5 metres from the other); use a pair of compasses to mark those distances to scale on your diagram (e.g. draw an arc 2 cm from one point and an arc 3.5 cm from the other); where the two arcs intersect will be a point on the edge on the pond. Repeating these



Planning maths in your school grounds

To make the most of your school grounds for teaching maths, outdoor lessons should be written into your curriculum planning, so that it is an expectation that lessons are taken outside on a regular basis. When lessons in the school grounds are regular and frequent, children can quickly learn the expected behaviour.

At a maths curriculum planning session, work through your scheme of work, highlighting opportunities for school grounds lessons. You could start with the

ideas included in this Groundnotes. Look for gaps, either throughout the year or in areas of the curriculum, and talk about what other learning opportunities there are. When you review your lessons, include opportunities for staff to feedback on how their school grounds lessons went including what worked, and what needs changing?

Some teachers will be more confident than others in teaching outdoors. Consider how you can share this expertise, for example through team teaching, or spending staff meeting or training time sharing good practice. A particular concern can be pupil behaviour beyond



the confines of the classroom. In fact, children are usually better behaved in outdoor lessons as they are more motivated and interested, but there are some general planning tips in the Groundnotes* on *Managing behaviour in the outdoor classroom*.

Of course, maths is not the only subject to teach outdoors. You might want to build in a rolling programme of curriculum review and gradually take more lessons in all subjects into the school grounds. Creating a timetable for school grounds lessons will ensure that there are no clashes over the use of this valuable space.



*These Groundnotes are available from the Member Services area of our website.

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