Primary Magazine
Issue 37

National Centre for Excellence in the Teaching of Mathematics

Introduction

Welcome to the 37th issue of the Primary Magazine. This issue is our summer edition and so a little bit different from normal. Last summer we gave you 10 things to do during the summer, in the churchyard, on a scavenger hunt, during a picnic, at the zoo, in the library, at the bowling alley, on the beach, in the cinema, at the park and in a restaurant. This summer we focus on the weather. We give you the necessary weather facts and give plenty of mathematical ideas to go with them – you could do these during your holidays or consider working on them with your class in September. The weather holds plenty of opportunities for some real life mathematics.

Contents

Stormy Weather

Storms. Love them or hate them, we get off pretty lightly in this country. We get very few compared with other parts of the world. Ever wondered why? It's probably because of our particular climate. The most likely time for a thunderstorm in the UK is after a heat wave in the summer. They are the most common in the tropics.

Powerful storms such as thunderstorms, hurricanes and tornadoes are generated when warm, light air rises quickly into higher, colder levels in an unstable updraft that can reach over 100 miles per hour. Each type of storm forms under specific conditions.

Thunder and lightning

Thunder storms can vary from fairly mild rainstorms to very damaging storms with hail and high wind. Thunderstorms form when warm air rises from the Earth's surface and moves upwards quickly into the colder levels of the atmosphere. If conditions are right, tornadoes can form from this updraft. Normally, however, the result is rain, wind, lightning and thunder.

Without lightning, there would be no thunder and therefore no thunderstorm. Thunder is the noise lightning makes as it travels through the air. Lightning occurs during all thunderstorms. During a storm, it strikes Earth 100 times every second.

Lightning forms when updrafts of air carry water droplets, which have a charge, up to heights where some freeze into ice and snow particles. They form a cloud. As these particles begin to fall back to Earth, charges within the cloud become mixed. The differences in charge are released as lightning. You'll normally hear the sound of lightning a few moments after you see the sky light up. Light travels faster than sound, so if you are at a distance from the storm, lightning and thunder may seem disconnected.

The speed of light is 299 792 458 metres per second and the speed of sound is 343.2 metres per second. A Boeing 747 has a highest speed of 260 metres per second. This might help you appreciate the speed of sound.

We don't have thunderstorms as often as some other parts of the world. However, when we do, they can cause great damage and disruption to services. In June this year, we had one that spread throughout the south east of England and caused delays in departing flights at Gatwick Airport when lightning struck a control tower and put it out of action.

Here are some mathematical facts to play around with:

- at any given moment, there are an estimated 2 000 thunderstorms in progress over the Earth's surface
- it is also estimated that there are around 44 000 thunderstorms around the Earth every day!
- thunder clouds can extend upwards as high as eight to twelve miles
- the upper portions of the storm are made of ice. About 50% of the rain that reaches the ground was ice
- the average thunderstorm releases the energy equivalent to a small nuclear power plant
- thunderstorms typically produce heavy rain for a brief period, anywhere from 30 minutes to an hour

- about ten percent of thunderstorms are classified as severe – one that produces hail at least three-quarters of an inch in diameter, has winds of 58 miles per hour or higher, or produces a tornado
- lightning often strikes outside of heavy rain and may occur as far as ten miles away from any rainfall
- your chances of being struck by lightning are estimated to be 1 in 600 000, but could be reduced even further by following safety precautions
- almost all thunderstorm clouds grow to heights above 20 000 feet, 35 000 feet is typical
- many people really enjoy thunderstorms, and some don't. If you don't, you could move to St Paul Island in the Bering Sea off Alaska. On 8 November 1992, they reported a thunderstorm – the first in 40 years!
- there are about 16 million lightning storms in the world every year
- the south eastern region of the US has the greatest number of thunder storms per year, with some areas in Florida experiencing an average of 90 days of thunderstorm activity per year. This is mostly due to its closeness to the Gulf of Mexico and the Atlantic Ocean, which provide an ample amount of warm, moist air
- the Midwest and Great Plains regions of the US average between 40 and 60 days of thunderstorms per year. This central area of the U.S. is home to the most severe thunderstorms in the world
- the longest recorded thunderstorm was in 2006. It started in NE Oklahoma and ended in central Michigan, travelling 800 miles and lasting for over 17 hours.

Ideas for you – or your class

You could paint a picture of a thunderstorm. The results can be quite dramatic. Make the lightning strikes to specific measurements and at specific angles to each other for a mathematical touch. Mix black and white paint to a variety of ratios for shades of grey for your clouds. Make sure you record your ratios so that someone else can mix paints to these. Do they end up with the same shade you had?

You could count the seconds between seeing a lightning strike and hearing the thunder. Are they closer when you are in a storm than if you are a long distance from it?

You could locate the countries where thunder storms are prevalent (see map at the top of this page). Do you know any thunder-themed nursery rhymes?

'I hear thunder' used to be a popular song. Why not sing this with the children and add rain drop noises for them to count? You could use a musical instrument such as a chime bar for this or drop stones into a tin.

I hear thunder, I hear thunder,
Oh, don't you? Oh, don't you?
Pitter-patter raindrops,
Pitter-patter raindrops
I'm wet through,
I'm wet through.

You could watch this short clip of eight lightning strikes and count how many seconds from the lightning strike to the sound of thunder. You could draw the lightning as it appears in the clip and then describe the types of lines it makes and investigate angles.

Listen to My Favourite Things from *The Sound of Music*. If you have the film you could watch the actual clip which has thunder sounds during the song.

How many things does Julie Andrews mention to keep the von Trapp children's minds off the thunderstorm? Make a list and find different ways to sort them in a Venn, Carroll or tree diagram.

You could sing along using the words from this YouTube clip.

Tornadoes

Possibly the most feared hazard associated with thunderstorms is the tornado, a spinning wind that can whirl at over 480 kph (300 mph).

Both tornadoes and hurricanes are spinning columns of air capable of causing great damage. Tornadoes are more localised and typically found on land, while hurricanes can cover vast areas and draw their power from the warm tropical oceans. Hurricanes can last for days or weeks and cover thousands of miles of land. Unlike tornadoes, they lose their power source when they leave the ocean and end.

Tornadoes range from only a few feet to one mile in diameter and are short in duration, normally only a few minutes long. Though these storms are localised, they can be extremely violent. The wind speed inside a tornado's funnel can exceed 200 miles per hour, enough to turn everyday objects into deadly projectiles. Tornadoes occur all over the world, at every time of the year, but they are most common in the summertime in the mid-west of the United States, in an area commonly known as Tornado Alley.

Tornadoes form from thunderstorms, though not all thunderstorms generate tornadoes. An unstable column of warm air rising within cumulus clouds can start to rotate because of changing wind directions at or near the ground. These updrafts alter the air's rotation from horizontal to vertical, creating conditions in which a funnel can develop. If conditions are right and the funnel forms, it can extend to the ground, forming a tornado.

The UK has had several tornadoes over the years. Across Northampton, Warwickshire and Hampshire in 2007 there was a series of small ones which were classed as moderate to strong and caused a significant amount of damage to property.

The widest tornado on record is the Wilber-Hallam in Nebraska in May 2004. It had a width of 2.5 miles (4 km) at its peak. You could use this fact in the classroom to explore circles. Scale this diameter down to centimetres and ask the children to draw a representation of the tornado. They could find the radius and make a circle, as described in A little bit of history (under the heading *Athens and the Parthenon*) in Issue 36 of the Primary Magazine.

This YouTube clip of a tornado growing and moving is worth watching. You could time the length it takes to get to its final size.

Information from:

- learner.org
- naturalhazards.org

Rainy Weather

It's summer, it's the holidays, but it's raining again. So what could you do in (or out of) the rain and with a mathematical theme? Let's start off with five fascinating facts about rain:

1. one of the driest places on Earth is Arica in Chile (South America), where less than one millimetre of rain falls every year. A coffee cup would take around 100 years to fill
2. every minute of the day, around 900 million tonnes of rain falls on the Earth
3. the record for the most rain in a week was set in February 2007 on Réunion, a small island in the Indian Ocean. A powerful storm saw more than five metres of rain fall there in just seven days – that's enough to leave a double-decker bus under water
4. the UK record for the most rainfall on a single day was set in 1955 in the village of Martinstown in Dorset: nearly 30 cm of rain fell in 24 hours
5. St Osyth in Essex is the driest place in the UK: it gets just 51cm of rain a year on average.

These facts came from the Met Office website.

Why not try a bit of probability? It is raining today, but will it rain tomorrow? Can a simple flip of a coin predict the weather? First you need to decide which side of the coin is which – heads it will rain, tails it won't, or the opposite. Toss the coin just once and record the prediction. Check the predictions for a week. You could use a chart or the back of an envelope. If the results are interesting, i.e. not what you would expect, then you might want to continue to see what happens.

day	prediction for tomorrow	true or false?
Monday	rain	
Tuesday	dry	
Wednesday		
Thursday		
Friday		
Saturday		
Sunday		

Make your own rain gauge, so that you can measure what you are complaining about. The Met Office Education website offers a set of simple instructions, while the BBC has a printable PDF. The Royal Meteorological Society offers some rain gauge history, too. However you do it, decide what you want to find out and keep a record to see what it tells you. Does it really rain more at the weekend? On Bank Holidays? etc.

Read Rain, Rain, Come and Play! to find out how a small nursery school developed their outdoor area over three years. Enjoy watching a short film (only 40 seconds) of the children problem solving with water and a cardboard box. This was in the Case Study in Issue 2 of the Early Years Magazine.

Find a young child to play Incey Wincey Spider with – topical and fun on a rainy day.

Dress appropriately and head outside to see who can find the biggest puddle, or make the biggest splash. Great fun and you can always shower afterwards!

If it's wet and warm, go outside in your swimwear and have fun. You can still play football and cricket, make an obstacle course or a water park, throw water balloons and wet sponges at targets and do a bit of hula-hooping. If the rain stops, get out the sprinkler to continue the fun (unless they're banned!). Who needs a pool?

Or take an umbrella out with you and take turns to sing rain themed songs – like *Singing in the Rain*, *It's Raining, It's Pouring*, and *Rain, Rain, Go Away*. Use a tent for the audience and give each singer a score out of ten. Add the scores to find the winner.

Play a board game or make one. Theme according to the interests of the players.

Take a look at some of the indoor activities suggested for last summer –

- The mathematics of the library,
- Bowled over with mathematics,
- Cinemas and mathematics, and
- The mathematics of eating out.

Imagine yourself in a rainforest. Browse Rainforests and mathematics in Issue 30 of the Primary Magazine to get some ideas.

If you have children, and even if you don't, why not set up an indoor sports day. Many of the activities suggested in Focus on...Sports Day could be adapted for indoors, or carried out in the garden between showers.

And if all else fails, just curl up with a good (mathematical) book. On my bookshelf waiting to be read, I have *Zero, the biography of a dangerous idea* by Charles Seife ISBN 978-0-285-63594-4 and *A Mathematician Reads the Newspaper* by John Allen Paulos ISBN 978-0-140-25181-4. Browse an online bookstore or your local bookshop to find something that interests you. Buy on a sunny day ready for a wet one.

Sunny Weather

We all wish for sunny days over the summer season and plan for enjoyable days out at the beach, at the park, in the garden or other outdoor venues, but did you know that the sunshine provides many opportunities for mathematical exploration?

What do people do on sunny days and what are the most popular activities? Ask the class to plan and design a survey to find out. Consider the best means of collecting and representing the data and then interrogate it to see what can be learned. Most importantly, think about how you can further use the information learned to inform other activities. Why are you investigating the most popular activities? Is it because you intend to plan a sunny day activity such as a trip to the beach or a picnic in the park? Knowing what you intend to do with the information will also help children to consider the best sample group to question. Issue 26 explores the mathematics behind going to the zoo, to the beach, to the park, as well as asking Can picnics can be mathematical?

Why not investigate the source of these sunny days... the sun itself! Did you know that:

- the sun's interior could hold 1.3 million Earths?
- the sun's outer layer has a temperature of over 6 000°C?
- the sun has been active for around 4.6 billion years?

Take the opportunity to explore some of these large numbers. How many times could the children, teachers or family members have lived their lives during the course of the sun's active period? How much hotter is the sun's surface than the hottest day in the UK this year? Can you build a scale model showing the size of the Earth and other planets in relation to the sun using the following information:

sun/planet	Sun	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
diameter (km)	1 390 000	4 880	12 100	12 800	6 790	143 000	121 000	51 100	49 500	2 270

(source: Motivate Maths Enrichment for Schools)

Why do we have seasons? Some people think that our seasons occur because at some parts of the year we are nearer to the sun, but it is actually because the Earth is tilted. The Earth's axis is tilted at an angle of 23.5° and the different amounts of sunlight around the Earth during the year create the seasons. Discuss the fact that it takes 365.24 days for the Earth to move around the sun and use this information to explore why we have leap years. Children may also have noticed the differing amounts of sunlight we have each day throughout the year. When is the longest day? When is the shortest day? Ask the children to use the data available on the Project Britain: British life and Culture section of the Woodlands Junior School website to explore the average amount of sunlight we receive daily each month as well as the average record maximum and minimum temperatures. What would be the best form of representing this data? In which months do we get the most/ least sunlight? How does that affect what we do? What was the highest ever temperature recorded? How does this compare with other countries? The Sunrise Sunset project also highlights the different lengths of days in June and December in the UK, Thailand and Australia and explains why this occurs.

Sundials are a great source of mathematical exploration – from the creation and design of the sundial through to telling the time. In Issue 13 we looked at the history behind sundials and waterclocks, while Sundials, a Bowland Maths activity, is a teaching resource that can be used with much older primary children to look at symmetry, angles, nets and data as well as telling the time. Discussion and other resources around this resource can be found on our online Bowland Forum. You can also learn how to make a sundial in your playground at Ehow: How to make a Sundial for Kids - all you need is a small stick and a few stones.

- choose an unshaded area to set up your sundial. Put the stick or pencil in the ground, or in a large piece of modelling clay, if your space is on a concrete or wooden surface
- observe the stick's shadow carefully over the course of the day. Add a stone to your sundial for each hour, from sunrise to sunset. Mark the exact spot where the shadow falls each hour
- to make it easier to tell the time, label each stone with the corresponding hour in which it was placed
- using your sundial to tell time may take practice. Start by looking at the sundial on the hour, which is when the shadow should fall precisely on a stone. With practice, it will become easier to determine the time, even when the shadow falls between two rocks.

Originally, all time on Earth was calculated using a sundial, so every city had its own time. When well-regulated mechanical clocks became widespread in the early 19th century, each city began to use some local mean solar time. The first time zone was created in 1847 by railways in Great Britain using Greenwich Mean Time. Sandford Fleming of Canada proposed worldwide hourly time zones in 1879. By about 1900, almost all time on Earth was in the form of standard time zones. It is interesting to explore with children the idea of different time zones around the world explaining that when the sun is high in the sky in one part of the world, it will be night-time in another place. Children can use the map on mathsisfun to compare the times of day all over the world.

Children enjoy playing out in the sunshine and often need to be reminded of the safety aspects of exposure to the sun's rays. This can be explored through a mathematics activity by asking: ' Which times of day do we most need to stay in the shade?'. Explain to the children that the most dangerous part of the day is when the sun is at its highest in the sky. Linking science knowledge, can the children describe the length of their shadow at this point of the day? Will their shadow be long or short? Consider where the most popular sunny spots are on the playground and conduct an experiment to find out at what times of day their shadows are shortest. How can they use this information to keep everyone safe in the sun? Cancer Research UK has designed a set of activities to help children stay safe in the sun, and offers guidance on setting up a lesson to explore shadow lengths at different times of the day.

Finally, if you are interested in mathematical history, why not read with your children about how Eratosthenes calculated the size of the Earth's circumference using his knowledge of the angle of elevation of the sun at noon in Alexandria and Syene, and how he calculated the distance of the Earth from the sun.

Enjoy the sunshine!

Windy Weather

Windy weather is encountered throughout the seasons. Here we explore the mathematical opportunities in studying wind direction, wind speed, and what the wind does.

Wind direction

"The North wind doth blow and we shall have snow..."

You may not be expecting snow, but what direction is the wind coming from today? And how does that relate to the other weather conditions?

The easiest way to see the direction of the wind is to hold a flexible object in the air. To check the direction changes over time, without making your arm ache, you can use a flag, windsock, or weather vane. Use a compass together with the flag, windsock, or weather vane, to find the direction of the wind.

Compare the wind direction that you observe to published weather forecasts, such as the BBC weather website. Working with children on this activity provides an opportunity to use compass directions, reinforce telling the time by having specific times of day when the wind direction will be read, and from them to devise their own method for recording data.

Instructions for making a weather vane

Each group needs a disc of hardboard as a base, and a length of dowel. The dowel is fixed to the centre point of the disc so that it stands up perpendicular to the base.

The base needs to be marked along the circumference N, E, S & W at 0, 90, 180 and 270 degrees.

Find the middle along a length of drinking straw and pin it horizontally onto the top end of the dowel. The straw needs to be able to rotate freely, so if there is friction put a small bead on the pin between the dowel and the straw.

Cut a vertical slit into each end of the straw and insert and stick an equilateral triangle made from card into each end. These triangles of card will catch the wind and make the vane turn. Place in an open space to check and record the wind direction over time.

Children can use measuring to create their weather vane and knowledge of angle and right-angles to make the compass points on the base.

Instructions for making an anemometer

You will need paper cups. Cut off the rolled edges of the paper cups to make them lighter. Each group of children will need four of these. They colour the outside of one of the cups with the marker.

Fix two strong cardboard strips into a cross shape, crossing them in the middle at right-angles. Staple four cups under the ends of the cardboard strips. Make sure that all the cups face the same direction around in a circle.

Make a hole in the centre of where the cardboard strips cross. Attach the cross through the hole with a pin or nail to a long dowel and fix the dowel to a base or insert it into the ground. The cross must be able to turn freely, parallel to the ground.

Wind speed

Wind speed can be measured using a paper windmill or an anemometer. It works by one part of the device turning freely in the wind. A section of this turning part is coloured. Count the number of times the coloured part completes a full rotation to find the RPM (revolutions per minute).

Instructions for making a range of different paper windmills can be found from The Creative Science Centre. They also invite contributions of new windmill designs. Making windmills can involve accurate measuring of length and angle, exploring shape and rotational symmetry, and data handling as they are tested and improved.

Wind speed is important for wind energy so could form part of an environmental theme. Wind turbines, which change the movement of the wind into electricity, need to have a constant wind speed of about 14 miles per hour. Data needs to be recorded before a developer will look into building wind farms.

What the wind does

Designing Kites Combining Maths & Art (part of Learning Maths Outside the Classroom) has full instructions and information about lesson planning for making kites in your mathematics lessons. Through kite-making children experience planning, measuring, understanding the relationship of weight to surface area, getting the angle of the bridle line right in relation to the main body of the kite, listening, learning and taking part. This resource opens with these inspiring words:

One successful kite flyer commented,

> *"It's impossible to fly my kite without smiling. I feel like I am flying too"*.

When children finally reach that climactic moment when the mathematics, the aesthetics of design and the science of construction combine successfully and the kite flies, then everyone involved smiles, and teachers know they have achieved a major goal. Total immersion in the project often results in children being unaware of the maths involved in the project, as a result of the high motivation to solve geometry's challenges. Such a project helps them to 'get a feel' for mathematics and to see it as real part of everyday living.

To start a conversation with children about the effects of the wind, you could try using a book such as *Room on the Broom* by Julia Donaldson and Axel Scheffler for Foundation Stage and Key Stage 1, or *Walter's Windy Washing Line* by Neil Griffiths and Judith Blake, which has many opportunities for exploring number in Key Stages 1 and 2.

Enjoy those windy days!