maths inside

mathsinside.com

Looking for inspiration?

This suite of resources has been created to inspire entrants, and support families, teachers and those out-of-school to make deeper connections with their surroundings. The *maths inside* is waiting to be discovered!

Each resource targets a CfE level & documents a submission journey

INTER-DISCIPLINARY LEARNING

University of Glasgow | School of Mathematics & Statistics

maths inside Resource Suite — Supporting Notes

The *maths inside* project seeks to nourish a love for mathematics by embarking on a journey of discovery through a creative lens. To create a collaborative resource bank open to everyone, we invite you to treat these "Supporting Notes" as a working document for entrants, parents, carers, teachers and schools to make their own. Please share your tips, ideas and activities at info@mathsinside.com and through our social media channels. Past winning entries of the competition are also available for inspiration and for using as a teaching resource. Already inspired? Enter the competition!

Contents

Credits

This suite of resources are the fruit of a collaborative project between undergraduate and postgraduate students from the University of Glasgow — School of Mathematics & Statistics, and Dr Andrew Wilson (*maths inside* Founder and Director)

The authors are Natalie Baird, Tanushree Bharat Shah, Ali Clacy, Dimitrios Gerontogiannis, Jay Mackenzie, David Nkansah, Jamie Quinn, Hector Spencer-Wood, Keren Thomson, and Andrew Wilson

Discovering and documenting the *maths inside* a Sundial

What is this?

This is an example to inspire and support you to design your own interdisciplinary learning (IDL) activity based on the *maths inside* photo competition, and leads pupils towards the creation of an entry. This activity is based on second level experiences and outcomes, and complements The Sundial resource.

Curriculum for Excellence (CfE) experiences and outcomes: Second level

- I can convey information, describe events, explain processes or combine ideas in different ways. LIT 2-28a
- I am learning to use language and style in a way which engages and/or influences my reader. ENG 2-27a
- I can carry out practical tasks and investigations involving timed events and can explain which unit of time would be most appropriate to use. MNU 2-10b
- I have worked with others to explore, and present our findings on, how mathematics impacts on the world and the important part it has played in advances and inventions. MTH 2-12a
- I can create and present work that shows developing skill in using the visual elements and concepts. EXA 2-03a
- Through observing and recording from my experiences across the curriculum, I can create images and objects which show my awareness and recognition of detail. EXA 2-04a

See also, for example, LIT 2-06a, LIT 2-20a, LIT 2-23a, LIT 2-26a, MNU 2-03b, TCH 1-01a, and EXA 2-02a.

Purpose of the activity

To explore, through outdoor learning, the function and design of a sundial, methods of recording time and their accuracy, and the impact of mathematics in the world. To embark on a creative journey to record the discoveries made in an engaging piece of writing and in a visually appealing photograph. To provide opportunity to apply digital literacy skills.

Learning activity

- Visit a local sundial with pupils
- using the questions in the documented example journey, invite pupils to
  - consider how a sundial works
  - compare the sundial with other time recording devices

- Ask pupils to write down their discoveries in a commentary, either individually or in groups
- Have each group or individual take a photograph of the sundial, or a detail of it, and discuss what makes a visually appealing and engaging photograph
- After returning indoors, digitally add the *maths inside* sticker (how to guides available) and submit to the competition

Extension activity

- Invite pupils to create their own sundial, and experiment with an appropriate scale to mark the passage of time

National benchmarks

- Uses appropriate style and format to convey information
- Includes relevant ideas, knowledge and information
- Organises and presents information in a logical way
- Uses tone and vocabulary appropriate to purpose
- Attempts to engage and/or influence the reader through vocabulary and/or use of language as appropriate to genre
- Chooses the most appropriate timing device in practical situations & records using relevant units
- Contributes to discussions and activities on the role of mathematics in the creation of important inventions, now and in the past
- Records from experiences across the curriculum, showing recognition of detail, for example, observes and captures the detail seen in a natural form, such as a feather or a plant or an interesting personal item, such as a bicycle
- Explains, with supporting reasons, what works well and what could be improved in their own or others' work, using appropriate art and design vocabulary

Possible approach to assessing learning

Some of the following may support your assessment of progress and to celebrate pupils's learning:

- How effectively and clearly are the central ideas in the commentary communicated?
- Does the commentary make interesting or surprising connections between the subject of the image and underlying mathematics?
- How visually engaging and aesthetically pleasing is the image captured?
- How well does the image capture the central ideas of the commentary?
- How connected are the title, commentary and image?

in the home

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early years example

Resource Suite

All Sorted!

I noticed that some buttons have two holes and some have four, so I separated them into piles. They need different stitches to tie them on. Then I sorted them by colour and I could find the right button to sew on my brown teddy bear, my friend can find the best button on for his white shirt, and other friend could fix their blue purse with a missing button. I have a big brown teddy bear and a small one too so I made my brown buttons line up from big to small. My bear whispered in my ear that it is wise to separate buttons based on their size and so this line is called size-wise. I found many more ways of grouping my buttons, some are shiny and some have patterns – some go together because they don't! I like collecting buttons and putting them in different groups.

– Resources Suite (Pre)

University of Glasgow | School of Mathematics & Statistics

Maths Week Scotland

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Button Mix-up and Sort

I have a bottle of buttons in my room. I love collecting them! They are all mixed up. Can you see how many different types of buttons are here?!

How could these be sorted? What features would you sort them by? How many different colours can you see? Where are the biggest ones? And the smallest? Can you find ones that are shiny, or rough, or smooth? Where are the buttons with two holes? Or four? There are many options!

Can you see that some buttons have four holes and some have two? I separated them in two piles and took a photo then gave it the title

> Buttons in Stiches!

and commentary

> I noticed that some buttons have two holes and some have four, so I separated them into piles. They need different stitches to tie them on

I like sorting the buttons by their holes, but then I noticed I have many different colours of buttons. What colours of buttons do I have in the first picture above? How many are there? Can you count how many? I thought about this and sorted them by colour, took a picture and it looked like this

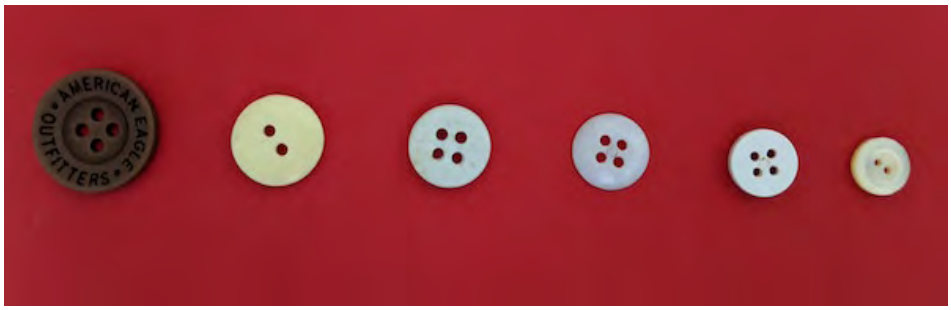
I chose the title for this picture

> Colour Coded

and wrote the commentary

> If I want to sew a button on my brown teddy bear, I will sort them by colour so I can easily find the brown one. If my friend wants to sew a missing button on his white shirt, he can find one in the white pile. My friend has a blue purse with a missing button – she can easily find the blue button. So, I decide to group them by colour

I like them sorted by colour, but take another look at my pile of mixed buttons. What sizes of buttons do you see? How many different sizes are there in the pile? Can I sort them by size? What size buttons can I use for my small teddy bear and what size for my big one? I picked out six buttons of all sorts of sizes and took another picture



I gave it the title

> Size-wise

and the commentary

> I have a big brown teddy bear and a small one too so I made my brown buttons line up from big to small. My bear whispered in my ear that it is wise to separate buttons based on their size and so we have Size-Wise.

What different ways of grouping these buttons can you think of? How could you sort the buttons into piles? I thought a bit more and took a picture with many different ways to group them for my submission — take a look!

For my final entry with all my explorations I chose the title

> All Sorted!

With the commentary

> I noticed that some buttons have two holes and some have four, so I separated them into piles. They need different stitches to tie them on. Then I sorted them by colour and I could find the right button to sew on my brown teddy bear, my friend can find the best button on for his white shirt, and other friend could fix their blue purse with a missing button. I have a big brown teddy bear and a small one too so I made my brown buttons line up from big to small. My bear whispered in my ear that it is wise to separate buttons based on their size and so this line is called size-wise. I found many more ways of grouping my buttons, some are shiny and some have patterns — some go together because they don't! I like collecting buttons and putting them in different groups.

What can you find around you? How can you grouped them? Could you group them differently? How many different ways can you group them? Can you find all the ways to group them?

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The photos above are credited to *Tanushree Bharat Shah*.

in the home

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early years example

Resource Suite

Sky-high Shapes

My rainbow has the colours in the order of the rainbow song and they can only been seen from the outside cause I coloured them picture on one side. I placed my rainbow in the highest window in my home so that it can be seen by lots of people near or far. My rainbow is different and the same to those in nature. It is the same because I can only see my rainbow from one side. It is different because it is not symmetrical, but I think it looks nicer this way!

– Resources Suite (P1)

University of Glasgow | School of Mathematics & Statistics

Maths Week Scotland

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The Rainbow on my Road

Have you seen a lot of rainbows around lately? Have you made your own colourful hope rainbow to display on your window? Have you ever seen a real rainbow? Do you think you can find some maths inside the rainbow, whether it is a homemade rainbow or the beautiful rainbows which appear during certain weather, can you take a picture and write about the maths inside your rainbow?

Whilst I was oot and aboot at the supermarket, I noticed this rainbow on my shopping bag. I thought to myself – how did they fit little love hearts into the shape of the rainbow? Can I fit different shapes inside the shape of a rainbow? What shape is the rainbow itself? Do all of the colours have the same shape? Why do the colours appear in this order – is it based on a natural rainbow or was it to make it pretty, is there a specific pattern?

This photo could lead to the title

> Small shapes, big rainbow

with the commentary

> This picture of rainbow is made up of lots of smaller colourful heart shapes

I looked at my commentary and thought I could do better!

So I took a look at the rainbow I made to display in my window and had a think.

I coloured in the rainbow in a different order to the shopping bag, does all rainbows follow the same pattern of colours? What is the pattern of colours? Why did I choose this pattern of colours, did I pick my favourite colours, did I copy a picture or a friend? What order do I sing the colours of the rainbow song in, do my friends sing the order in the same way? Is my rainbow symmetrical (is it the exact same on both sides, would it appear the same in a mirror?), why is my rainbow not symmetrical? Are rainbows in nature symmetrical?

Looking at my rainbow from the outside of my house I can see all the colours, but on the inside of my house I can only see white paper. Can I make my rainbow identical on both sides of paper? Why have I displayed my rainbow in this way? How would I change my rainbow so that I can see the colour from inside my house and white from the outside of my house? Where is my rainbow placed? Is my rainbow on the inside of my window indoors or is it stuck outside the window outdoors? What does my rainbow have around it? Does it have other shapes? Does it have writing? Have I put this writing/shapes in a

position? Where have I placed this writing around my rainbow? Where have I placed the rainbow itself, is it on an upstairs window, downstairs window, drawn on the ground with chalk? Why have I put it here – can more people see it, is it the highest I can reach, did someone taller than me help me put it up higher?

The picture of my hope rainbow for our carers leads to the title

> Sky-high Shapes

with the commentary

> My rainbow has the colours in the order of the rainbow song and they can only been seen from the outside cause I coloured them picture on one side. I placed my rainbow in the highest window in my home so that it can be seen by lots of people near or far. My rainbow is different and the same to those in nature. It is the same because I can only see my rainbow from one side. It is different because it is not symmetrical, but I think it looks nicer this way!

Later in the day on my walk, I spotted a real rainbow in the photo below. What shape is this rainbow? Why is the rainbow this shape and not another shape? Can I see all of the rainbow or only part of the rainbow? When did I see this rainbow – was it sunny, cloudy, rainy? What weather combinations do we need to see a rainbow, and why does it appear in this weather? Have I seen a rainbow anywhere else – in bubbles, in oil, through a special type of glass? How did that rainbow form? Where was this rainbow, was it above me, below me, far away, close? Was this rainbow big or small – the rainbow I noticed was big and it was very wide but not very tall. What colours do you see? How many colours are there – do the colours look like they blend together? Is this rainbow the same as a rainbow you would draw?

This image of an actual rainbow could lead to the title

> When there is rain look for rainbows

followed by the commentary

> When the sun shines brightly through raindrops, we can see a rainbow! The rainbow is in the shape of a very big circle, but we can only see part of it. We can only see it when the sun is behind us

Now I am not sure which photo, title and commentary to submit to the competition — luckily I can submit both because they fit it two different categories!

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The photos above are credited to *Keren Thomson*.

oot an' aboot

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first level example

Resource Suite

Why Rectangles?

The window is rectangular. This is because it is the easiest shape to build with because their right angles allow them to sit next to each other without the worry of gaps

— Resource Suite (P3)

University of Glasgow | School of Mathematics & Statistics

Maths Week Scotland

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It's Huge!

What is the biggest thing that you can think of? How about the largest thing in your home, or outside near you? What is the *maths inside* it? How can you take a photo of it to show the *maths inside*? What title and commentary could you write to describe the *maths inside* your huge object?

Here's an example — a block of flats!

My actual block of flats is the biggest object I can find at home! Now that I have found the largest thing, what maths can we find inside it by looking closer? Can you see that in this photo there are lots of rectangles? This could lead to a title saying

> It's my home!

Followed by a commentary such as

> My block of flats has lots of rectangles

Although this is true, I think we can dig deeper into the maths in this photo of my block of flats.

To find more maths in this photo, we may ask "why are the rectangles laid out like this?". Does it make the flats look better? Can you find a pattern in the rectangles? Another question you may ask is "why have rectangles been used?". Why not another shape, such as circles?

By looking closer at the photo, you can see that there is symmetry between the windows of the flats! This makes the block of flats nicer to look at.

Now that we have found the symmetry in the windows, how can we use our photo to show this? Why could cropping the photo like below help show our *maths inside*?

Making the windows the main feature in our photo helps show that we have found the *maths inside* our huge object!

With our cropped photo, we can base our title and commentary around it! For example, our new title could be

> Symmetry!

With a commentary saying

> This photo shows that there is symmetry in my block of flats. This can be seen in the front windows

What could be another example of the *maths inside* my huge object: my block of flats?

Can you see that the doors on the top floor of my block of flats are rectangles? This is because it's an easy shape to build around because of its straight edges!

How can we dig even deeper than this though? We know other shapes have straight edges too, for example triangles. What is another reason that means that rectangles are easy to build with? What other facts about shapes do we know?

One thing we know about is angles!

As rectangles have right angles at each corner, they are easy to line up next to each other! This makes them easier to work with. Builders don't have to worry about whether there will be gaps in their walls, as each right angle will fit perfectly with the one next to it! Why can't triangles do the same thing?

Now that I have found another reason that rectangles are used in my flat of buildings, I can look even closer at my initial photo. How can we improve it to show off our knowledge about angles? Can you see that the windows in our photo are also rectangles, and use the same property we worked out above?

We could once again crop our photo so that it shows just the windows however when we do this our photo becomes blurry!

Could we take a closer photo of the windows so that our photo is better? After all, this is a photo competition! On a trip in Edinburgh I took this picture of the flats I saw there. Time to construct our final entry! We have our photo, but we're forgetting one thing - a *maths inside* sticker which can be found on the *maths inside* website!

Now that we have a clearer picture of windows, we can base our title and commentary around them! You could have a title saying

> Why Rectangles?

Followed by a commentary saying

> The window is rectangular. This is because it is the easiest shape to build with because their right angles allow them to sit next to each other without the worry of gaps

Now it's your turn! Where can you find something huge? You can find the biggest thing in your home, or go outside and find something huge! What maths can you find inside it?

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The photo Block of flats at Canford Cliffs, Poole is credited to *Malc McDonald*, the photo grassmarket, Edinburgh is credited to *Emran Yousof*.

oot an' aboot

maths inside
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second level example

Resource Suite

Whoosh!

Frisbees have the same shape as the wing of an airplane! The top part is curved, and the bottom part is flat. This makes the air move faster across the top of the frisbee than on the bottom, and this causes the frisbee to fly when thrown! Also, as a frisbee spins, it builds something called angular momentum. This gives the frisbee stability and allows it to stay in the air and travel long distances!

— Resource Suite (P5)

University of Glasgow | School of Mathematics & Statistics

Maths Week Scotland

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WHOOSH!

We have recently been allowed to play and exercise outdoors. What activities can you do outside? What's your favourite? Have you been doing some fun activities in the sun? What are the links between these activities and maths? Can you investigate them? Can you take a photo that captures what you discover, add a *maths inside* sticker and write about your discoveries in a commentary?

Throwing a Frisbee is one of my favourite activities! Do you also enjoy it? This gets me thinking: what is the maths behind a frisbee? How does it stay up in the air? Why does it glide differently depending on how it is thrown?

Here is my example: a frisbee! This is such a fun activity which can be played while social distancing! I used the internet to research how a frisbee works and found out about the *maths inside!*

This photo could lead to the title

> whoosh!

followed by a brief commentary about how it stays up in the air. Such as

> Frisbees have the same shape as the wing of an airplane! The top part is curved, and the bottom part is flat. This makes the air move faster across the top of the frisbee than on the bottom, and this causes the frisbee to fly when thrown! Also, as a frisbee spins, it builds something called angular momentum. This gives the frisbee stability and allows it to stay in the air and travel long distances!

Can you take a photo and create a title and commentary of your favourite outdoor activity! What aspects of maths might you include? What are the rules behind the game — are they mathematical? What are the shapes, colours, and patterns? How does any apparatus used work? Could you change the rules? Or could you create your own activity and discuss the maths inside? Now it is your turn!

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The photo dog with frisbee is credited to *Tony Trocino*.

oot an' aboot

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second level example

Resource Suite

Settling For Hours, Maybe Minutes

A sundial is a device that tells time. It does so by recording the position of a casted shadow of a vertical object onto a flat surface in suitable intervals, for example, every hour. We made our own sundial by placing a stack of pencil tied together with string and placed it upright onto a table. We marked the position of the shadow every hour with a pebble. This helped us estimate the time of day. Unlike a clock, these estimations were good for bigger intervals of time such as hours, maybe minutes, but not good for seconds. So, with our homemade time device, we are able to give good estimates on how long a journey to my local supermarket takes, but we are not able to give a good estimate on how long it takes to brush our teeth. We do this by using the link between time, speed and distance.

– Resource Suite (P7)

University of Glasgow | School of Mathematics & Statistics

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The Sundial

Whilst having a walk outside, we came across a fascinating device, it turned out to be a device that told the time called a sundial.

We then came up with the title

> A Sundial

and commentary

> A sundial is a device that can tell time by using the sun and shadows.

This is an interesting example, but we could find out more about the sundial and include this information in our commentary. We could wonder — what is the *maths inside* a sundial? How could we find this out? Let us explore with some questions!

How does a sundial tell the time? What parts are there to a sundial? How does it work when it is cloudy? Or at night? Who uses sundials? Where can they be found? How can I make one? A sundial is made up of a flat surface and a vertical object that points straight up from the flat surface. As the sun's position moves across the sky, the shadow cast by the vertical object moves across the flat surface. If we record and mark the positions of the shadow at suitable intervals, for example, every hour, we can use this to tell time.

We thought a bit more and now have the title

> A Time Telling Device

and the following commentary

> A sundial is a device that can tell time. It does so by recording the position of a casted shadow of a vertical object onto a flat surface in suitable intervals, for example, every hour.

This is a better, but we could do more! One way is to get more creative and see if we can make a sundial ourselves.

What is needed for our homemade sundial to work?. We know we need a flat surface and a vertical object, but we also need sunlight. We chose to make our sundial with a small table and a stack of pencils tied together with some string. We put this near a window and recorded the positions of the casted shadow by placing a pebble where the shadow was cast, every hour.

We now have this improved commentary

> A sundial is a device that tells time. It does so by recording the position of a casted shadow of a vertical object onto a flat surface in suitable intervals, for example, every hour. We made our own sundial by placing a stack of pencil tied together with string and placed it upright onto a table. We marked the position of the shadow every hour with a pebble.

Let's keep digging with questions to discover a deeper connection between the *maths inside* our objects.

When does the sundial not tell the time? We cannot record the times when the sun is not out and so out sundial does not work during the night and during cloudy days.

What other devices are similar to a sundial? What are the sundial's advantages? What are its disadvantages? A sundial is similar to a clock, but a clock is more accurate. A clock can tell you small interval times like seconds, but our sundial can only tell you bigger interval times like hours, maybe minutes. However, our sundial is easier to make.

Where is a clock used? What happens if I use a sundial instead of a clock? We can use our sundial to estimate how long a journey could take? What is the connection between time, speed and distance?

This leads us to our final title

> Settling For Hours, Maybe Minutes

and our final commentary

> A sundial is a device that tells time. It does so by recording the position of a casted shadow of a vertical object onto a flat surface in suitable intervals, for example, every hour. We made our own sundial by placing a stack of pencil tied together with string and placed it upright onto a table. We marked the position of the shadow every hour with a pebble. This helped us estimate the time of day. Unlike a clock, these estimations were good for bigger intervals of time such as hours, maybe minutes, but not good for seconds. So, with our homemade time device, we are able to give good estimates on how long a journey to my local supermarket takes, but we are not able to give a good estimate on how long it takes to brush our teeth. We do this by using the link between time, speed and distance.

What questions could you ask? Where would you take your picture? What *maths inside* would you investigate?

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The photos above are credited to David Nkansah.

oot an' aboot

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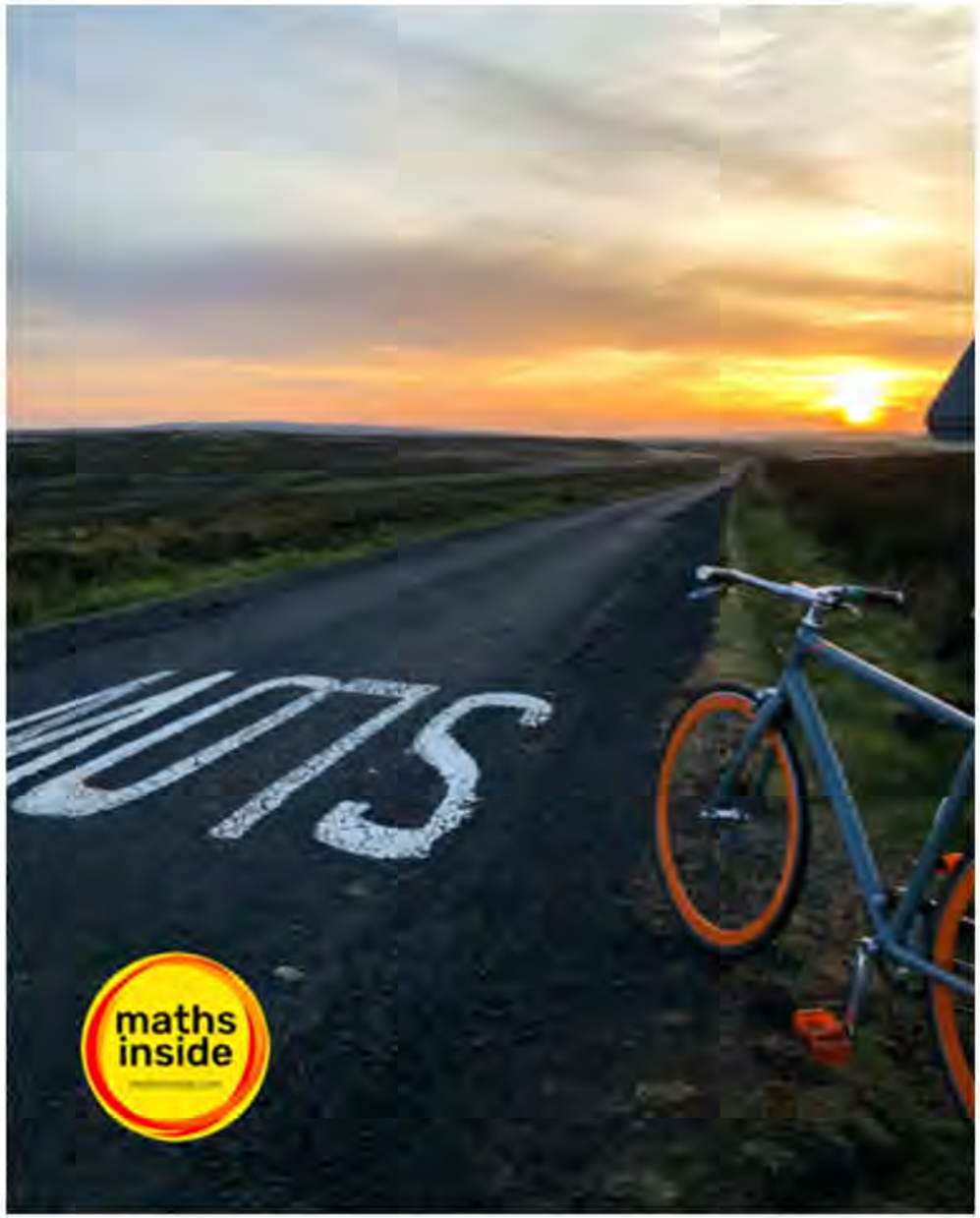
third/forth level example

Resource Suite

Cycling in Order

The order that we do things, matters. When I got a puncture while out cycling, before I could carry on, I had to fix it. If I tried to do the reverse order - cycle my bike before fixing the puncture - it would be more hard work and dangerous. This is because the bike doesn't move as easily with a flat tyre and so it is more difficult to cycle. And when the tyre is flat, it moves around in the wheel which makes cycling dangerous, especially around corners. But if the puncture is fixed before I cycle, these problems disappear!

— Resource Suite (S3)



University of Glasgow | School of Mathematics & Statistics

Maths Week Scotland

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Below, you can find an example documenting the submission journey for an **Third/Forth Level** entry to the *maths inside* photo competition (credits).

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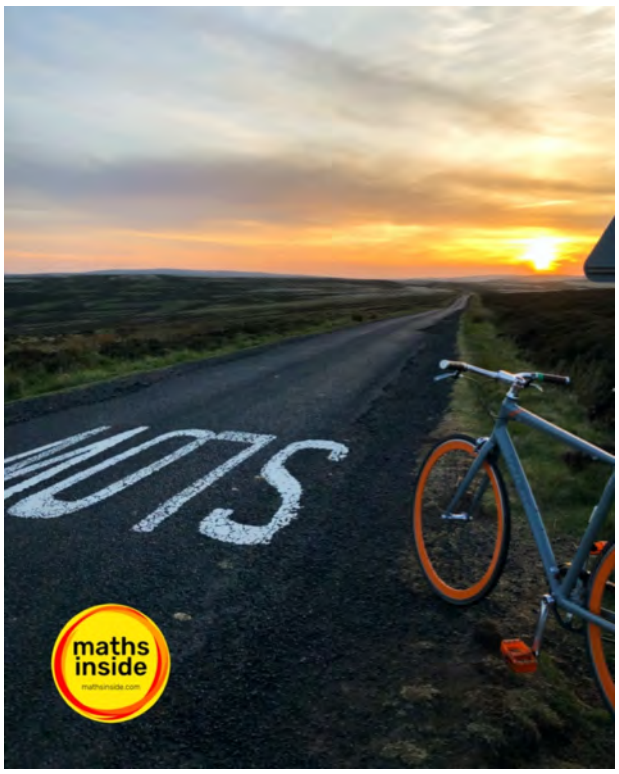
Cycling in Order

Have you ever thought about the maths inside riding a bike? I like riding my bike and am lucky that I can do this more recently. What maths is involved in bikes? How can you capture the maths inside in a title, commentary and photo with the *maths inside* sticker on it? Let's explore together!

Picture a bicycle in your mind, it uses many shapes: circles, cylinders, triangles, quadrilaterals — why does it use these shapes? We might investigate this "why" and talk about it in our commentary but let us take a look beyond the shapes to another interesting mathematical idea that is inside my bike…

When I went for a bike ride recently, I got a puncture. This was a bit annoying, but it made me notice some strange maths inside my bike ride — the idea that order matters! I realised this because I would have to fix my puncture *before* I could cycle home. If I tried to do it the other way around, the cycle home would not be so fun! There was a nice sunset at the time, so I thought it was my perfect chance to take a photo with this mathematical idea hidden inside!



The next task is to come up with a title and commentary for my photo. Let's have a look at my first try. The title I chose was

> Cycle Ride

And I wrote the following commentary

> The order that we do things, matters. While out on a cycle, I got a puncture. So, before I could cycle home, I had to fix it.

What do you think of this title and commentary? Can we make it better in any way? I think we can!

Maybe we could think about the idea a little bit deeper in our commentary. To do this, it's often good to ask ourselves lots of questions! Why does the order matter here? What would've happened if the order was reversed — if the person cycled home *before* fixing their puncture? It's important to explore the "why" in your concepts — this often leads to a deeper understanding! Here, we could ask why we would prefer one ordering over the other.

We might also want to choose a title that not only describes the photo, but also, relates to the mathematical ideas that we thought of!

So, maybe we could update our title to be

> Cycling in Order

And our commentary could be

> The order that we do things, matters. When I got a puncture while out cycling, before I could carry on, I had to fix it. If I tried to do the reverse order - cycle my bike before fixing the puncture - it would be more hard work and dangerous. This is because the bike doesn't move as easily with a flat tyre and so it is more difficult to cycle. And when the tyre is flat, it moves around in the wheel which makes cycling dangerous, especially around corners. But if the puncture is fixed before I cycle, these problems disappear!

What could you write in your commentary? What photo will you take to capture the *maths inside*? Where else in life or nature does the order matter and why? What would it be like if lambs were born after summer? How would the world be if order never mattered? This would be pretty weird — cycling home before or after fixing my puncture would've felt the same! What other situations can you think of that would be strange if the order didn't matter?

Remember that submissions need to be original to be eligible for the maths inside photo competition. Judges can only accept original photos, commentaries and titles that are not featured, shared or displayed elsewhere (this includes social media and other competitions). See the T&C for more information, and please do get in touch if you have any additional questions.

credits

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The photo above is credited to Hector Spencer-Wood.

in the home

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third/forth level example

Resource Suite

The Order of the Eggs

Boiling an egg and then removing the shell results in a boiled egg. But, if we first remove the shell and then boil it, we get a poached egg. The two eggs are very different, and some people might prefer the one over the other. This is an example where the order we do things matters. The main reason this is happening is the eggshell! For example, when we boil the whole egg, the eggshell doesn't really change. In fact, the eggshell stays firm and gives shape to the yolk and the white. This leads to a nice-looking boiled egg. Now, if we first break the eggshell then the yolk and white will be uncovered in the boiling water. This is the reason why a poached egg has a messier shape..

— Resource Suite (S2)

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The Order of Things

Have you ever wondered why life is so complicated, messy or chaotic? Why at the same time is so beautiful and interesting with countless dreams to pursue? Why every decision we make it will shape our future? Well, this is because the *order matters*!

Let's explore this concept through a simple example. Can you see how the two images are related?

Of course, both show eggs. But the left one is a poached egg and the right one is a boiled egg.

Why does the order matter here? You could think that the order matters in which egg you will eat first. But there is something deeper here! This something is not in the pictures, but you can spot it from the pictures. This something is the *order of the steps* needed to make the eggs.

Say that you wake up in the morning and want to make eggs for your friends. They don't like fried food, so basically you can only boil the eggs. The two main moves you need to make are

A: boil the egg

B: remove eggshell

Making move *A* first and then move *B* gives a boiled egg. Making move *B* first and then move *A* gives a poached egg. So, *changing the order of the **same** moves gives different results*!

And now as a mathematician, being a very curious person, what can you ask? For example, what would happen if, before boiling the egg, we opened a small hole on the eggshell using a pen? What would be the result and the shape of the cooked egg? *What name would you give to this discovery?*

What two (or more!) different actions can you find in your surroundings? What is the result when you make these moves in different orders? Can you capture this in a photo with the different outcomes next to each other? How could you title and write about this in a commentary? *What will you find in your journey of discovery?*

With all these thoughts in my head, I took the photo below of my two very different eggs!

Perhaps choosing a title like

> The Order of the Eggs

and a commentary

> Boiling an egg and then removing the shell results in a boiled egg. But, if we first remove the shell and then boil it, we get a poached egg. The two eggs are very different, and some people might prefer the one over the other. This is an example where the order we do things matters.

This is a good commentary, but we can still find deeper reasons why this is happening.

Can you spot the why? And if yes, can you see the how?

So, for a better commentary we would also add that

> …The main reason this is happening is the eggshell! For example, when we boil the whole egg, the eggshell doesn't really change. In fact, the eggshell stays firm and gives shape to the yolk and the white. This leads to a nice-looking boiled egg. Now, if we first break the eggshell then the yolk and white will be uncovered in the boiling water. This is the reason why a poached egg has a messier shape.

I also thought that the eggs were quite small in my photo, and so when I added the maths inside sticker I cropped (cut-off) some of the unwanted parts of my photo to focus on the subject to make it clear. Here is my entry

> The Order of the Eggs

> Boiling an egg and then removing the shell results in a boiled egg. But, if we first remove the shell and then boil it, we get a poached egg. The two eggs are very different, and some people might prefer the one over the other. This is an example where the order we do things matters. The main reason this is happening is the eggshell! For example, when we boil the whole egg, the eggshell doesn't really change. In fact, the eggshell stays firm and gives shape to the yolk and the white.

> This leads to a nice-looking boiled egg. Now, if we first break the eggshell then the yolk and white will be uncovered in the boiling water. This is the reason why a poached egg has a messier shape."

We don't care about order because "order matters for cooking eggs". We care about it because it creates variety, beauty in nature and fun! Mathematics is the science that studies the order of things. In mathematics one tries to find and understand how things are related and in which order, and mathematicians always ask *"Why?"*

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The photo *Poached Egg* is credited to Greg Hirson. The photo *L'œuf à la cocque* is credited to sansplans. The photo *The Order of the Eggs* is credited to Dimitrios Gerontogiannis.

in the home

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senior phase example

Resource Suite

Straight from the Source

This is a photograph of water flowing from my bathroom tap. The water particles are flowing past each other in smooth layers without mixing, so the light passing through the water is only refracted by the outer surface of the water. Because of this, we can see through the water and to a warped image of what lies behind the stream. This behaviour is called laminar flow. Laminar flow is influenced by the speed of the flow, the consistency of the fluid that is flowing, and the shape of the channel the water is coming out of. This is an important concept in applied mathematics, physics, and engineering

— Resource Suite (S5)

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Flow

Have you ever thought about how many different types of things flow? Almost anything that flows is a fluid. Fluids are all around us and they move in some pretty interesting ways. Have you ever pondered this connection between water, air, and even gerbils in sufficiently large quantities! Have you ever examined the water coming out of your bathroom tap? What different states can it be in? What happens if you turned the tap on full blast? How is the water flow when the tap is only opened just enough to get it beyond a stream of drips? Try it now.

This is a photograph from inside the steam of water coming from my bathroom tap when it is only just enough to get a smooth flow. We can see from the bottom of the stream to the faucet.

Since this is a submission to the *maths inside* photo competition and I've already added the sticker, it needs two more things: a title, and a commentary. What title could you give the photo? What could you

write in your commentary? What part of the photo could you choose to highlight? Why did you choose this part? What makes it interesting? How could you describe what's happening? Why is it happening?

I titled my photo

> Straight from the source

and gave it the commentary

> The particles in the water coming from my bathroom tap are flowing past each other in smooth layers, so the light within the stream isn't refracted and we can see all the way to the source

What is that at the top of the picture? How often do you look at your own bathroom tap from that angle? What do you think of this photo? Could it be considered an aesthetically pleasing photograph? Or a technically interesting photo? To take it, I put my phone in a sandwich bag and hoped it was pointed in the correct direction (be careful if you try this!). The maths inside photo competition is a photo competition, so to make a better entry, we should both take a better photograph and develop our commentary.

What could make a better photograph? What does the viewer need to be told in the photo above? What is the subject? What is happening? Why is it interesting? An important part of taking a photograph that makes sense without being told about the context is framing. What could we change just about the framing of the photograph to help tell a more compelling story? One thing is to pull back, to make it clearer that the subject is a tap. Could you play with the framing, lighting, focus, and contrast to make a visually interesting photograph? I took the photograph below which I think is better for this competition

What can we add to the commentary? What questions do you have about it looking at it for the first

time? How could you answer them? What do you see in the first photo that you don't in the second? Why does this change happen? I chose to keep the same title

> Straight from the source

and change my commentary to

> This is a photograph of water flowing from my bathroom tap. The water particles are flowing past each other in smooth layers without mixing, so the light passing through the water is only refracted by the outer surface of the water. Because of this, we can see through the water and to a warped image of what lies behind the stream. This behaviour is called laminar flow. Laminar flow is influenced by the speed of the flow, the consistency of the fluid that is flowing, and the shape of the channel the water is coming out of. This is an important concept in applied mathematics, physics, and engineering.

This commentary covers the same ground as the first one, but then it takes a deeper-dive, telling us about why the behaviour (glassy flow) arises not just a consequence (it's see-through). I also tell you what flows like this are called, which is an interesting detail.

Now it's your turn! Where is the *maths inside* your life? Can you photograph it, add a *maths inside* sticker and title, and write a commentary that explains what you have found?

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