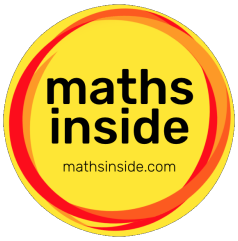

> This resource is part of a suite of materials and activities created to inspire entrants, and support teachers, and parents to enter *maths inside*: a photo competition open to everyone in Scotland. *maths inside*: see different, make connections, celebrate!

In this series of example submission journeys, you can find details of searching, questioning, and discovery of *maths inside* the things and spaces around us! Follow these stories and learn how to catch the beauty of a discovery in a photo, title and commentary (linked activities and resource pack).

Visit mathsinside.com for entry details, further information, and follow us for updates!

Below, this example documents the submission journey for an **Senior Phase (S4–S6)** entry (credits).

Trees within trees: Symmetry Inside | Senior Phase example submission journey

I've always been interested in learning about symmetry since I was wee. I love seeing it appear in my school subjects in fascinating ways! There is symmetry in molecules in Chemistry, cells in Biology and even in poems in English!

For my submission for the maths inside competition I want to look at the symmetry inside unexpected things around me, so I started by having a look at the houseplants on my windowsill. I took a picture of one, and stuck a maths inside sticker on the front to begin my submission.

Can you see the symmetry in this plant? What if we look at certain parts of the plant, its leaves, or its stems? For example, how many leaves come out at a time, and where do they come out from? What about the stalks themselves, do they follow any pattern along the main "trunk" of the plant? After studying it a bit more, trying to answer my questions, it is time to begin my submission.

I will title this entry:

> "Secret Symmetry"

and my commentary will be:

> "My jade plant shows off an interesting kind of symmetry. Two leaves are produced at a time, and between each pair of leaves, they rotate by a quarter turn around the stalk. The smaller offshoots from the main stalk also rotate around the main stalk."

Now that I have begun my submission, I can think about asking myself some more tricky questions so that I can really explore my idea. I spoke about a pattern in my commentary, but I didn't explore why the plant follows a pattern at all. Why this pattern, and not another? How does the plant itself know how to make this symmetry? What about other plants, what kinds of symmetry do they exhibit? Is there a preferred kind of symmetry across different plants?

Aside from questions about my commentary, I have to keep in mind that this is a photo competition

and so, in order to win, I need a great photo! How visible are the patterns I am referring to from the picture alone? What about the quality of the photo? How can I make it so that it is easier to focus on the subject and spot the patterns? What should be in the background of this picture? Where should I position the camera, and why?

Spending some time thinking about these questions, talking to my friends about it, and doing some research to answer the questions I can't figure out myself, I can now polish my submission. One thing that interested me was that my friends have different ideas of symmetry from their own subjects and experiences. I was told that in classical music, composers played with symmetry to develop a theme and explore its variations. This inspired me to look for some unique examples of symmetry in the natural world. So, instead of taking a better photo of my subject, I decided to go for a walk to visit a garden where I could find some better examples.

This leaf has a unique kind of symmetry. Can you spot it? Start at the centre of the leaf and look at the white veins. At first you can go in 6 different directions. Choosing any of these and moving along it, we meet another junction, this time with 3 directions (including the one we came from). Moving down one of these paths, it appears as if the vein splits into 6 directions again! I did a search online into the maths behind leaf veins, and found an article that said they form something called a fractal, which is a kind of mathematical pattern that repeats itself the closer you look. As it turns out, the kind of fractal

on the leaf is, funnily enough, called a tree!

Now to refine my entry, I'll change the title to:

> "Trees within trees"

and I'll write a short explanation of my photo and the maths inside it:

> "Certain plants show off some interesting examples of symmetry. For example, this leaf has veins which form a mathematical tree! This kind of structure is called a tree in maths because of their resemblance to trees in real life, and these are examples of fractals. Fractals are kinds of patterns which have a special kind of symmetry called self-similarity. Plants like to maximise the sunlight they receive, or how efficiently they can transport nutrients, so they make use of clever patterns and symmetries to allow them to do this. In maths problems, understanding the symmetry of a system often helps simplify the solution, so it makes sense that plants would want to make their job easier and implement some symmetry to solve their problems too."

Now I am ready to submit my entry to the competition!

further things to think about

THINK: add?

Open to all ages with prizes in each level. You only need a mobile, the internet & curiosity! Enter maths inside *on your own or as a team, mind to add the maths inside sticker, and submit in one, or in as many categories as you like. The photo should be your own, without changes, and for a chance to win, cannot be shared anywhere else. View the T&C for more information, and please do get in touch if you have any questions.*

linked activities and resource pack

Complementing each journey is an example interdisciplinary learning (IDL) activity matched to Curriculum for Excellence experiences and outcomes (Es&Os). Also available are image banks containing images and questions to inspire interdisciplinary investigation and learning. These resources and activities are all available in a downloadable pack.

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, Education Scotland, and Dr Andrew Wilson (*maths inside* Founder and Director).

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The photos above are credited to Christopher Johnson.