



# Purposeful Paper Folding

By Fran Watson

*In this article, which is part of our [Puzzling with Paper Feature](#), Fran describes her passion for paper folding as a springboard for mathematical exploration. She outlines the positive learning opportunities (in terms of both subject content and positive learning dispositions) provided by paper-folding activities and draws attention to several tasks on the NRIC site.*

Very often mathematics is viewed by children as being about numbers. Some children suffer from the misconception that it is *only* about numbers and if their numeric ability hasn't resulted in an enjoyment of learning about numbers to date, they might be inclined to label 'mathematics' as uninteresting and therefore risk missing out on the beautiful world of geometry waiting to be discovered. The awe-inspiring wonder of patterns, shapes, visual proofs and possibilities that could be explored in classrooms and can lead to, at the least an appreciation of, and at best a fascination with, the mathematics we see in the world around us every day.

I have been influenced by many exciting teaching ideas over the years, but the one which has really taken hold and had, I think, the greatest impact in my classroom has been the use of paper folding in my teaching of maths. It has enthused, calmed, inspired and delighted both colleagues and children alike and I have become a passionate advocate of its benefits.

After several years of trying things out to see what worked and then adapting, adjusting and developing those activities that seemed to offer the richest opportunities for learning, I discovered that there was a whole population of people who felt the same. I was captivated by the regular form of a 3D origami model made by another delegate at an Easter maths teachers' conference and became completely absorbed in how to build one. I was inspired by the myriad of 2D paper folded patterns that Liz Meenan shared at a Cambridgeshire Maths Conference and wanted to create my own. I reasoned that if I was hooked by the beauty of the folded form and curious about the designs, then my learners would be too. So I started to explore further.

It turned out there was a body of research on the subject, that there have been six International conferences on Origami in Science, Mathematics and Education held all over the world since 1989 and that these people also knew to be true the things I was discovering in my classroom. The activities in [our Puzzling with Paper Feature](#) provide ways in which to develop some of the following positive learning opportunities:



- Practical and purposeful collaborative activity is an essential part of a curriculum that seeks to develop problem solving and creativity. (Challenge 1 in both [Paper Patchwork 1](#) and [Folding Flowers 1](#), for example, offer the chance to create and explore within given constraints.)
- That origami is an accessible endeavour that provides challenge in both these areas for a wide age range (Frigerio, 2002; Haga, 2002; Cornelius and Tubis, 2009; Pope and Lam, 2009; Hull 2006 all in Pope and Lam, 2011) and helps to develop fine motor skills in young children and refine them in older learners. See also Froebel's work on Kindergarten education (Heewart, 1992 in Pope and Lam, 2011).



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- That encouraging collaboration and discussion amongst students of all ages can help to develop their confidence and understanding.
- That unfolding and re-folding origami offers learners the opportunity to work out how a model has been constructed and recreate those steps for themselves.
- That looking at 2D designs to 'see' what shapes can be identified will develop creative learners, open to new ways of looking at things and dispel the mathematical myth that there always has to be one right answer. (Challenge 2 in [Paper Patchwork 2](#) and [Regular Rings 2](#) provides photographic examples in the Teachers' Resources, of the sorts of designs that can be created and talked about, to 'see' new shapes.)
- That when children are encouraged to collaborate, promoting a 'those who can, help others' approach, this develops fluency of vocabulary in the describer and requires perseverance from both learners.



Students who find the accuracy of folding challenging can be urged to reflect on their own experience of other physical skills learnt: "Do you remember learning to walk? Did you learn without making mistakes then? Did you fall over a lot? How did you improve? Do you now walk around without really having to think about it? Look at how skilled you've become at something that you practise every day!" and shown that practice really

does produce progress and that their perseverance will also develop alongside their precision and fluency of folding, without the barrier of being mentally 'stuck' (i.e. they know what to do to improve).

It didn't seem to matter in my classroom that the problem solving taking place was often unconnected with 'real life' mathematics. The children were motivated by the end product of the model or design they were creating and even those who didn't want to 'take it home' once complete, were demonstrably proud of their individual and collaborative efforts.

In an article illustrating the use of origami in teaching geometry (Pope, 2002 in Pope and Lam, 2011) students are given two models, encouraged to leave one assembled but to deconstruct the other in order to work out how it was made. Crucially they are given no other instructions and when/if mistakes occur (pieces look slightly odd or don't quite fit together in the same way that their complete model does) they are expected to puzzle it out together, rather than looking for input from the teacher. This approach, coupled with the task of 'explaining with as few words as possible' what they have learnt on a poster, to be used by another class who haven't yet made/seen the models they were given, results in a variety of responses. Students reflected on those parts of the task they had found trickiest in order to communicate these clearly to others and, ironically, talked in more detail than expected about how to show what they had learnt using as few words as



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possible. This offers a new challenge and change of direction for my existing origami lessons but one that I am happy to take up.

Refining/tweaking these activities is an on-going process after each lesson, workshop, staff meeting or conference. Experience showing you, literally, a new folding mistake which can then be used to highlight a possible difficulty to be avoided/overcome/learnt from. Overhearing students use new vocabulary or old vocabulary in new ways, to perfectly illustrate their understanding and then being able to share that with other learners, is delightful. As is reveling in the opportunity provided to children to develop their reasoning and problem solving. My biggest shift over the years of using origami as a teaching tool in maths, has been to alter the focus from simply recreating a beautiful or interesting object (and following/making sense of instructions whether verbal, written or demonstrative) to developing learners' curiosity about something they see, asking them to pose questions about it, fostering the thoughtfulness needed to plan how they might do it for themselves and encouraging the perseverance that carries them towards their goal.

One of the reasons for recommending mathematical paper folding so unreservedly is the serenity and joy that those involved exhibit. Learners, whether adult or child, become completely absorbed, often to the exclusion of other usual classroom distractions (each other, the bell, snow ...!) Focus, particularly for those who usually struggle to maintain it, is supported by the demands of a physical task and the satisfaction of a problem solved or design constructed from their own ideas, more than compensates for the potential frustrations felt along the way.

The activities in this feature aim to provide all manner of opportunities for you and your learners to develop your creativity and problem solving skills simultaneously. I hope you too will decide that paper folding in our mathematics classrooms should not just be for Christmas!

## **References**

Pope, S. and Lam, T. K. (2011) In: P. Wang-Inverson, R. J. Lang and M. Yim (eds). *Origami*<sup>5</sup>. Boca Raton: CRC Press.