G.A.T.E.WAYS

invites gifted Year 5 and 6 children

with a love of maths to

'Pop Up Power..

..the mathematics of paper engineering'

G.A.T.E.WAYS is an independent organisation offering challenging and enriching activities and experiences to develop and extend highly able children. Established in 1994, G.A.T.E.WAYS runs a range of stimulating school programs as well as the Saturday *Brainwaves Club*. This *JOURNEY* for both girls and boys will run over four sessions. Skyscrapers rise from the gutter. Characters stand up, move a limb. Eyelids wink, lips open and close. Objects dangle, spin, and fly past each other. Open a modern pop-up book and a seemingly two-dimensional page transforms itself into a rich three-dimensional world. The minds behind paper engineering—as the discipline is called—must solve several kinds of problems at once. Building an intricate world with moveable parts out of paper is one marvel. Making it entirely collapsible is another. The mechanism used produces a whole range of exciting possibilities and movements such as translation, rotation, reflection and enlargement.

As physicist Robert Lang once said, "Anything can be made with..(paper-engineering)..from birds and bugs to stents and space telescopes. It's just a matter of math." In this paper-engineering program we will aim to create some paper masterpieces. The process of planning and construction will allow for building imagery, testing prediction and, connecting to geometric concepts. We will explore how to make things strong and how to make complex, interacting objects. We'll find out all about angles and shapes in 2D and 3D. Maths has never been such fun!

Requirements: Bring a ruler, a set square, a compass, protractor, a good pair of paper scissors (not fabric scissors or rounded-end scissors), some pencils, a pencil sharpener and an eraser. If you are left-handed, a pair of left-handed scissors is a good idea. Also bring, a snack (no nuts please), a small photograph (of the enrolled child), and a stamped, self-addressed DL envelope for your report.

Session 1: Hungry, hungry Hippos and Lions and Wombats

Long and short beaks and snouts, mouths with teeth and tongues and perhaps a bit of drool! Our first introduction to creating moving models with paper will be animal-mouth pop-ups. Every animal has a different shaped mouth and we will be investigating how adjusting lengths and angles will change the mouth and how it moves. Can you position your snout just where you need to? Are the angles and folds exactly where they should be? The challenge today is measuring, folding and cutting with mathematical accuracy with the aid of a set square, ruler and compass. If you work carefully you will come home with more than one pop-up card with an opening mouth. Raaawwwwrrrr!

Session 2 : Flap and Flop the pop-up card

Pull that tab with the arrow on it. What happens? We will use measuring and geometry to make a tab-style pop-up card. Use a protractor to accurately measure and draw lines and angles. Use a compass to measure lengths, ready to cut and make it pop! Bring your artistic flair and imagination as well: once we have completed one simple flip-tab pop-up you will have a chance to design your own. Can you work out what the new measurements will be, and how you will draw and cut the pieces? What happens when you pull on the tab? If you've got the measurements and angles all correct, it should work like clockwork.

Session 3 : Geometric Origami

Challenge yourself to explore the world of geometry to be found using paper. You will learn how to fold some perfect regular shapes like octagons and hexagons just by using a piece of square paper: no protractor, compass or ruler allowed! Test out your folding skills by tessellating your shapes to make a pattern. Will they fit together? Are the angles just right? To bring all of this into three dimensions, we will find different ways to make some cool geometric shapes by slotting pieces of paper together. It's kind of like making your own lego out of paper - how many different geometric shapes are possible? It's all up to the angles!

Session 4 : Put it all together and make it!

Put together the Geometry of 3D shapes we learned last week and the pop-up skills of the previous two weeks and we will be able to build some awesome moving paper cards or even moving 3D paper toys. You'll be amazed at what people have made with paper - moving toys, pop up artwork and a huge range of different origami that can move and change shape. You'll need imagination, the skills you already have and a bit of assistance to work your way through one of several projects. Take your creation home and show everyone your maths and paper-engineering skills!

Work requirements & Assessment

Children may be asked to complete some homework between sessions.

At the end of the program a short, written report will be completed on each student and forwarded home to parents.

About The Presenter

Emma Carter has studied Mathematics and Physics at the University of Melbourne. She has taught secondary school maths up to VCE and worked at Scienceworks as well as The Discovery Science and Technology Museum. She enjoys presenting science and mathematics workshops with G.A.T.E.WAYS.