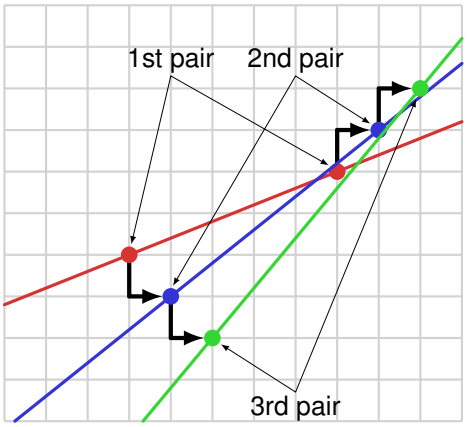
Australian National University

AUSTRALIAN MATHS TRUST

String art, paper folding and gravity

Part 1 – String art

For this activity you will need: a pencil, a ruler and a blank sheet of grid paper – any size square grid will do.



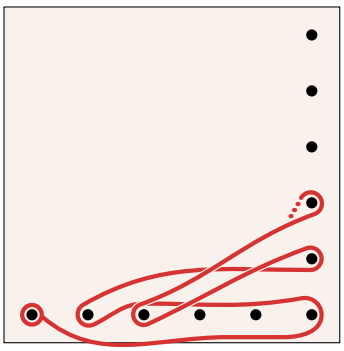
- Start by choosing any two points on the grid (shown red). For best results, make sure they are at least 5 cm apart and avoid having one directly above the other. Also choose a pair which is a bit different to your classmates' so that you can compare results.
- Rule a line through your points, extending to the edge of the page in both directions (shown red).
- From one of your chosen points, move along the grid one unit **down** and one unit to the **right**. From the other point, move one unit **up** and one unit to the **right**. This creates a second pair of points (shown blue). Rule a line through them as before.
- Repeat the previous step, continuing to move down-right and up-right from one pair of points to the next (shown green, and so on).
- When you have done as much as you can in this direction, go back to the original pair of points and start again in the opposite direction: up-left and down-left, respectively.

As you add more and more lines, a shape should start to emerge.

How does your shape compare to your classmates' shapes? Did anyone make one that was 'upside down' compared to the rest?

Explore more connections here: `www.geogebra.org/m/nqzpps2z`

Why did we call this 'string art'? It is based on the same idea as an artwork created by weaving string around pegs on a pegboard or nails on a block of wood, as shown. If you have access to these materials, try this version too. Don't forget to pull the string tight!



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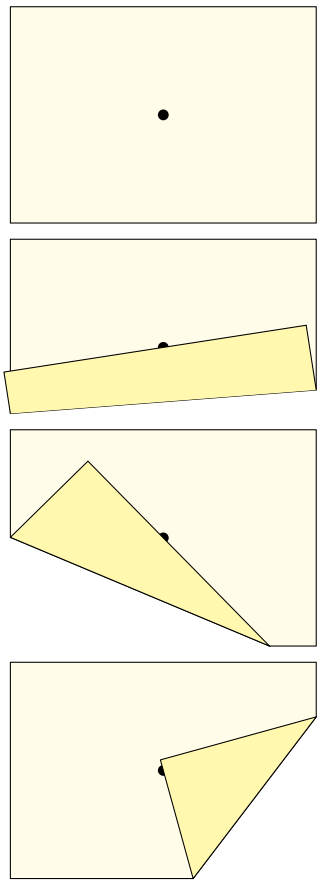
Part 2 – Paper folding



For this activity you will need: a pencil and a blank sheet of paper.

- Place the piece of paper sideways in front of you.
- Put a dot somewhere near the middle of the page. Choose a position which is a bit different to your classmates so that you can compare results.
- Fold the bottom edge of the paper up so that it exactly meets the dot. This can be done in lots of different positions – just choose one and make a sharp crease in the paper.
- Now unfold the paper and repeat the previous step, choosing a different position where the bottom edge meets the dot.
- Repeat as many times as possible, using different positions all the way along the bottom edge.

As you make more and more folds, a shape should start to emerge – sound familiar?

How does your shape compare to your classmates' shapes? To get a steeper curve, should the dot be moved closer to the bottom edge or further away?

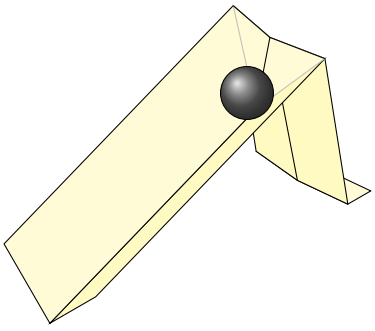
Explore more connections here: `www.geogebra.org/m/t9qjscrj`

Part 3 – Where have you seen this shape before?

Throw a ball to a friend. Better yet, watch from the side as two friends throw a ball to each other. The path that the ball follows is a *parabola*. Remarkably, this is the same shape that is formed in Parts 1 and 2!

The angle and speed at which the ball is thrown affects the precise shape of the parabola, just like moving the dots in string art or paper folding. The straight lines in these activities are the *tangents* to the parabola: they touch the curve without crossing through it. Tangents represent the direction that the ball is travelling at each instant as it moves through the air. Studying tangents in detail requires tools such as the discriminant of a quadratic or calculus.

To use gravity to draw a parabola, you will need: a large sheet of butcher's paper, sticky tape, strips of stiff cardboard, a marble and some paint (plus all the usual clean-up gear).



- Tape the butcher's paper to the desk and prop up the back legs so there is a gentle slope towards you.
- Make a ramp: fold a strip of cardboard lengthways and make two more folds at one end to form the support.
- At the bottom of the paper, aim the ramp towards the back of the desk on a slight angle. Roll the marble down the ramp and make a note of the path it follows.
- Experiment with the length, height, position and angle of the ramp and the angle of the desk. When you've found a path you like, dip the marble in a little paint and roll it again.