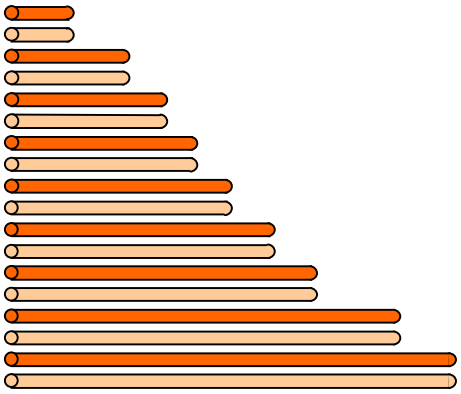
MAKING A PARABOLA WITH SPAGHETTI

The SKA will be created using thousands of radio telescopes all working together. All radio telescopes have the same shape dish. This shape is called a *paraboloid.* You can make a *paraboloid* by getting a *parabola* and rotating it around its centre.

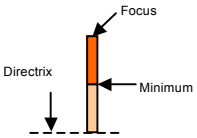
Whilst it is fairly easy to plot and draw a parabola on graph paper, it is not the only way to do it. Here's a more *investigative* way of making one.



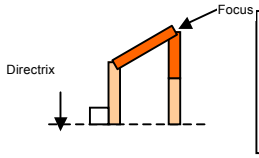
You can make a parabola by using lengths of spaghetti, straws, or strips of paper. You will need about nine pairs of spaghetti of increasing length.,

This activity makes use of the definition of a parabola as "the locus of points that are equidistant from a line and a point not on the line".

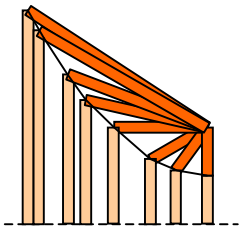
The line is called the *directrix* and the point is called the *focus*.



Start by placing the pair of shortest lengths of spaghetti on top of each other. Draw a line perpendicular to the bottom of this pair - that will be the directrix. The top of the pair will be the focus of the parabola. Where the two lengths meet is the minimum of the parabola.



Take the next shortest pair of spaghetti pieces and place an end of one piece at the focus, and the end of the other on the directrix. Find where the two pieces join. Make sure the spaghetti that touches the directrix stays perpendicular to it. Mark where the two pieces of spaghetti meet.



Continue placing the other pairs of spaghetti. Make sure that for each pair, there is one length that touches the focus, and one that's perpendicular to the directrix. Join the marks of where the lengths meet, and you will draw an approximation of a parabola. The more points you have, the closer that approximation will be.

Whilst any set of lengths will generate a parabola, an easy set to start with is (1, 2, 5, 10).

- The lengths of 1 stack vertically, giving the focus (the top of the two lengths), the minimum (the middle) and the directrix (perpendicular to the bottom). The directrix therefore is going to be one unit length underneath the minimum of the parabola.
- The lengths of 2 will form a square with the focus as a corner, and a section of the directrix as a side.
- The lengths of 5 will form a (3,4,5) triangle - the hypotenuse will be 5, the long leg will be the horizontal distance from the focus, the short leg will be the vertical length from the focus. Similarly, the lengths of 10 will make a (6, 8, 10) triangle.

This gives you four points on the parabola. If you build this parabola on graph paper, you can then easily investigate how the gradient of the parabola changes the further one travels from the minimum.

It also gives you the co-ordinates for these points, making it easy to determine the equation for the parabola.

How does this equation relate to the positions of the focus and the directrix?