SPIRAL GALAXIES

There are galaxies out in space that look like spirals. In fact, our galaxy, the Milky Way has recently been shown to be a spiral galaxy.

One of the things that *SKA* will help us do is determine how galaxies form spirals.

Mathematicians study shapes like spirals, and because they can act like flat springs, they get used in a lot of different ways. They're handy shapes to know about, and look awesome too!

How to draw a spiral

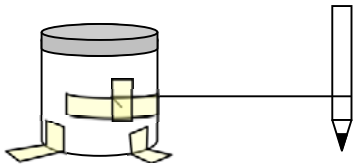
There are many different spirals, and many different techniques to draw those spirals. The sort that is probably the easiest to draw is called an *Archimedes' Spiral*. Here are two different ways to draw one...

From Outside – In.

You will need:

- Paper- we started with a piece of newspaper
- Sticky tape
- String (about 30-40 cm)
- Pencil
- A glass (or other cylindrical object, e.g. bottle lid)

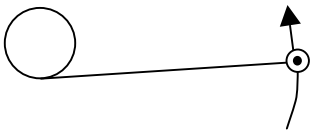
What to do:



Tie one end of the string to the pencil. Use the sticky tape to fix the other end to the side of the upturned glass.

(You may also want to tape the glass to the piece of paper. This will help stop the centre from slipping as you draw the spiral.)

Whilst keeping the string tight, start moving the pencil across the page. As the string winds around the glass, it will pull the pencil closer and closer to the glass. That's what an *Archimedes' Spiral* is- the distance between the arms of the spiral is constant.



You won't quite get to the centre of the spiral with this technique. However, it does allow you to explore what happens if you use different sized cylinders, or even different shapes.

What do you think might happen if you use:

A narrower glass as the centre piece? A wider one?

A square centre piece? Is that going to be different to a rectangular centre piece? What about a triangular piece? Make a prediction and test it.

From Inside – Out

Using the fact that for each degree the spiral turns through, the distance from the centre increases by the same amount, we can draw great approximations of spirals.

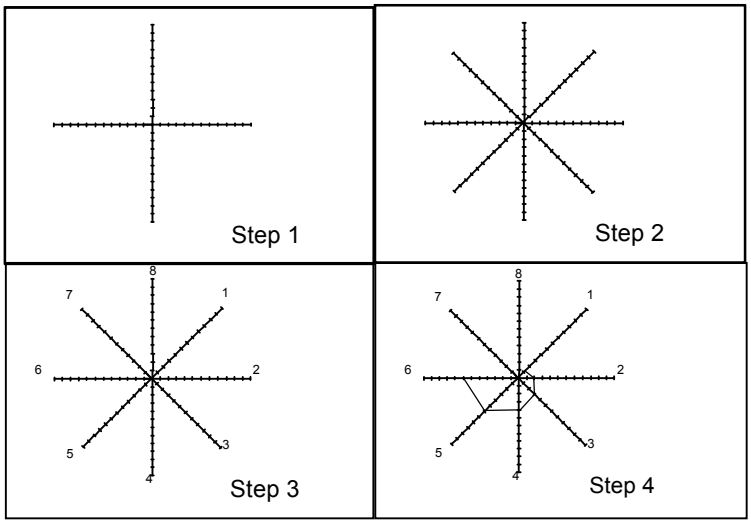
What you need

Paper Pencil Ruler

What you do

1. Draw two lines (axes) in the middle of the page. Mark off each centimetre.

2. Whilst we can draw a spiral at this stage, it may look a little *angular*. If we add another set of lines, the spiral will look much smoother…



3. Label each line, much like a clock. In this example, as there are only 8 lines coming from the centre, so we can label the lines 1 to 8.

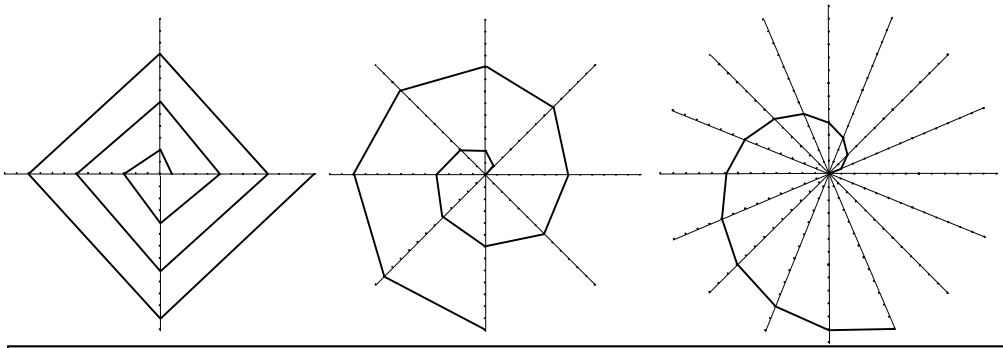
4. To make the spiral, we need to join the 1st point on line 1, the 2nd point on line 2, 3rd on line 3…

When you've gone all the way around, you join the 8th point on line 8 to the 9th point on line 1 and continue. This gives an opportunity to investigate *modular arithmetic*.

You can look at 9 as 8+1; 10 as 8+2; 11 as 8+3.

Thinking of division, you can see that 9 ÷ 8 = 1 rem 1 ; 10 ÷ 8 = 1 rem 2; 11÷8=1 rem 3. The first number (the *quotient)* is how many times the spiral has turned completely, and the remainder tells you which line spiral is at.

For example, as 452÷8= 56 rem 4, you know the 452nd point will be 56 *turns* out from the centre and on line 4.



Increasing the number of lines coming from the centre makes the spiral looks much smoother. However, in these examples you can see the spiral is becoming much less tight. Can you think of what to do with the number of dots on the lines to overcome this?