

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

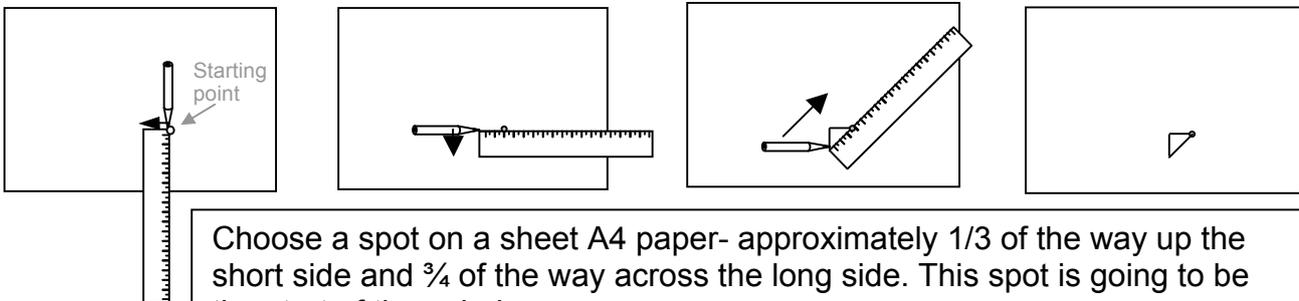
There are many different types of spirals, and many different techniques to draw those spirals. This sort of spiral is called a 'square-root snail', or *Spiral of Theodorus* after the ancient Greek mathematician who first worked with them. What's special about this spiral is how the distance from the centre grows at each new point of the spiral. Starting at $\sqrt{2}$, the distances from the centre are $\sqrt{3}$, $\sqrt{4}$ (or 2), $\sqrt{5}$, $\sqrt{6}$, $\sqrt{7}$, $\sqrt{8}$...

Can you prove it?

You will need:

- Paper
- Pencil
- Ruler, or set square

What to do:

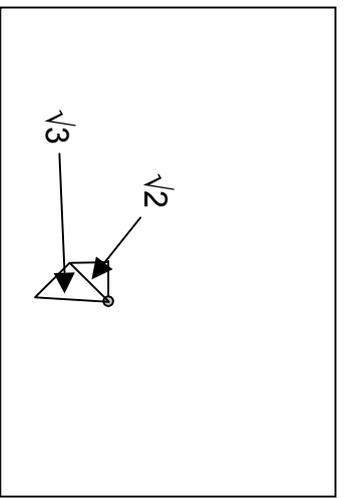
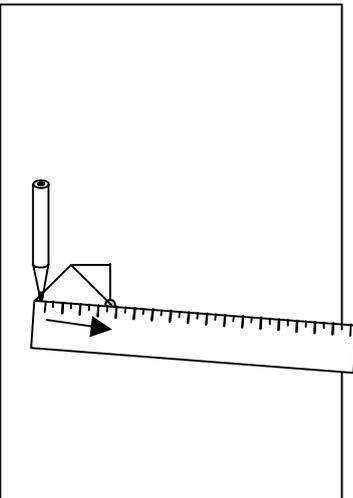
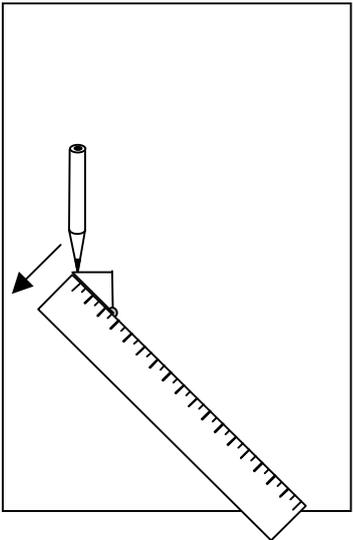


Choose a spot on a sheet A4 paper- approximately 1/3 of the way up the short side and 3/4 of the way across the long side. This spot is going to be the start of the spiral

It's worth noting that this position was chosen whilst using a 15 cm long, 2.7 cm wide ruler. The best starting position will depend on the size of the ruler you're using. Finding it is an exploration well guided by your intuition.

The first line you draw sets the scale of the spiral- we can call it a unit length. To draw this sort of spiral, we'll need to draw quite a few lines that are exactly the same length. To do that easily, it's a good idea to use a template. We used the width of the ruler- which is much easier if you have a ruler that doesn't have rounded corners. There are many alternative devices that you could use- anything with a right angle and a side length of between 1 and 4 cm (eg square counters) will be convenient for this activity.

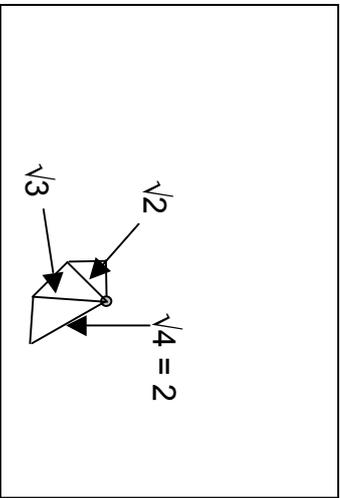
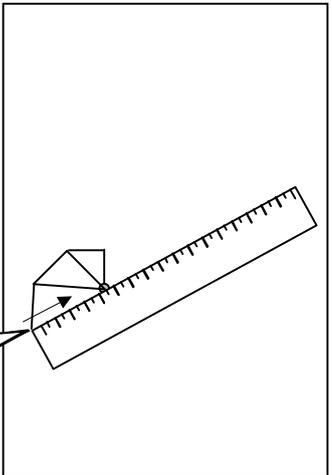
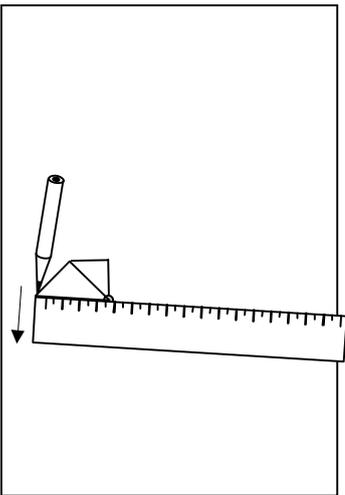
With your chosen template (in the example, the ruler), draw the first line – the unit length. Using the template, draw a line of the same length at 90° from the end of the first line. You've made 2 legs of a right angle triangle- join them by drawing the hypotenuse. The starting point should be one of the 45° corners of this triangle.



Use the template to add another unit length at right angles to the first triangle's hypotenuse. That means we've got 2 legs of a new right angle triangle, so you can add the new hypotenuse, and repeat the process...

As long as you keep adding unit lengths at right angles to the most recent hypotenuse, you will quickly draw out the spiral.

What happens if you use a different angle? You might find that angles greater than a certain value give rise to spirals that go outwards, and that less than a certain value spiral inwards... What angle do you think that is?



Repeat this many times

