

## [Investigating filling jugs with Scratch]

When thinking about how the water height changes as we're filling jugs, we have a few intuitions to help us. Basically the wider the jug, the longer it will take to fill. But sometimes the width can change. We have diagrams of vases that change either suddenly, uniformly, or at differing rates in the case of round jugs.

Once again, we can utilise scratch to help us watch this happen dynamically and investigate.

There's two pencils here. One of them is going to act as filling the jug. The pencil drawing represents water entering the jug. Then the other pencil is going to draw a graph, modelling the height filled so far as time passes.

To make the pencils draw from the tip rather than their centre, we just needed to edit them and align the tips at the centre.

Now the way this code works, is we set the width and height and then ask the pencil to draw. Each time it draws, we add 1 to the time, and we set the filled so that each time it draws a row, it'll increase by 1. When we run it, we can see it tracing out a rectangle and the right hand pencil draws a straight line, because the height is increasing at a constant rate.

If we decrease the width, we can see that the right hand pencil goes upwards at a faster rate, while if we increase the width, the slope is less steep.

Now we can also add a bit of code in so that the width keeps on changing. In this case we start at 10, but then increase the width by 1 after each row is drawn. This gives us the triangle or trapezium shaped jugs. The graph drawn in these cases decreases in slope as time passes, because it takes longer and longer for the pencil to draw a row.

Another block of code can make it so that the width changes suddenly after the height reaches a particular point. In these cases, the graph is composed of straight segments, each at a different but constant gradient.

Then finally we have some code that draws round jugs. In this case the slope decreases as the width increases, but then starts to increase again once the width starts decreasing.