NRICH

The Golden Ratio

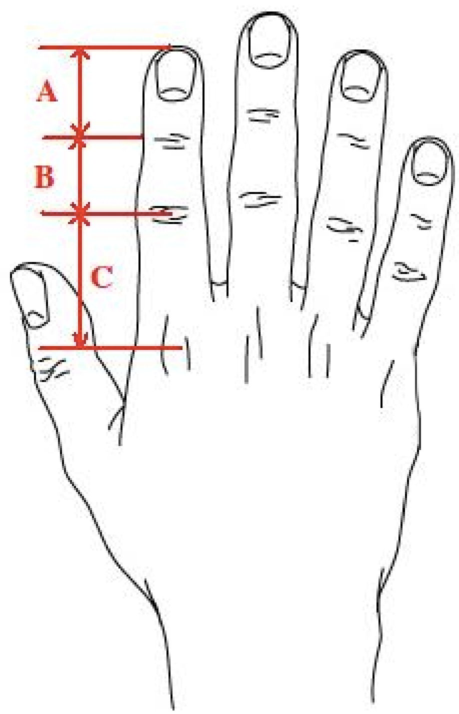
Age 11 to 14
Challenge Level

The Golden Ratio and the human body

This exercise is divided into 3 parts:

A. The golden ratio
Measure the following:

Distance from the ground to your belly button
Distance from your belly button to the top of your head
Distance from the ground to your knees
Distances A, B and C
Length of your hand
Distance from your wrist to your elbow



Now calculate the following ratios:

Distance from the ground to your belly button / Distance from your belly button to the top of your head
Distance from the ground to your belly button / Distance from the ground to your knees
Distance C / Distance B
Distance B / Distance A
Distance from your wrist to your elbow / Length of your hand

Write all your results on the following table:

Student name	Ratio 1	Ratio 2	Ratio 3	Ratio 4	Ratio 5
...					
Average					

Can you see anything special about these ratios?

B. The fibonacci sequence

Now look at the following sequence of numbers:
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89...

The following number is the sum of the previous two. This is Fibonacci's sequence.

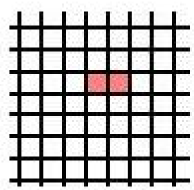
Now do the following ratios on a calculator and give answers in non-fraction numbers:
1/2 =
3/2 =
5/3 =
8/5 =
13/8 =
21/13 =
34/21 =
55/34 =
89/55 =

As you go on and on dividing a number in the sequence by the previous number you get closer and closer to the number you discovered in the first part of the exercise, phi = ϕ = 1.6180339887498948482.

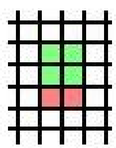
C. The golden rectangle

We can also draw a rectangle with the fibonacci number's ratio. From this rectangle we can then derive interesting shapes.

First colour in two 1x1 squares on a piece of squared paper:

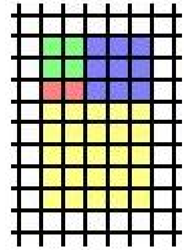


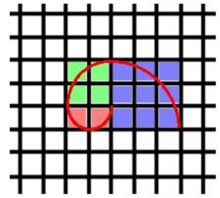
Then draw a 2x2 square on top of this one:



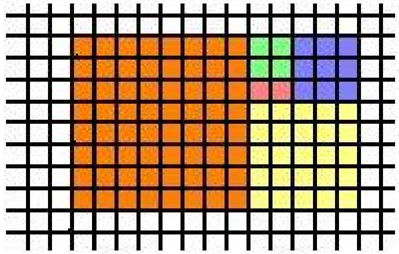
Then draw a 3x3 square to the right of these:

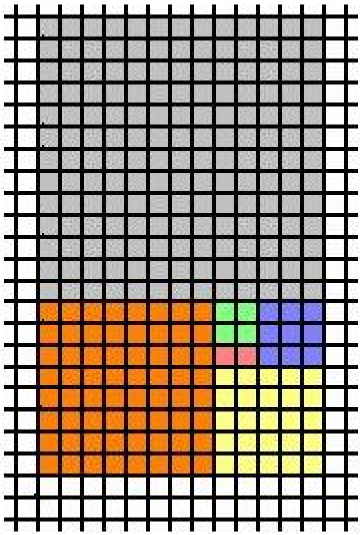
Then draw a 5x5 square under these:





Then draw a 8x8 square to the left of these:

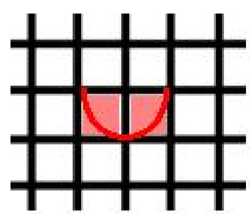


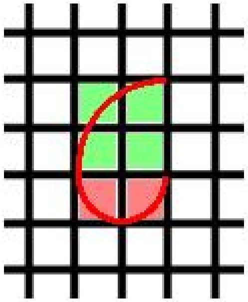


Then draw a 13x13 square on top of these:

We could go on like this forever, making bigger and bigger rectangles in which the ratio of length/ width gets closer and closer to the Fibonacci number.

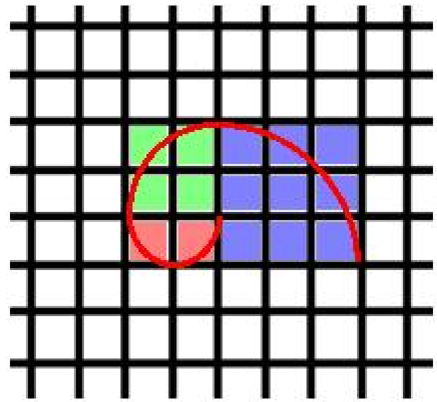
Let's try making a more interesting shape, going back to our first 1x1 squares and using a compass, place the compass tip on the top right hand corner of the right hand square and draw a semi circle like this:



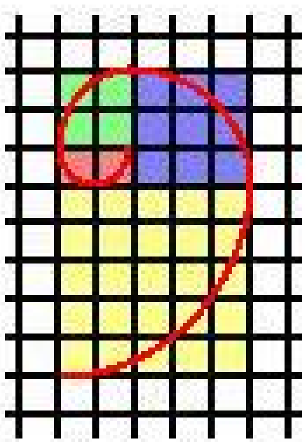


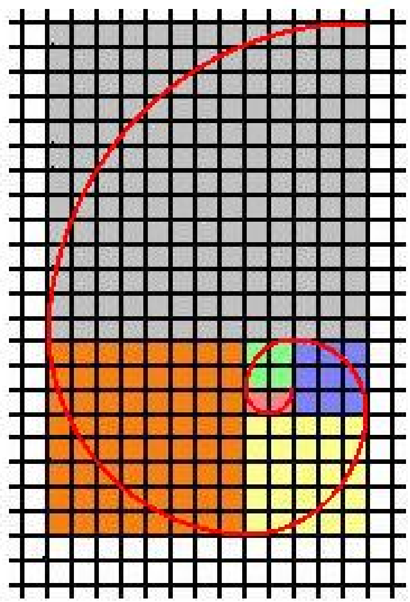
Then place the compass tip on the bottom left corner of the 2x2 square and draw an arc like this:

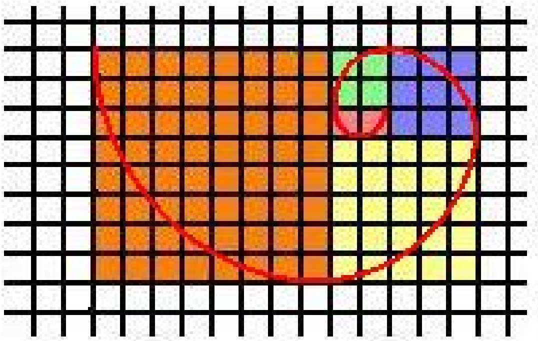
Then place the compass tip on the left hand, top corner of the 3x3 square and do the same:



Do the same for the other three squares to obtain:







This shape is widely found in nature, can you find any other examples?