

Constructing a Nautilus Shell and Looking for the Golden Ratio

1. The Fibonacci numbers are a pattern that has been studied for years. Notice that the pattern begins with two of the same number. Then to get the third number in the pattern you add the first two numbers ($1+1=2$). To get the fourth number you add the second and third numbers ($1+2=3$). What will the fifth number be? You add the third and fourth numbers ($2+3=$ ___) Continue this pattern and find the next 12 numbers.

1, 1, 2, 3, ____, ____, ____, ____, ____, ____, ____, ____, ____, ____,

2. Use your calculator to find the ratio of two consecutive numbers. The chart has been started. You need to complete the top row based on your Fibonacci Sequence. Then fill in the chart below:

ratio	1/1	1/2	2/3	3/	/	/	/	/	/
decimal									
ratio	/	/	/	/	/	/	/	/	/
decimal									

Notice that the decimal you write each time is getting closer and closer to a particular number. You should see that all the decimals are approaching 0.618. This is fantastic. This number has been used for years in design. It is called the golden number.

3. Now let's see how that can be related to something geometrically.

Pictured on the next page is a piece of graph paper. It is a golden rectangle. The width and length of the rectangle are two Fibonacci numbers. Which two numbers are they?

_____ and _____ Notice these two numbers give you almost the golden number when you divide them.

Draw a vertical line dividing the rectangle into a **square on the left** and another **rectangle on the right** of the square.

Look at the new rectangle, which also a golden rectangle. What are its dimensions?

_____ and _____

Draw a line separating it into a **square on the top** and **another rectangle below** the square.

Look at the new rectangle. It is also a golden rectangle. What are its dimensions?

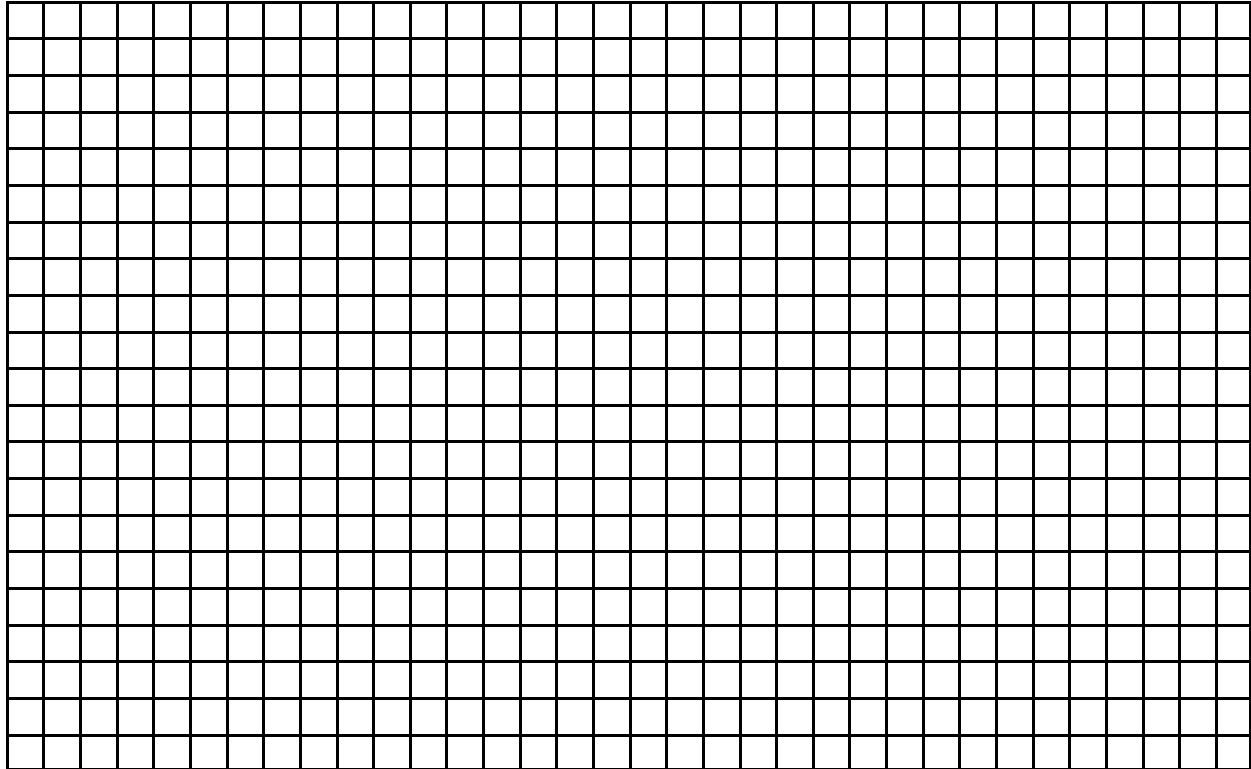
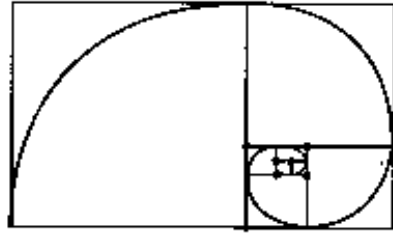
_____ and _____

Separate the new golden rectangle into a **square on the right** and a **rectangle to the left** of the square.

Separate the new golden rectangle into a **square on the bottom** and a **golden rectangle above** the square.

Separate the new golden rectangle into a **square on the left** and a **golden rectangle on the right** of the square.

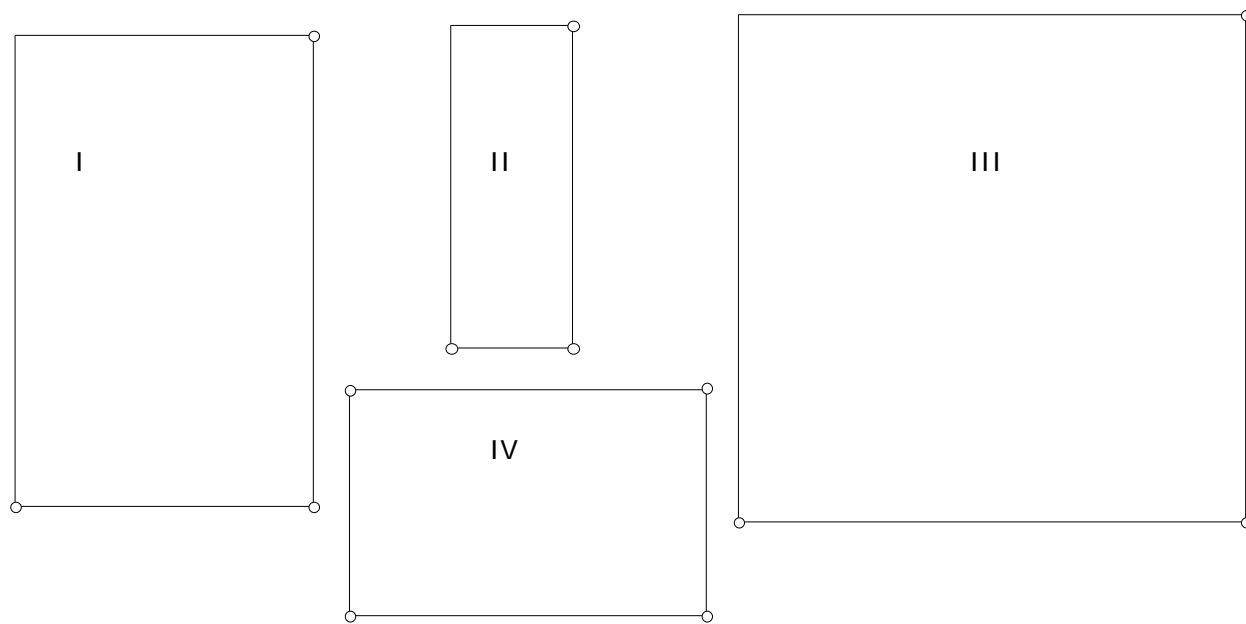
Using this diagram as your guide, can you construct a golden spiral in the golden rectangle using a compass. Begin by drawing a quarter circle arc in the largest square as shown in the diagram. Then draw an arc in the second largest square the same way. Continue until the arcs are too small to draw. REMEMBER EACH TIME YOU ARE ONLY DRAWING A QUARTER CIRCLE, BUT YOU ARE CONNECTING IT TO THE PREVIOUS ARC.



- This spiral is called a nautilus shell.
- It is visible in nature:

4. The golden number or golden rectangle is used throughout nature and architecture. Look at each of the rectangles below.

- Which two rectangles are more pleasing to the eye? _____
- Measure the length and width of the rectangle. Divide the smaller measurement by the larger measurement. Which two rectangles are closest to the golden ratio? _____
- Did you find that the most rectangles that were most pleasing to the eye were also those whose ratio was the golden ratio?



The golden ratio appears in many rectangles in the Parthenon. Trace a couple of the rectangles. Measure them and check to see if they are in the golden ratio.

