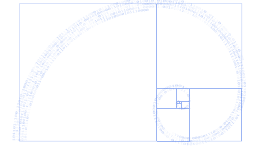


# Fibonacci Sequence and Its Influence on Nature

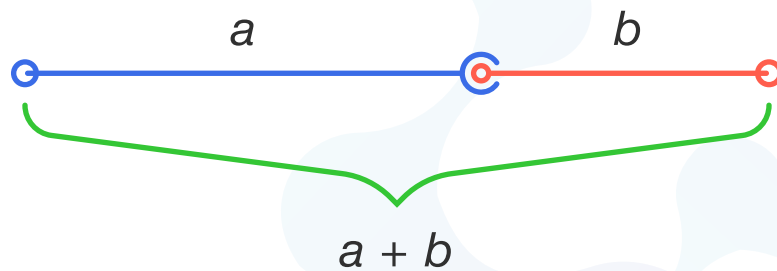


I love nature and believe that it is one of the most perfect things existing on Earth. Rich and harmonious, nature exists according to certain laws, which are, sometimes, unknown to us, humans. The laws of nature are the greatest mysteries bothering and intriguing people for many ages. It turns out that the regularity of natural phenomena, the structure and diversity of living organisms on our planet, everything that surrounds us, striking the imagination with its harmony and orderliness, the laws of the universe, the movement of human thought and the achievements of science, as well as many other amazing things, can be explained by the Fibonacci sequence. The Fibonacci sequence is one of the greatest theories that has been attracting the greatest scientists and philosophers for many ages. Since I am particularly interested in breaking the limits and learning new things, I decided to study this topic in detail in order to figure out what influence has the Fibonacci Sequence on nature. In particular, I decided to explore the relationship of this sequence with nature and other mathematical processes because I realized that this knowledge will boost my competence and increase my learning opportunities.

When I realized that some patterns repeat in nature in various organic materials, I was truly impressed. For me, it was particularly interesting to find out how some plants know how to grow up or form their seeds. Thus, I decided to have a closer look at two related topics, the Fibonacci sequence and the Golden Ratio, which represent the same number, phi (1.618). Whereas it could be a mere coincidence, I realized that this topic requires an in-depth investigation.

We clearly distinguish all the objects surrounding us. We like some of these objects more than others, whereas others do not seem very attractive to us. Sometimes our interest can be caused by a certain life situation, and

sometimes by the beauty and perfection of the observed object. The proportional shape of an object allows getting the best visual perception by causing a feeling of harmony. It should be noted that a holistic image always consists of several parts of different sizes, which are in a certain ratio with each other. As such, the Golden Ratio is the best representation of the perfection of the whole object and its parts in science, nature, and other areas of human life. The following figure represents the Golden Ratio formula:



The proportion of the Golden Ratio is considered aesthetically pleasing and because of this, many artists and architects, including Salvador Dali and Le Corbusier, used it in their works. In photography, for instance, the phi grid is an interpolation of the Fibonacci spiral and today is considered the fundamental method for creating a pleasant composition in the frame. The goal is to align the object with the lines created by the spiral or use it as a separator to create the right feel for the frame.

The relationship between the Fibonacci numbers and the Golden Ratio suggests some ideas about curious patterns surrounding us. These patterns are so interesting that there is a temptation to try to find sequences similar to Fibonacci numbers in nature and even in some historical events.

Nature really gives rise to such assumptions. For instance, one can pay attention to the arrangement of sunflower seeds. If one looks at the sunflower, he or she will see that the seeds are located in two rows of spirals twisted in different directions. This sequence asymptotically tends to some constant relation. Consequently, there is an assumption that the Fibonacci sequence is

an attempt of nature to adapt to a more fundamental and perfect logarithmic sequence, which is almost the same, just starting out of nowhere and going nowhere. Nature, however, requires some kind of whole beginning. In other words, nature cannot create something out of nowhere.

Fibonacci numbers are named after Leonardo Fibonacci from the city of Pisa, Italy. In fact, these numbers were known long before Fibonacci back in ancient India, where they were used in metric versification. However, the Italian scientist managed to support this theory with reasonable explanation taking rabbits for example. The sequence of the Fibonacci numbers is determined by the formula  $F_n = F_{n-1} + F_{n-2}$ . That is, the next number is obtained as the sum of the previous two. The first two numbers are 1, then 2 (1 + 1), then 3 (1 + 2), 5 (2 + 3) and so on: 1, 1, 2, 3, 5, 8, 13, 21...

Of course, such an interesting phenomenon as a Fibonacci sequence attracts attention. Nevertheless, there is something mysterious in this strictly verified regularity. Given its mysterious nature, it is not surprising that the Fibonacci sequence appeared in many works of mass culture. For example, it is mentioned in Dan Brown's best-selling book "The Da Vinci Code." The Fibonacci sequence serves as the code by which the main characters managed to open the safe.

The Golden Ratio and the Fibonacci sequence are closely connected. The ratio of consecutive Fibonacci numbers comes together and approaches the golden ratio, and the expression of the closed formula for the Fibonacci sequence includes the Golden ratio. A Fibonacci spiral or golden spiral is a sequence of connected quarters of circles inscribed inside arrays of squares with sides equal to Fibonacci numbers. The squares fit perfectly together due to the nature of the Fibonacci sequence in which the next number is the sum of the two in front of it.

Believe it or not, but one can find a representation of Fibonacci sequence even in the human body as a part of nature. For example, each bone of the index

finger, from the tip to the base of the wrist, is larger than the previous one by approximately the Fibonacci coefficient 1.618, which corresponds to Fibonacci numbers 2, 3, 5 and 8.

The principles of the Golden Ratio are used in mathematics and other sciences, in architecture and arts. They underlie the architectural proportions of many remarkable architecture masterpieces, mainly in antiquity and the Renaissance. The presence of the Golden Ratio and Fibonacci numbers in wildlife allows talking about some single mechanism of their occurrence. As such, Fibonacci numbers and the Golden Ratio are a mathematical description of some formative process. The golden ratio is widespread in nature, thus it is one of the most harmonious laws of the universe, which defines the structure of the surrounding world and directs life to development. The Golden Ratio rule is used by nature to form the trajectories of tornadoes, in the formation of elliptical galaxies, in the construction of the auricle, and even defines the trajectory of the frightened deer scattering fleeing from a predator.

After carrying out an investigation, I have learned a lot of interesting things about the Fibonacci sequence. Moreover, I have learned how to recognize it in the surrounding objects. All in all, the Fibonacci sequence and numbers are very widely used in various fields of the mathematical and non-mathematical world. Not surprisingly, the study of this issue has become very intensive in the twentieth century. This was facilitated by the new problems of informatics, which were facing by the intellectual elite of society. It is quite surprising how many things can be calculated using the Fibonacci sequence and how its parts manifest themselves in a huge number of combinations. This topic does not lose its relevance to this day because the Fibonacci sequence is not just a numbers game, but the most substantial mathematical expression of natural phenomena of all that has ever been discovered.