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## Golden Ratio in Nature

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**Abstract :** The Golden Ratio is a proportion that has come to represent beauty and perfection in mathematics, art, and nature. In this paper I seek to define the Golden Ratio and explore the ratio's history and its connection with the Fibonacci Sequence. Further, I intend to present some techniques for using the Golden Ratio and its derivatives in art and photography. Last, I will reflect on classmate feedback and discussion to introduce areas for further study and improvement for future presentations.

**IndexTerms** - Fibonacci sequence, Golden Ratio

### I. INTRODUCTION

In mathematics and the arts, two quantities are in the golden ratio if the ratio between the sum of those quantities and the larger one is the same as the ratio between the larger one and the smaller. The most beautiful things that catch our eyes are the ones that the most symmetrical. Nature is replete with such beauty- whether trees, flowers, seeds, vegetables, fruits and so on.. We are more likely to notice a symmetrical body and proportional face. We also find certain buildings and monuments more attractive than others because they have mathematical symmetry built into them. Things that appeal to us seem to confirm to a golden ratio. In this paper I would like to discuss about what is golden ratio and where do we find it in nature and life?

Other names frequently used for the golden ratio are Golden mean, Golden number, Extreme and mean ratio, Medial section, Divine proportion, Divine section, Golden proportion, Golden cut and Mean of Phidias.

### II. HISTORY

The Golden Ratio can be found everywhere if only one decides to look. It is in nature - in the distribution of sunflower seeds, the cochlea of your inner ear, and in the galaxies. It is in art - as a modern day photography technique and in the works of old master artists such as Da Vinci and Michelangelo. And it is in architecture - as seen in the Parthenon and Great Pyramids of Giza (Ilic). To some, this seems like information bias, the more we look for it the more it is found, but to others it is proof that the Golden Ratio is as old as the Earth itself. One of the oldest and most prominent occurrences of the Golden Ratio is the Great Pyramid of Kufo. The Great Pyramid is part of a collection of three pyramids in Egypt built for the Pharaoh Kufu in 2694 BC. It is the last remaining of the Seven Wonders of the Ancient World and covers and impressive 13 acres. Despite its size and age, the Great Pyramid was built with a staggering amount of precision. The maximum difference in side measurements is only 4.4 cm with the space between individuals blocks no more that 1/50th of an inch (Bartlett 299). This attention to detail in construction implies a conscious effort and a concentrated plan. Is it possible that the Ancient Egyptians were adhering to the Golden Ratio in their search to make a perfect resting place for Pharaoh Kufo? At first this seems like an easy enough question to answer - just measure and calculate. Due to the age of the Pyramid, however, this is not as simple of a task as it seems. In his article "The Design of the Great Pyramid of Khufu," Christopher Bartlett uses historic data and projection techniques to relate the hypotenuse of triangular cross sections of the Pyramid with base width.

Today the Golden Ratio is represented by the Greek numeral Phi ( $\phi$ ) chosen in honor of one of the great Greek sculptures of the 400s BCE, Phidias (Blacker et al.). Phidias led design and supervised the construction of the Parthenon in Athens, Greece. Now a famous landmark, the Parthenon was originally intended as a temple for Athena the Greek goddess of wisdom ("Parthenon"). In the spacing of the columns and overall height and width of the Parthenon, the Golden Ratio can still be seen.

### III. FIBONACCI SEQUENCE AND GOLDEN RATIO

The Fibonacci sequence, named after the Italian Mathematician Leonardo Fibonacci, is a sequence in which the next term can be defined based on the previous terms. Any starting numbers are acceptable, but the classic example begins with 0, 1 producing the following sequence:

0, 1, 1, 2, 3, 5, 8, 13, 21, . . .

### IV. GOLDEN RATIO AND ART

The Golden Ratio is believed by many to be an indicator of beauty and perfection. As such, it can be used as a tool for creating effective compositions in art. Two methods for using the Golden Ratio in art are the Phi Grid and the Golden Spiral.

The Golden Spiral is constructed using the Fibonacci sequence. As this sequence can be used to define a sequence that converges to  $\phi$ , the fibonacci sequence can be used to assemble rectangles that are approximately proportioned according to the Golden Ratio.

When used in art, the most complicated part of the composition is placed in the tightest segment of the Golden Spiral and the rest of the composition roughly lines up with the rectangles 5 or follows the shape of the spiral. The Phi Grid is made of rectangles that follow the Golden Ratio. As opposed to the classic compositional Rule of Thirds, the Phi Grid has a narrow section through the middle intended to focus the viewers eye on the center of the composition.

## V. CONCLUSION

Golden Ratio attracted the mathematician, architects and painters of ancient time. They used it to create beautiful geometrical figures, monuments or paintings. In present era software developers, mathematicians, designers, plastic surgeons has taken it to its new heights which are good mathematics and human being both.

I would also be interested in researching the Golden Ratio's relationship with neuroscience and psychology. What is happening in our brains when we see the Golden Ratio and why is it so pleasing to the eye? Is this socialization or a biological response? I think that the Golden Ratio is so interesting because there is always more to learn and more subjects to be explored using the ratio as a lens for examination.

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