CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
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Project Number
S1925

Project Title
Fibonacci Numbers and the Golden Ratio in Plants

Abstract

Objectives/Goals
Many scientists believe that certain plants have a Fibonacci number of spirals in a golden ratio phyllotaxis (the arrangement of leaves on a stem) because the limit of two consecutive Fibonacci numbers approaches the golden ratio. For me that conclusion did not have enough support, so I investigated why plants with a golden ratio rotation between each new leaf/cell exhibit a Fibonacci number of leaves/spirals.

Methods/Materials
Examined and recorded data from plants at the San Francisco Botanical Garden to get a tangible understanding. Used a protractor to measure divergence angles between leaves and counted the number of leaves/spirals around their phyllotaxies. Calculated the first 50 ratios between consecutive Fibonacci numbers. Drew the phyllotaxies from the ratios in the previous step with a protractor.

Results
The limit of two consecutive Fibonacci numbers approaches the golden ratio. The drawings of the phyllotaxies showed that the denominator of the ratios was also the number of spirals.

Conclusions/Discussion
The rotation of each successive cell in a plant's phyllotaxis is determined by a ratio. The ratio's denominator is the number of spirals around the phyllotaxis because that is the maximum number of possible rotations between each cell/leaf without overlap ("Denominator Rule"). Since the ratio of two consecutive Fibonacci numbers approaches the golden ratio, a golden ratio phyllotaxis follows the "Denominator Rule" of the ratio between two consecutive Fibonacci numbers; therefore, a golden ratio phyllotaxis has a Fibonacci number of spirals. A golden ratio phyllotaxis may also have engineering applications. Since the cells in golden ratio spirals are compacted very tightly, engineers may treat molecules the same way, producing stronger materials.

Summary Statement
I investigated why plants with a golden ratio phyllotaxis exhibit a Fibonacci number of leaves/spirals.

Help Received
Mother helped glue the board.