



**CALIFORNIA STATE SCIENCE FAIR  
2009 PROJECT SUMMARY**

<b>Name(s)</b> <b>Jennie M. Werner</b>	<b>Project Number</b> <b>J1614</b>
<b>Project Title</b> <b>Fractals: The Geometry of Nature</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> To analyze the following fractal patterns which are found in nature: 1. Tree: Based on the length of the first iteration, derive a formula to find the total length of all the branches based on the tree's fractal pattern 2. Koch Snowflake: Based on the length of the side of an equilateral triangle, derive the formula to find the perimeter and area, given the number of iterations.</p> <p><b>Methods/Materials</b> 1. Geometer's Sketchpad software was used to generate two different fractals: Koch Snowflake and Tree. 2. The measuring functions in Geometer's Sketchpad were used to measure the first five iterations of the fractals. 3. The data was entered into a spreadsheet. 4. By looking for numeric patterns, formulas were created to calculate data for additional iterations. 5. To validate that the formulas were correct, the results from the formulas were compared with measuring function data taken from Geometer's Sketchpad.</p> <p><b>Results</b> Calculations for the following were derived: Tree: Length of the branches Koch Snowflake: Total Area and Perimeter (See display board for the results as capital sigma notation can not be used in the abstract application.)</p> <p><b>Conclusions/Discussion</b> It is possible to write a formula that calculates the total length of all the branches in a Tree fractal and to derive the formula to find the area and perimeter of a Koch Snowflake.</p> <p>Being able to estimate the measurement of objects in nature has many practical applications to solve real world problems. Because fractals are mathematical equations they can be used to measure objects in nature that seem rough and random. Calculating the length of the branches in a tree can help figure out the number of leaves on a tree and thus the amount of CO<sub>2</sub> a whole forest takes in. Another use for fractals is for measuring a coastline. While the area of the Koch Snowflake is bounded, the perimeter continues to grow infinitely just like the coastline of an ocean.</p>	
<b>Summary Statement</b> I derived an equation to measure the perimeter and area of a Koch Snowflake and the total length of all the branches in a fractal tree.	
<b>Help Received</b> My mother drove me to the store to buy a display board.	