FINAL THOUGHTS FROM MR. MESSNER (1/3)

Cantor Middle Thirds Set:

While the Cantor Set is not particularly visually interesting to construct (students could title a lesson page, "*Cantor Set (iteration* = ∞*)*," leaving the rest of the sheet seemingly blank; one could even give them extra credit for including an infinite number of such sets), it is quite something to experience kinesthetically and aurally. Imagine moving across the set at a steady pace. Students can clap at the onset of a segment, leave their hands together for its duration, and visibly hold their hands apart with palms facing out during the gaps. Once understood, a class can be divided into groups clapping along with different iterations. Though less of a large group activity, the set can also be played on a piano. Iteration 0 is nine full beats on a low note played by one student. Iteration 1 is three beats on, three off, and three on played one octave up by another student. Iteration 2 is an octave above that, with beats of one. Iteration 3 is counted in triplets. The rarefaction of iterations is lovely when they are played simultaneously.

FINAL THOUGHTS FROM MR. MESSNER (2/3)

What I have done, but would not do:

Being asked to pioneer Chaos & Fractals at the *Maine Coast Waldorf School*, it seemed appropriate to attempt a calculation of the fractal dimension of the coast of Maine. (Grids of multiple scales, always a power of 2 times some unit, overlay a detailed map. The number of boxes the coastline crosses through is plotted on log-log paper against the scale of the boxes. The slope of the best fit line is the approximate dimension.) Similarly seduced by overly enthusiastic mathematical literature, I had my class follow a procedure for calculating the fractal dimension of balled paper. (Full sheets, half-sheets, quarter-sheets, etc., are crumpled tightly and their diameter measured. A log-log graph is then used in the same way.) The quality of our results did not justify the amount of class time required for the experiments. I have subsequently preferred to devote more time to other topics instead. If you have had a positive experience with similar calculations, I am open to being persuaded to reconsider them.

Final Thoughts from Mr. Messner (3/3)

What I have not done, but would love to do:

Chua's Circuit is a simple-to-construct electronic oscillator which exhibits both periodic and chaotic behavior. This can be visualized with an oscilloscope, and heard through a speaker as tones, harmonics, and chaotic acoustics. As Marisha Plotnik and Jim Kotz (*Chaos: A New Main Lesson*, AWSNA, 2001) note, since the phenomenon cannot be observed directly, it is all too easy to for students to mistake it for a mere computer simulation. It must be emphasized that Chua's Circuit is a real, physical system.

Plotnik and Kotz also reference capturing the behavior of dripping water by photogate and plotter, along with a column of oil to slow the drops enough to be seen. Other physical systems you may wish to research (internet videos and resources abound) are the double pendulum, and the chaos (or chaotic) water wheel.

Blessings on your mathematical adventures! —Matthew Messner