Inclusion of Fractal Geometry in the Mathematics Curriculum Framework

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Virginia Board of Education (July 23, 2009)

Good Morning. My name is Andrew Derer. I am the secondary mathematics department chair at the MathScience Innovation Center. The Center is a 43-year old consortium of 8 school districts in the Central Virginia area. We provide professional development for educators, lessons to students during the regular school day, and special courses on Saturday and during the summer. Annually, we serve about 150,000 participants face-to-face and about 500,000 virtually.

Four years ago, our governing board - which consists of superintendents, school board members and community representatives - engaged in a visioning process. Our new mission is "to be the innovator, incubator and advocate of 21st century math and science programs for K-12 educators and students." Our initial focus areas include fractal geometry, nanotechnology, engineering, distance learning and mathematical modeling and simulations. We have spent the last four years developing teacher and student programs in the area of fractal geometry.

If you are unfamiliar with fractals it is because it is a new field of mathematics. Fractals were named by Franklin Medal winner, Benoit Mandelbrot in 1975. His research, with the assistance of computers, has unlocked a new area of mathematics which has allowed us to complete the mapping of the human genome, increase early cancer detection, compress images for storage and retrieval, and exponentially improve communications in wireless technology. *Business Week* called fractals one of the top ten sciences of the future.

Classical Euclidean geometry deals with regular patterns such as lines, circles, and triangles. It is well-suited to studying the world humans created and built using classical mathematics. Fractal geometry deals with the irregular rough patterns found in nature - the trees, rivers, clouds, and weather systems. Until fractals came along these natural objects defied mathematical description.

Fractal usage is being more recognized in everyday life. Fractals have appeared in several primetime television shows including NOVA. The state of New Jersey has added fractal mathematics to their state curriculum. Many classrooms of students in New Mexico have Fractal Fridays at the end of each week to learn about fractal concepts.

When Governor Kaine visited in April, he stressed the need for students to be innovative, especially in a time of limited resources. Fractals do just that. If we give our students the opportunity to learn this new geometry, they will not fall behind in 21st Century learning but will come out ahead of their peers.

The MathScience Innovation Center recommends that the Board consider the inclusion of fractal geometry concepts in the mathematics framework. The Center has identified six major strands for a fractal curriculum. A document detailing these concepts is enclosed in your packet.

These six major strands can be seamlessly integrated into the curriculum framework. For example, 5th graders can explore fractal patterns as part of SOL 5.17. Seventh and eight graders can study self-similarity as part of SOL 7.13 and 8.13. Iterative processes can be included in Algebra I (A.7) and fractal dimension in Algebra II (AII.6). In Computer Mathematics, students can use fractal mathematics in designing computer graphics (COM.8). Already, fractals are included in Discrete Math (DM.10).

Resources abound for teaching fractal concepts. There are free websites, applets, software downloads, and even printable templates for teachers to use. During the next year, the MathScience Innovation Center will post substantial resources to its site, *Fractal Keys: A Pattern Paradise*. All of these resources can help Virginia students succeed in learning mathematics appropriate for the 21st century in which they will live and work.