Patterns, Fractals, and Math Demonstration

Objectives:

- Use the topic of fractals to motivate excitement about math. Boil math down to the study of patterns.

Common Core Mathematics Standards: 4th Grade

- Standard: 2. Patterns, Functions, and Algebraic Structures: Make claims about relationships among numbers, shapes, symbols, and data and defend those claims by relying on the properties that are the structure of mathematics. Make sound predictions and generalizations based on patterns and relationships that arise from numbers, shapes, symbols, and data

  (a) Generate and analyze patterns and identify apparent features of the pattern that were not explicit in the rule itself.


Prerequisite Knowledge and Materials:

- Prerequisite Knowledge

  - Students are expected to be third through fifth graders. Ability to alter the topic per grade will be required. Eg. Focusing more on the shapes and recognizing patterns for younger students, while looking at the concepts of area and perimeter with the older students.

- Materials

  - STEM Presentation Slide-show. Contains links that will be used in the presentation to generate fractals. [Slides]

  - Displayable writing surface for the introduction game. Eg. White board, chalkboard, large pad of paper.

Set/Hook:

General Math game to introduce myself. I can get 1089 from any 3 digit number you pick. I can only reverse the order of the digits, add and subtract them. [Math Magic Link] Once we have done two examples talk about the pattern that generated this “Math Magic”. Continue into introductions and why math is important to me. Focus on the importance of looking for patterns in Math. Explain bullying and disease research simply (for those altering this, give other pertinent examples of finding mathematical patterns to solve real world problems.)
Procedure:

1. What are Fractals?
   - Begin with a discussion about the fractal in the background. See if kids can see the patterns at smaller and smaller levels.
   - Simple Cantor Set example. Taking the middle 3rd out of each full line. Walk through each step and as you get deeper ask leading questions to get the kids to see the concept of self similarity (without using that word).
   - What happens when the pattern is more complicated? Go to the snow flake line example. What is the pattern here? Instead of deleting the middle third... We draw a triangle where the middle third was. Give kids some time to speculate.
   - Finally switch to the Zooming Gif and talk about the concept of Self-similarity. Each time you zoom in the image remains the same.

2. “Hands on”: Create your own fractal
   - Follow the link and demonstrate how you can create your own fractal by showing the full snowflake. Link to the previous example. Fractal Link
   - Let the group(By picking out kids and following their directions) generate a few fractals, first using the built in ones, and getting them to guess at the pattern, and then by drawing their own.
   - For each fractal draw attention to the pattern and self similarity. Use the zoom option to show the self-similarity. Why can’t the computer go smaller?
   - For the older kids draw attention to the table on the side and talk about length, area and perimeter and the behaviors as we add stages. In which cases are there convergence or divergence? The tree is an excellent example of divergence while the Triangle is a great example of convergence. What is the difference in the patterns that gets this behavior?

Closure:

The goal of this presentation is to excite kids to study math. Fractals are a hands on way to look at patterns and generate hypotheses.

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