

Mathematics

with Assistant Professor
Pierre-Olivier Parisé

Talking points

Knowledge

1. What is a fractal?

Comprehension

2. Besides those mentioned in the article, what other examples of fractals can you think of?
3. How does ray tracing allow animators to produce realistic lighting in scenes?
4. Why does ray tracing not work for fractal objects?

Application

5. What are the applications of Pierre-Olivier's technique for rendering 3D fractals?

Analysis

6. Coastlines are an example of a fractal found in nature. Why do you think this means you can never accurately measure a coastline?
7. Why do you think mathematicians are suited for so many different careers?

Evaluation

8. What mathematical career would you most like to have, and why?
9. To what extent do you think it is important that mathematicians develop foundational mathematics, even if initially there might not be any practical applications for their work? Why?

Activities

Create your own fractal shapes!

1. Koch Snowflake: Draw an equilateral triangle. Add a smaller equilateral triangle to each of your original triangle's three sides (to create a six-pointed star). Add an even smaller equilateral triangle to each of the star's twelve sides. How many times can you keep adding smaller triangles to every side of your increasingly multi-sided shape?

2. Sierpiński Triangle: Cut out an equilateral triangle. Divide it into four equilateral triangles, discard the middle triangle, and replace the three remaining triangles into their original position forming an equilateral triangle with its centre missing. Repeat the process on each of the three remaining triangles. How many times can you keep removing the centres of the triangles?

3. How would you create a **Sierpiński Carpet** (the square version of the Sierpiński Triangle)?

4. How would you build a **Sierpiński Tetrahedron** (the 3D version of the Sierpiński Triangle) and a **Menger Sponge** (the 3D version of the Sierpiński Carpet)?

"Fractals have always been good at drawing people into mathematics because you can appreciate their beauty without understanding them," says Pierre-Olivier. Use the fractals you have created (plus any other fractal images) to produce a classroom display to inspire and excite 11-to-14-year-olds about mathematics.

More resources

- Build your own fractals using Pierre-Olivier's website: mathopo.ca/ifs-salon
- Infinitely zoom into fractal patterns with the XaoS Fractal Viewer: xaos-project.github.io
- Explore fractals with the Fractal Foundation: fractalfoundation.org/resources
- Pierre-Olivier recommends this video for a visual introduction to ray marching: youtube.com/watch?v=svLzmFuSBhk
- Pierre-Olivier was inspired to become a mathematician thanks to the accessible articles in Accromath: accromath.uqam.ca