Lesson Plan: Create a Sierpinski Triangle

By Carol Schlenk

Subject: Fractal geometry

Grade level: 8-10

Rationale or Purpose: This lesson introduces students to the beautiful complexity of geometric fractals.

Materials:

- Student handout - *Create a Sierpinski Triangle*
- Rulers (marked in inches)
- Red, blue, green, orange, and purple colored fine-tip markers or pens
- Access to the interactive Sierpinski Triangle in the *Teachers As Scholars Online Toolkit*

Lesson Duration: One 45-50 minute class period

Objectives: Students will be able to define the term "fractal" and follow written directions to construct a Sierpinski Triangle using paper and markers.

Texas Essential Knowledge and Skills (TEKS):

Mathematics

- Geometry 111.34 (a2), use geometric thinking to understand mathematical concepts and the relationships among them.
- Geometry 111.34 (a5), use a pictorial representation to solve meaningful problems by representing figures, transforming figures, analyzing relationships.
- Geometry 111.34 (b2A), use constructions to explore attributes of geometric figures and to make conjectures about geometric relationships.
- Geometry 111.34 (c2), use properties of transformations and their compositions to make connections between mathematics and the real world in applications such as fractals.
- Geometry 111.34 (f1), use similarity properties and transformations to explore and justify conjectures about geometric figures.

Activity:

Step 1: Ask students to imagine looking at a leaf. Then ask them to imagine looking at that same leaf under a magnifying glass. Then a microscope. Then a scanning electron microscope. Explain that with each magnification they would see more and more detail in the leaf.

Step 2: Explain that a fractal is a geometric shape, just like a circle, square, or rectangle, but a fractal has properties these other shapes do not. A fractal can be subdivided into parts or components, each of which is a smaller-size copy of the original figure. It can be any pattern that shows greater complexity as it is enlarged. To provide students with a sample fractal, consult the websites located in the Math Bibliography.

Step 3: Explain that an important quality of fractals is self-similarity, meaning that fractals contain smaller and smaller copies of themselves. As you zoom in on a fractal, you see more and more detail. To illustrate, have students view the interactive Sierpinski Triangle in the *Teachers As Scholars Online Toolkit*. Point out that each change in the pattern that reveals more detail is called an **iteration**.

Step 4: Explain that the fractal used in this lesson is the Sierpinski Triangle or Gasket, invented by the famous Polish mathematician Waclaw Sierpinski in 1915.
Advise students that as part of this lesson they will create a Sierpinski Triangle of their own, using paper and markers. Distribute the *Create a Sierpinski Triangle* student handout.

Step 5: Point out that the triangle on their handout has three equal sides, making it an equilateral triangle (as well as an isosceles triangle).

Step 6: Distribute rulers and markers to students.

Step 7: Read the first step of the handout aloud with students and have them measure the sides of the triangle and mark their red dots and draw the red triangle. Explain that with each of subsequent step, the students will be creating smaller and smaller triangles. Have students complete their Sierpinski Triangles.

Modification: For special needs students, require fewer iterations or mark triangle points with different colors to guide the drawing process. Have gifted and talented students research and create a Sierpinski Square or Carpet.

Student Product: A color-coded Sierpinski Triangle

Closure: Ask students to define the term "fractal." Then ask them to describe what each subsequent iteration did to the original triangle.

Assessment or evaluation: Ask students what would happen if they continued to create more and more new iterations of the original triangle.

Extensions:

- Research the lives of mathematicians, Waclaw Sierpinski, Benoit Mandelbrot, and Gaston Julia and answer the following questions:
  - How did each man's work with fractals begin?
  - What did these men have in common?
- Have students cut out their completed Sierpinski Triangles and tape them together to form one giant Sierpinski Triangle.