Review from Workshop 2: Scaling
Regardless of the scale, the actual coastlines appear to have the same amount of jaggedness.

Prof. Mandelbrot and his Work
Fractals

• Measure Roughness
• Fractals can be described as
  – Broken
  – Fragmented
  – Irregular
• Concept created by Benoit Mandelbrot. He pointed out that roughness is an organizing concept of much of the world.

Picture of Benoit B. Mandelbrot was taken at his lecture at Worcester Polytechnic Institute, November 2006 and the picture of the Mandelbrot set is from: The fractal geometry Web site, http://classes.yale.edu/fractals/ of Michael Frame, Benoit Mandelbrot and Nial Neger. Courtesy of Michael Frame.

Benoit B. Mandelbrot
Historical Perspective

“I coined fractal from the Latin adjective fractus. The corresponding Latin verb frangere means “to break:” to create irregular fragments.” Benoit B. Mandelbrot

“Clouds are not spheres, mountains are not cones, coastlines are not circles, and bark is not smooth, nor does lightning travel in straight lines.” Mandelbrot

This famous statement was made in regard to French artist, Paul Cezanne’s view that “the artist should see in nature ‘the cylinder, the sphere, the cone, …”

Notice the rectangle in each insert is magnified in the next picture.

Magnifications of the Mandelbrot set courtesy of Prof. Dr. Heinz-Otto Peitgen
Self-similarity

• Ferns
• The Sierpinski Triangle
Fern branches, fronds and tiny leaves all have the same shape.
Self-similarity: An object looks similar to itself under different magnifications
Activity: Constructing and coloring stages of the Sierpinski triangle

1. With the dot paper supplied and the Sierpinski directions, construct the first three stages of the Sierpinski triangle.

2. Outline and color your Sierpinski triangle so that the various stages are obvious. For help see the next slides.
Fill in the stages needed to construct a Sierpinski triangle.
Can you construct the next stage?
Notice the removed (downward) triangles at stages 1-4.

How many remaining upwardly pointing triangles are there at each stage?

Can you see a pattern? If this process never stops, what is left?

Stages of the Sierpinski Triangle

Stage 0  Stage 1  Stage 2

Stage 3  Stage 4
Activity: Writing Exercise