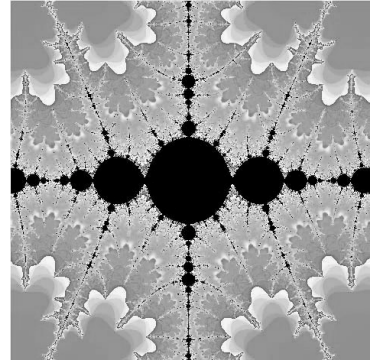


Introduction to Fractals

Big Idea

USE FULL SENTENCES. *Hint: What statements can you make about fractals?*



Vocabulary

USE FULL SENTENCES

- ② fractal

- ② infinite

- ② iteration

Credits

This document was adapted from Cynthia Lanius, <http://math.rice.edu/~lanius/frac/>.

Why Study Fractals?

Fractals are New!

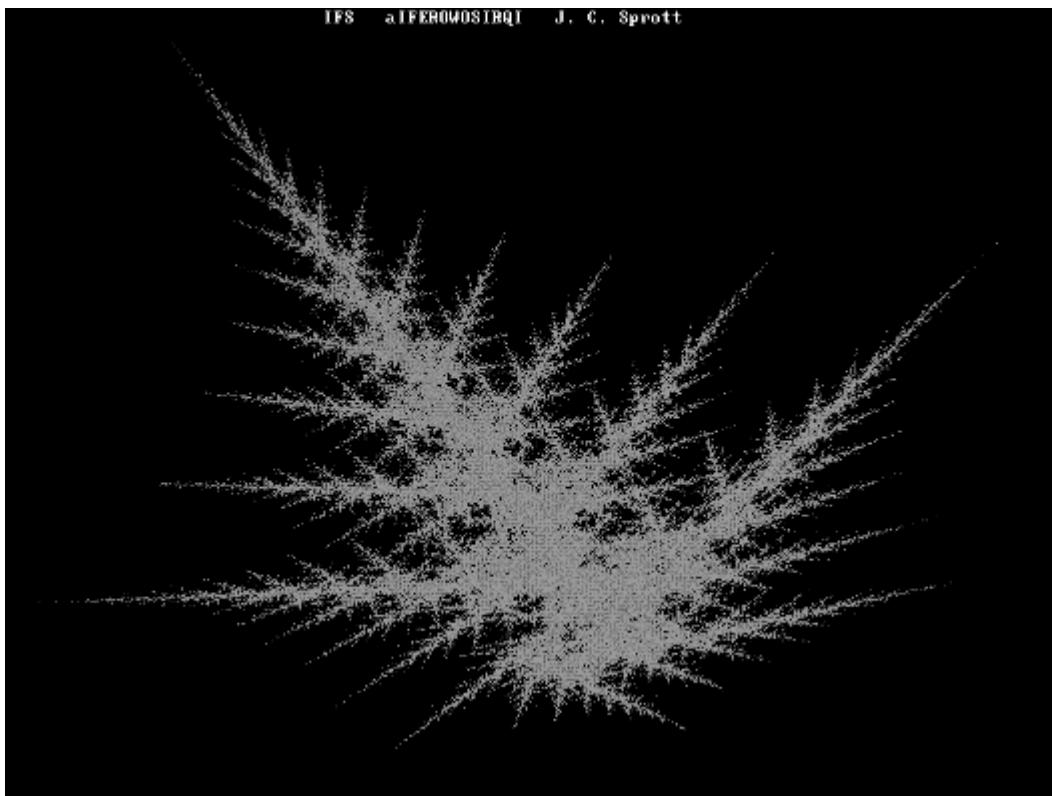
Most math you study in school is old knowledge. For example, the geometry you study about circles, squares, and triangles was organized around 300 B.C. by a man named Euclid. Fractal geometry, however, is much newer. Research on fractals is being carried out right now by mathematicians. Have you ever thought about a career as a mathematician?

You can understand them.

Much research in mathematics is currently being done all over the world. Although we need to study and learn more before we can understand most modern mathematics, there's a lot about fractals that we can understand.

Fractals often look like objects in nature.

Many objects in nature aren't formed of squares or triangles, but of more complicated geometric figures. Many natural objects - ferns, coastlines, etc. - are shaped like fractals. This picture is actually an example of a fractal that looks like a fern.



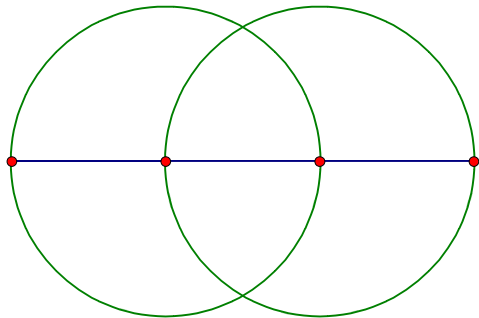
Building Your First Fractal



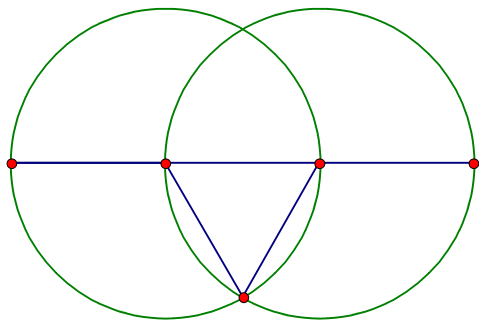
Start with a straight line



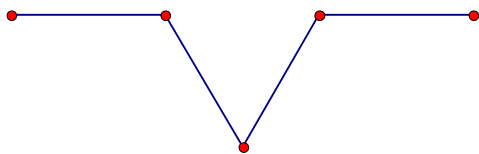
Divide it into three parts



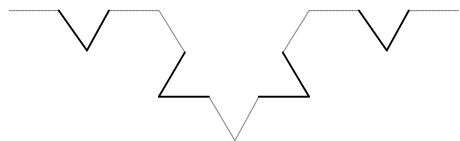
Draw two circles like this to form an equilateral triangle.



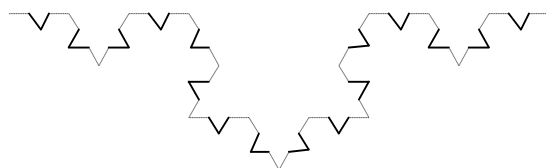
Now put a point at the intersection of the two circles and draw your triangle.



Now you have completed your first iteration of this fractal.



Now repeat the process with the new lines. This is the second iteration.



And again, repeating infinitely ...

Fractals

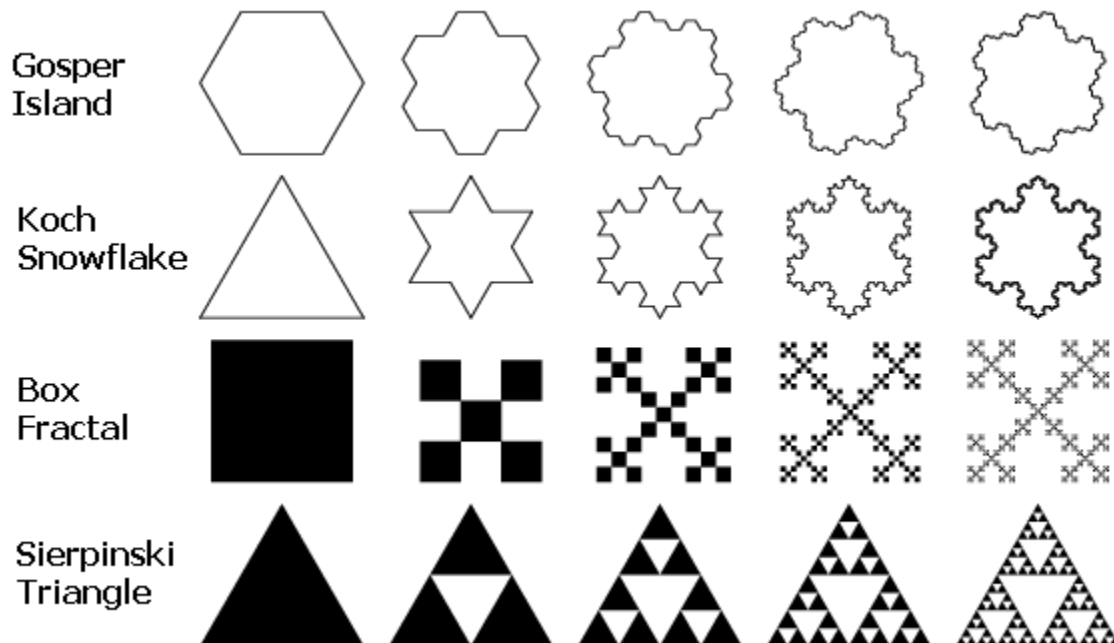
1. On a blank piece of paper, draw three iterations of this fractal. Use the Thirds Ruler in the back of this packet to draw this fractal. Draw the first line from 0 to 81 on the ruler. As you draw each iteration, measure the total length of all the lines using the Thirds Ruler. You will need a straight edge and compass to complete this drawing.
2. Fill in the table below with the number of segments, the length of each segment, and the total length. Predict the number of segments, the length of each segment, and the total length for the fourth iteration.

| Iteration | Number of Segments | Length of each Segment | Total Length of Segments |
|------------------|---------------------------|-------------------------------|---------------------------------|
| 0 | 1 | 81 | 81 |
| 1 | 4 | 27 | 108 |
| 2 | | | |
| 3 | | | |
| 4 | | | |

3. Write an equation showing the number of segments as a function of the iteration.
4. Write an equation showing the total length of the segments as a function of the iteration.
5. As the number of iterations approaches infinity, what will happen to the total length of the segments?

You probably noticed that the total length of the segments approaches infinity as the number of iterations approaches infinity. This is a property of fractals.

Other Simple Fractals



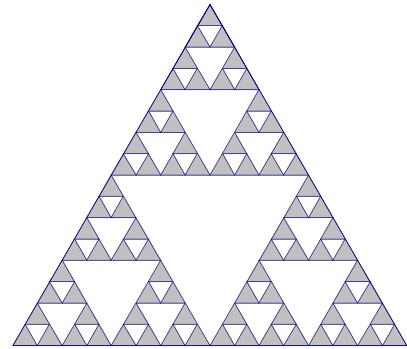
Fractals and Nature

- Use the Internet to find some pictures of fractals that look like nature. Print at least two pictures to turn in with this packet. You can use Google image search for this. Go to the URL <http://www.google.com>. Click on the 'Images' keyword. Type fractal into the input box, then press enter.



The Sierpinski Triangle

To make a fractal: Take a familiar geometric figure (a triangle or line segment, for example) and operate on it so that the new figure is more "complicated" in a special way. Then operate on that figure in the same way and get an even more complicated figure. Then do it again and again...and again.



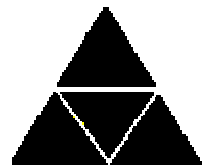
Let's make a famous fractal called the Sierpinski Triangle. You will need the triangular graph paper at the end of this packet.

Step One

Draw an equilateral triangle with sides of 2 triangle units each. Connect the midpoints of each side.

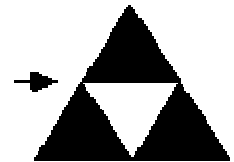
How many equilateral triangles do you now have?

Shade out the triangle in the center.



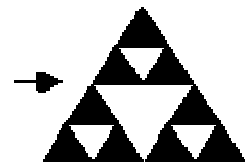
Step Two

Draw an equilateral triangle with sides of 4 triangle units each. Connect the midpoints of the sides and shade the triangle in the center as before. Notice the three small triangles that also need to be shaded out in each of the three triangles on each corner.



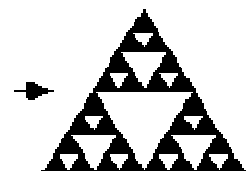
Step Three

Draw an equilateral triangle with sides of 8 triangle units each. Follow the same procedure as before, making sure to follow the shading pattern. You will have 1 large, 3 medium, and 9 small triangles shaded.



Step Four

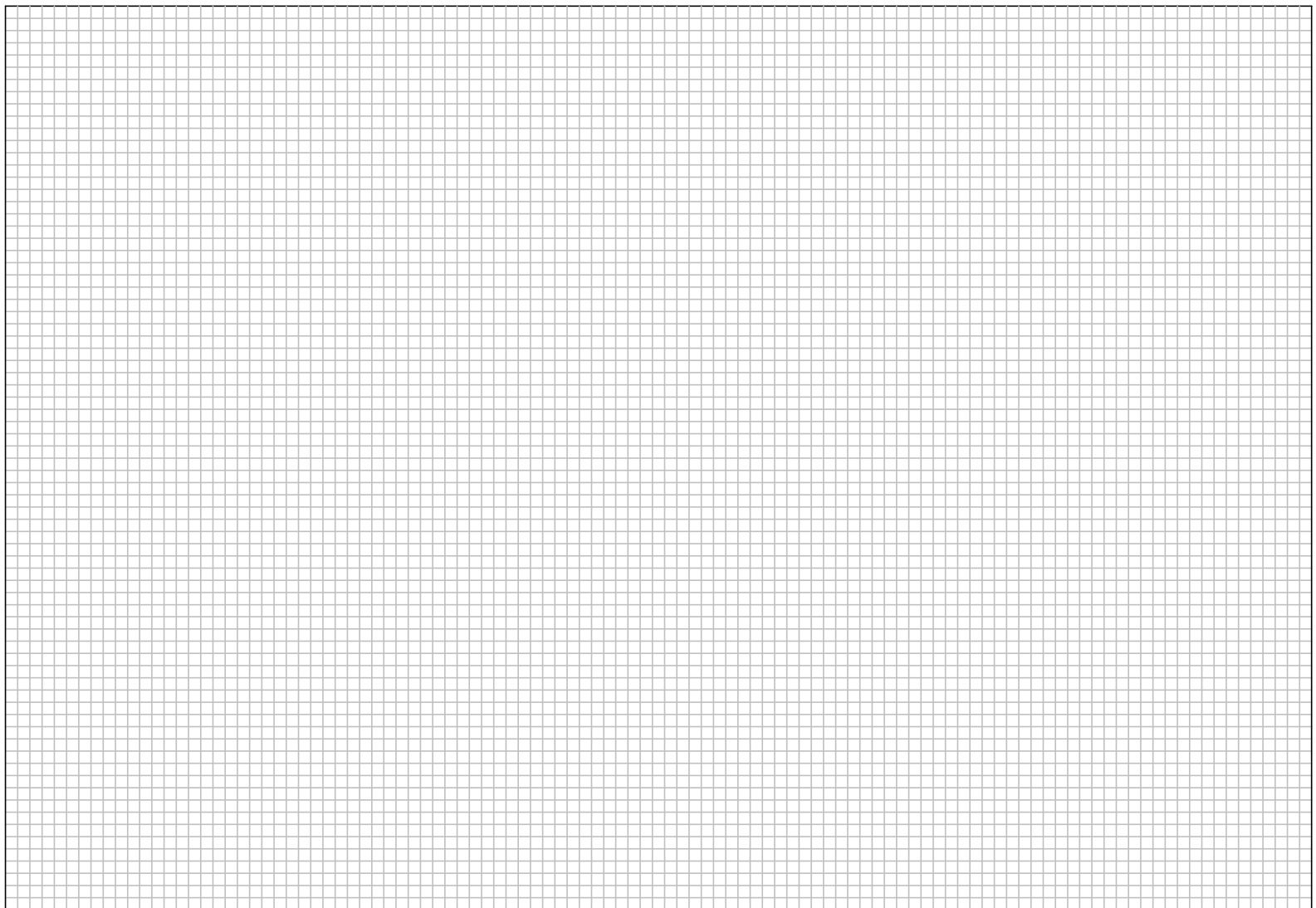
How about doing this one on a poster board? Follow the above pattern and complete the Sierpinski Triangle. Use your artistic creativity and shade the triangles in interesting color patterns. Does your figure look like this one? Then you are correct!



Invent a Fractal

Use the square or pentagonal graph paper in this packet. Invent a fractal based on either squares or pentagons.

Name _____ Period _____ Due Date _____



Other Resources

- ② Cynthia Lanius, Rice University, *Fractals*, <http://math.rice.edu/~lanius/fractals/WHY/inpr.html>, 2004, last accessed 3/1/2007.
- ② David Leberknight, University of Colorado, *Fractal Applet*, <http://www.softwarefederation.com/fractal.html>, last accessed 3/1/2007.
- ② Weisstein, Eric W., *Fractal*, From MathWorld--A Wolfram Web Resource. <http://mathworld.wolfram.com/Fractal.html>, 1999, last accessed 3/19/2007
- ② <http://ejad.best.vwh.net/java/fractals/intro.shtml>, 2 Feb 2001, last accessed 19 March 2007

Fractal Ruler

Thirds Ruler

