Project 8: Fractal Fun
Teacher Guide

Description:

The students will **perform research on** the Internet to learn about fractals. Then they will create a well-known fractal called the Sierpinski Triangle using graphics tools. Next, the students will mathematically analyze the fractal and then generate a report in a word processing document.

Grade Levels: 7-10

NCTM Standards (Grades 6-8 and 9-12):

> Standard 2: Patterns, Functions and Algebra
> Standard 3: Geometric and Spatial Sense
> Standard 4: Measurement
> Standard 5: Data Analysis, Statistics and Probability
> Standard 6: Problem Solving
> Standard 7: Reasoning and Proof
> Standard 8: Communication
> Standard 9: Connections
> Standard 10: Representation

NETS Performance Indicators (Grades 6-8):

4. Use content-specific tools, software and simulations (e.g., environmental probes, graphing calculators, exploratory environments, Web tools) to support learning.

5. Apply productivity/multimedia tools and peripherals to support personal productivity, group collaboration and learning throughout the curriculum.

8. Select and use appropriate tools and technology to accomplish a variety of tasks and solve problems.

NETS Performance Indicators (Grades 9-12):

7. Routinely and efficiently use online information resources to meet needs for collaboration, research, publications, communications and productivity.

8. Select and apply technology for research, information analysis, problem solving and decision making in content learning.

Materials:

Web browser and *Microsoft Word 2003*

Prerequisite Skills:

The students should have experience using a Web browser to access Web sites as well as previous experience using graphics tools to create, move, resize and group objects. Basic geometry knowledge is needed to analyze the fractal.

Suggested Time Allotment: Two or three class periods

Process:

Inform the students that they will learn about fractals. Explain that a fractal is any pattern that reveals greater complexity as it is enlarged. Have the students use a Web browser to access the sites listed on the Fractal Fun Student Handout to research fractals and to answer the questions listed below the Web sites on the handout.

Next, have the students follow the instructions on the handout to create the Sierpinski Triangle using the graphics tools in *Word*. Finally, have the pupils read the questions at the end of the handout and generate a report about the Sierpinski Triangle.

Evaluation:

Assess students on the quality and accuracy of the Sierpinski Triangle they create, as well as their analyses and conclusions about the fractal.

Extensions:

Have the pupils visit some of the following Web sites to learn about Pascal's Triangle:

> **www.maa.org/mathland/mathland_2_10.html**
> The Mathematics Association of America's page on Pascal's Fractals

> **www.cecm.sfu.ca/organics/papers/granville/support/pascalform.html**
> Simon Frazier University's interface for creating Pascal's Triangles

Technology Enrichment:

Suggest that the students create Sierpinski Triangles of different colors and sizes. Flip and rotate the triangles to make interesting designs and repeating patterns.

Fractal Fun
Student Handout

❑ Launch the Web browser and research fractals using the following Web sites:

> **www.glyphs.com/art/fractals/what_is.html**
> An arts-related site that defines fractals

> **http://sprott.physics.wisc.edu/fractals.htm**
> A site on fractals created by a professor of Physics at the University of
> Wisconsin

> **http://library.advanced.org/12740/netscape/tutorials.html**
> A 1997 ThinkQuest project on fractal tutorials

❑ After learning about fractals, answer the following questions:

> What does the term *fractal* mean?

> What do fractals have to do with mathematics?

> Locate a picture of a fractal on the World Wide Web that looks like an object in
> nature. Once found, right-click the image and save it as a file. What object in
> nature does the fractal look like?

❑ To make the fractal known as the Sierpinski Triangle, launch *Microsoft Word 2003*
and create a new document.

❑ On the Drawing toolbar, choose AUTOSHAPES → BASIC SHAPES and select the
ISOSCELES TRIANGLE option. A text box will appear that says *Create Drawing Here*.
Hold down the SHIFT key and create a medium-sized triangle in the center of the box

❑ Select the FILL COLOR drop-down arrow and fill the shape with a light color. Choose
EDIT → COPY and EDIT → PASTE to duplicate the shape. Fill the new triangle with white.

❑ Make sure the white triangle is selected and choose FORMAT → AUTOSHAPE. Choose
the SIZE tab and enter *50* in both the Height and Width boxes in the Scale group. Click
OK and confirm that the duplicate triangle is half its original size.

❑ Select DRAW → ROTATE or FLIP → FLIP VERTICAL. Reposition the flipped triangle so
its corners touch the midpoints of each side of the original triangle.

❑ With the smaller rectangle still selected, hold down the SHIFT key and select the larger
triangle so that both triangles are selected. Choose DRAW → GROUP to group the two
selected triangles.

❑ Use the COPY and PASTE commands to duplicate the grouped object.
Reposition the two objects so the lower-left corner of one touches the
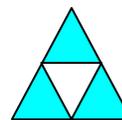
lower-right corner of the other.

❑ Choose the PASTE command again to insert another object. Position the newest object so its bottom corners touch the tops of the other two objects. Click on an empty area of the page to deselect all objects.

❑ Hold down the SHIFT key and select all three objects. Next, choose DRAW → GROUP to group them. Select FORMAT → OBJECT. Click on the SIZE tab, and enter *50* in both the Height and Width boxes in the Scale group. Click OK.

❑ Use the COPY and PASTE commands to duplicate the grouped object. Reposition the two objects so the lower-left corner of one touches the lower-right corner of the other.

❑ Choose the PASTE command again to insert another object. Position the newest object so its bottom corners touch the tops of the other two objects. Deselect the objects.

❑ Repeat the last four steps, then answer the following questions:
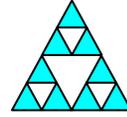
   Of the four triangles below, can you determine the fraction of each shape that is colored?
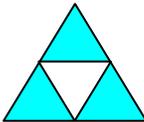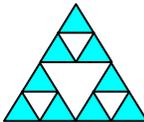
Triangle 1	Triangle 2	Triangle 3	Triangle 4
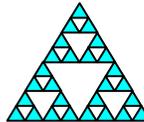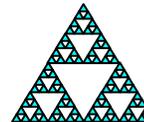
   Can you determine the pattern? Use the pattern to develop a formula to calculate the portion of Triangle n.

❑ Below your Sierpinski Triangle, write a paragraph defining the term fractal, and explain how a pattern was found to determine the fraction of the colored area of the Sierpinski Triangle. Discuss how the complexity of the Sierpinski Triangle affects the fraction of the colored area. Choose INSERT → PICTURE → FROM FILE and insert the fractal graphic saved from the Internet and describe the picture inserted.

❑ Save and print the document. Close the file and exit *Word*.