Additional Activity Materials:

- Handout 1
- Handout 2
- Grid Paper

Fractals: Lesson 5 (Sierpinski Tetrahedron) **Name:**

In the mini-project, you investigated the Sierpinski triangle. Below are the first few stages of this fractal.



1) Suppose the Stage 0 triangle has a side-length of 10.

a. Write an equation that will calculate the side-length of a black triangle at stage "n" (where "n" represents some number).

b. Did you write a linear equation or an exponential equation? Explain why.

2) In this activity you'll investigate the three-dimensional version of the Sierpinski triangle, called a "Sierpinski tetrahedron." Stage 0 of this fractal is a tetrahedron.

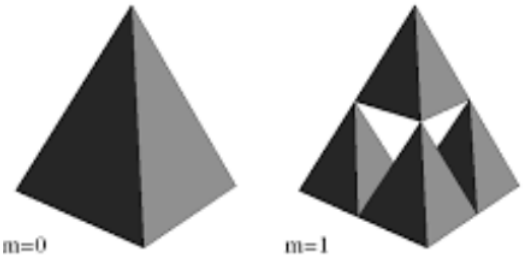
What is a tetrahedron? Look up pictures. How many "faces" does a tetrahedron have? Sketch one below.

3) Look at the first diagram on the "**Fractals: Lesson 5 (Resource Page)**". Here's how it was made:

> Connect the midpoints on the edges of a tetrahedron as shown, keeping the four new smaller tetrahedrons formed at the vertices and removing the remainder of the solid.

To the right is a picture of Stage 0 and Stage 1 of a Sierpinski tetrahedron.

a. How is the construction of the Sierpinski **tetrahedron** similar to the construction of Sierpinski **triangle**? How is it different? Explain.



b. On your handout, color the left-hand faces of the Sierpinski tetrahedron. Then color the right-hand faces with a different color. Now you should be able to clearly see the four pyramids in your design.

c. How many tetrahedrons are in Stage 1 of the fractal?

d. How many pyramids would there be in Stage 2?

4) Now, on the Resource Page, you're going to construct Stage 2 of the Sierpinski tetrahedron.

First, look back at the start of Exercise 3 and review the instructions from making Stage 1 of the fractal. You're going to repeat this process for **each of the tetrahedrons** in Stage 1. Some tips:

- Remember only the visible faces are shown.
- Count dots carefully since each new vertex for the smaller pyramids lies on a dot of the grid.
- The 16 resulting pyramids should all appear to have the same size and shape.

Then shade in all left-hand faces one way and all right-hand faces another way.

Try this for 5 - 10 minutes — but don't get stuck too long.

5) Each tetrahedron has four faces, six edges, and four vertices.

a. In all, how many faces, edges and vertices exist in the 16 resulting Stage 2 tetrahedrons of the object, counting shared vertices only once? How many of the faces are visible?

b. How many tetrahedrons would appear at Stage 3? At Stage 4? At Stage N? Describe how the figure would change if the process were repeated without end.

6)a. Use one of the dot grids on the back of the Resource Page to complete the **view of one face** of a Stage 1 Sierpinski tetrahedron.

b. Use the other dot grids to complete the view of one face of a Stage 2 and then a Stage 3 Sierpinski tetrahedron.

c. Is the pattern familiar? What is it?

7) Now we're going to make Stage 1 and Stage 2 of the **three dimensional model**.

- First, get the triangle grid paper.
- Construct **Stage 1** of the Sierpinski tetrahedron using grid paper and tape. Design it so that the **original Stage 0** tetrahedron has a side-length of 12.
- Now find three other people that have completed Stage 1 of the Sierpinski tetrahedron. Combine your work to make Stage 2. Then Stage 3. And so on.

While you're waiting for other groups to finish, continue working on "**Fractals: Lesson 4 (Part 2)**".