**Activity 5.6.4 Return to Sierpinski**

In Algebra 1, you investigated Sierpinski’s Triangle as part of the unit on patterns. It is time to revisit Sierpinski, this time the focus will be Sierpinski’s Carpet.

Sierpinski’s Carpet is a fractal beginning with a square. A recursive rule is then applied. Each iteration of creating Sierpinski’s Carpet involves dividing all unshaded squares into 9 congruent squares and then shading in the middle square.

**Initial:** Assume that the square below has side length of 1 unit.

1 unit



|  |  |
| --- | --- |
|  | What is the area of the unshaded region?What is the area of the shaded region?How many shaded squares are in the picture?How many line segments are in this picture?(Don’t include the grid lines, just the boundaries of the squares.) |

**Iteration 1:** Divide the unshaded square into 9 congruent squares and then shade in the middle square.

|  |  |
| --- | --- |
|  | What is the area of the unshaded region?What is the area of the shaded region?How many shaded squares are in the picture?How many line segments are in this picture? |

**Iteration 2:** Starting from the last iteration, divide each unshaded square into 9 congruent squares and then shade in each middle square.

|  |  |
| --- | --- |
|  | What is the area of the unshaded region?What is the area of the shaded region?How many shaded squares are in the picture?How many line segments are in this picture? |

**Iteration 3:** Starting from the last iteration, divide each unshaded square into 9 congruent squares and then shade in each middle square.

|  |  |
| --- | --- |
|  | What is the area of the unshaded region?What is the area of the shaded region?How many shaded squares are in the picture?How many line segments are in this picture? |

Keep in mind that a fractal is created by applying the recursive rule an infinite number of times. You are going to determine formulas to describe the fractal for any given iteration in this infinite process.

**Iteration n:** Organize your information from the initial shape and the first three iterations in the table below.

Once you have first four rows of the table complete, turn your attention to the individual columns. For each column, you need to determine a formula that will result in the correct value for the **nth** iteration. The formulas may or may not be dependent on finite geometric series. Part of the goal here is to determine whether or not geometric series are needed.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Area of Unshaded Region** | **Area of Shaded Region** | **Number of Shaded Squares** | **Number of Line Segments** |
| **Initial** |  |  |  |  |
| **Iteration 1** |  |  |  |  |
| **Iteration 2** |  |  |  |  |
| **Iteration 3** |  |  |  |  |
| **Iteration n** |  |  |  |  |

**Reflection:** Which columns involved finite geometric series? When you were developing the general formulas, how did you determine whether or not you had a geometric series?