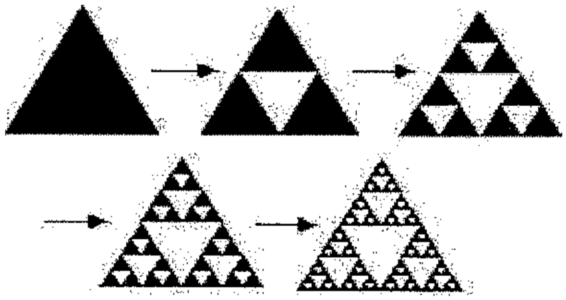
CCSS Algebra 4 AA4: Exponents Name ____________________

1. Sierpinski's Triangle is a famous and simple **fractal. Fractals** are patterns where part of the pattern is similar to the whole pattern. Use the first 5 steps of Sierpinski's fractal shown below to complete the table:



Stage	0	1	2	3	4	5
Number of Shaded Triangles	1	3	9	27	81	243
Fraction of Big Triangle Shaded	1/1	3/4	9/16	27/64	81/256	243/1024

2. Describe how the number of shaded triangles are growing in the pattern. Is this growth linear? Explain how you know.

Not linear. It's multiplying.

3. Describe how the fraction of the triangle that is shaded is changing in the pattern. Is the fraction of the triangle that is shaded increasing or decreasing? Is this change linear? Explain how you know.

Decreasing. Not linear. Multiplying.

4. If you extended Sierpinski's Triangle to stage 10, how many shaded triangles would the triangle have? What fraction of the triangle would be shaded? Show your thinking.

$1(3)^{10} = 59049$

5. What if you extended Sierpinski's Triangle to stage 20? Stage 50? Can you determine a general rule for determining the number of shaded triangles at any stage (in other words, stage x)?

$1(3)^{20}$ ✓ $1(3)^{50}$ ✓ $1(3)^{x}$

6. Can you determine a general rule for determining the fraction of the triangle that is shaded at any stage?

$\frac{3^x}{4^x}$ or $\left(\frac{3}{4}\right)^x$

7. If you kept going forever, how many shaded triangles would you end up with in Sierpinski's Triangle?

Infinity!

8. What fraction of the triangle would be shaded?

Zero!

9. What if you wanted to count the number of shaded triangles in 3 Sierpinski's fractals? How does this affect the general rule you found in question 6? Can you simplify the new rules?

$3 \cdot \text{Old rule} = 3(3)^x = 3^{x+1}$

10. Assume now that only 1 out of every 3 triangles are shaded at each stage of Sierpinski's fractal. How does this affect the general rules you found in question 6? Can you simplify the new rules?

Shaded △s	Fraction
$y = 1$	$y = (1/4)^x$

11. Watch: Doodling in Math Class: Infinite Elephants. Write a brief summary of what was described and how it relates to Sierpinski's Triangle.

Fit infinite shapes in a finite area by using an exponential decay.

12. Create your own "Sierpinski like" fractal. Give it a name. Choose how much to shade in each stage and write a general rule for the number of shaded objects and the fraction of the object that is shaded.