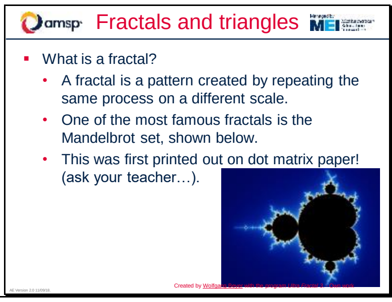
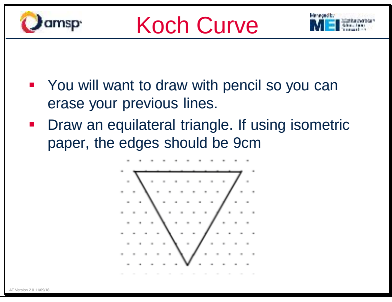
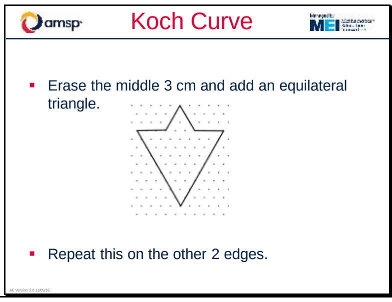
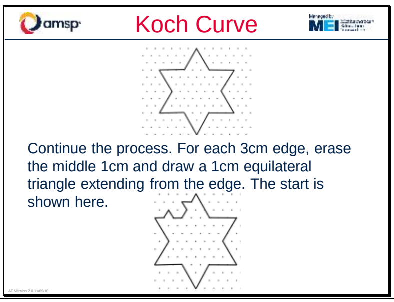
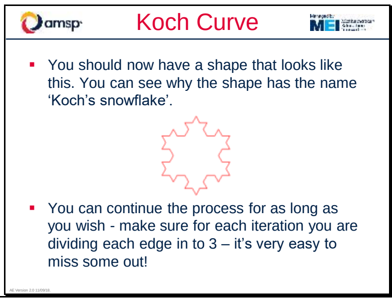
Fractals teachers notes.

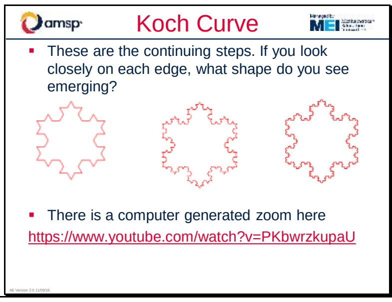
Slide 3		
Slide 4		Drawing Koch's snowflake without isometric paper is challenging, but some students may enjoy the challenge!
Slide 5		If using isometric paper, ensure that students are using the dots to make equilateral triangles.
Slide 6		

Slide 7

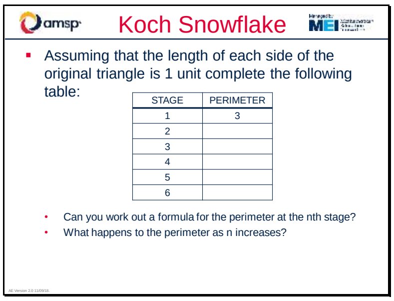


It is at this iteration that many students start missing edges to add the little triangle on (also when there are no dots to use if using isometric paper).

Slide 8

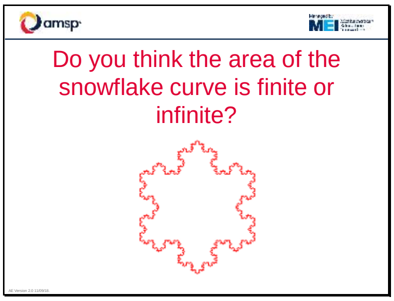
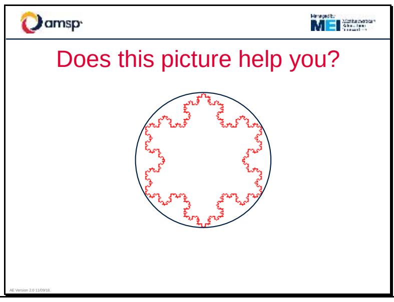
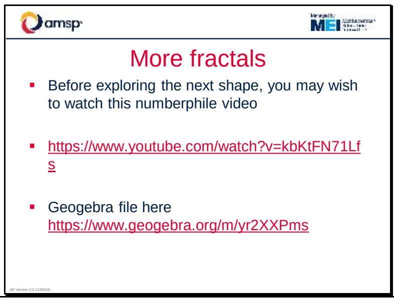
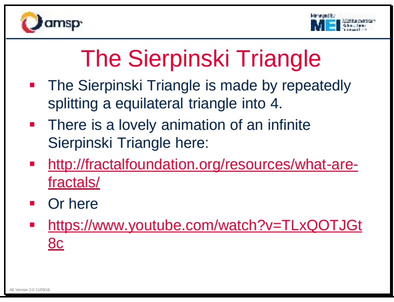


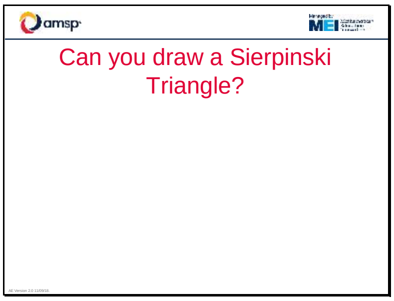
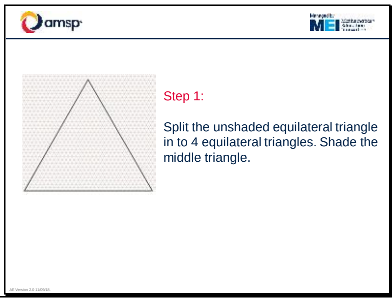
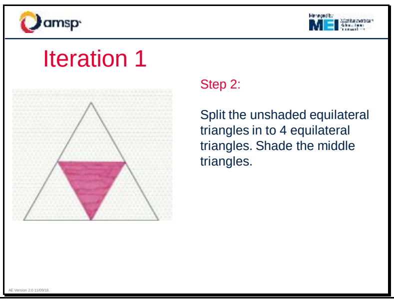
Slide 9



Stage	Perimeter
1	3
2	4
3	$\frac{16}{3}$
4	$\frac{64}{9}$
5	$\frac{256}{27}$
6	$\frac{1024}{81}$
n	$3\left(\frac{4}{3}\right)^{n-1}$

The concept of a fractal having infinite perimeter is not obvious for many students and is worth exploring. The snowflake zoom youtube clip can often help students convince themselves that it's not mathematical hocus-pocus and that the perimeter really is infinite!

Slide 10		The amazing aspect of the Koch snowflake is that the perimeter infinitely increases. However, the area is bounded by a circle, which would also bound the original triangle, so you have an infinite perimeter enclosing a finite area. The limit of the area is 8/5 of the original triangle. Students may wish to derive this, but it is not a straight forward process.
Slide 11		
Slide 12		
Slide 13		

Slide 14	 	Ask the students to draw the Sierpinski Triangle. There are various levels of challenge: If they've watched the video, you could give your students a blank sheet of triangular paper. They would have to work out how big to make the triangle themselves. Or Give them an outline of the large triangle they can use to get them started. Or You can take them through slides 15-20, which show each iteration of the triangle. Triangle paper is available in the fractals workbook on this page https://amsp.org.uk/resource/11-16-enrichment-lessons
Slide 15	 	
Slide 16	 	

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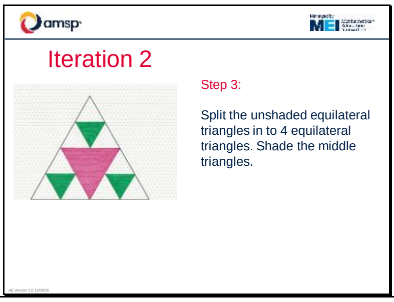
<tr><td>Slide 17</td><td>
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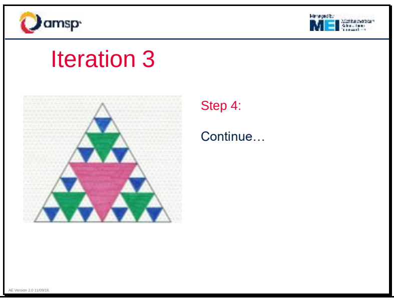
<tr><td>Slide 18</td><td>
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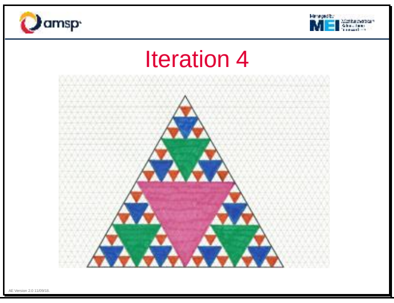
<tr><td>Slide 19</td><td>
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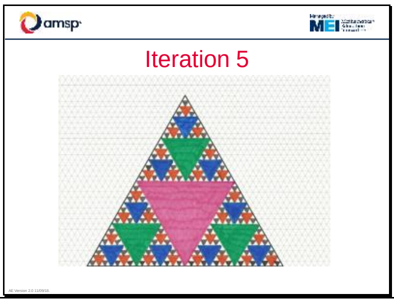
<tr><td>Slide 20</td><td>
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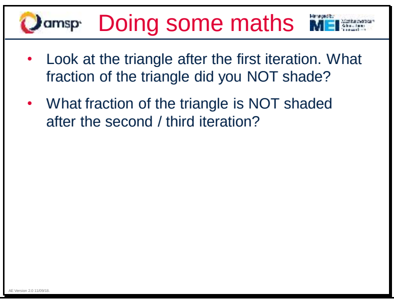
<tr><td>Slide 21</td><td>
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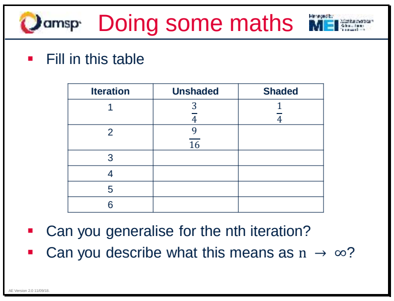
Slide 22



Iteration	Unshaded	Shaded
1	$\frac{3}{4}$	$\frac{1}{4}$
2	$\frac{9}{16}$	$\frac{7}{16}$
3	$\frac{27}{64}$	$\frac{37}{64}$
4	$\frac{81}{256}$	$\frac{175}{256}$
5	$\frac{243}{1024}$	$\frac{781}{1024}$
6	$\frac{3^6}{4^6}$	$1-\frac{3^6}{4^6}$
n	$\frac{3^n}{4^n}$	$1-\frac{3^n}{4^n}$

It is worth exploring what students think happens to the limits as $n \to \infty$, as many students will not realise that

$\frac{3^n}{4^n} \to 0$ as $n \to \infty$,

Slide 23