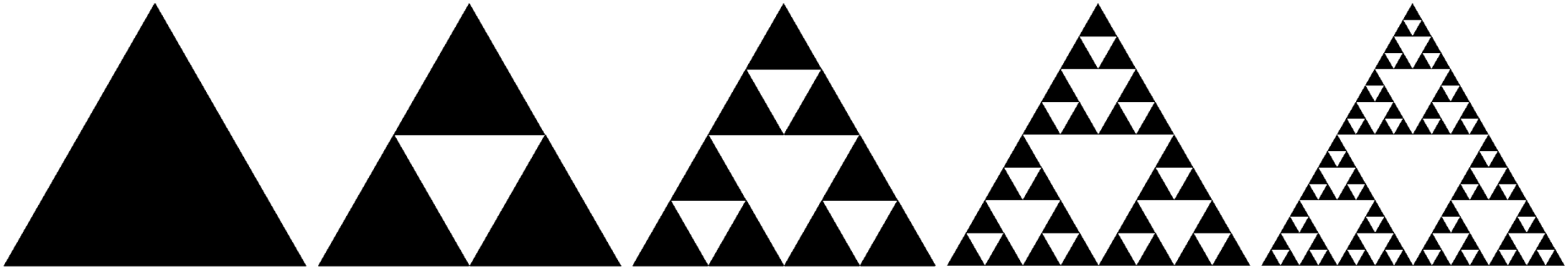
Merry Fractmas: teacher resources for integrating fractal geometry into Christmas crafts

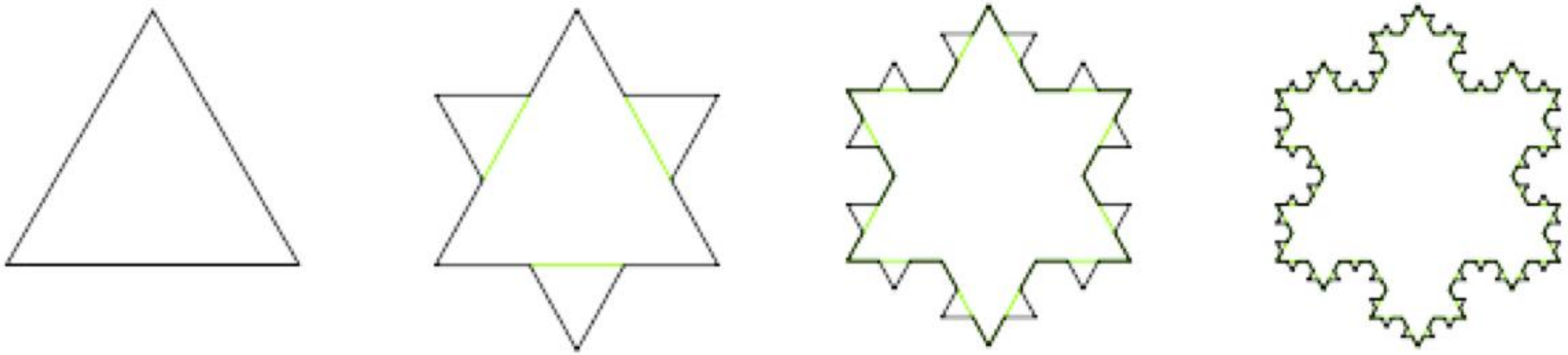
What is a Fractal?

They are geometric shapes in which patterns recur at progressively smaller scales. Each part of the shape has the same character as the whole: they are self-similar. They are often very pleasing to the eye and are sometimes found in nature. They are useful in modelling structures (such as snowflakes or the coastline) and in describing partly phenomena such as the shape of lightning bolts, crystal growth, or galaxy formation.

Equilateral Triangle Examples



This is the progression of a Sierpiński Triangle, named in 1915, by Wacław Sierpiński, from Poland. The triangles are equilateral and at different sizes they fit inside each other perfectly. It repeats again and again inside of itself. It can go on forever in this way, the triangles getting smaller and smaller each time.

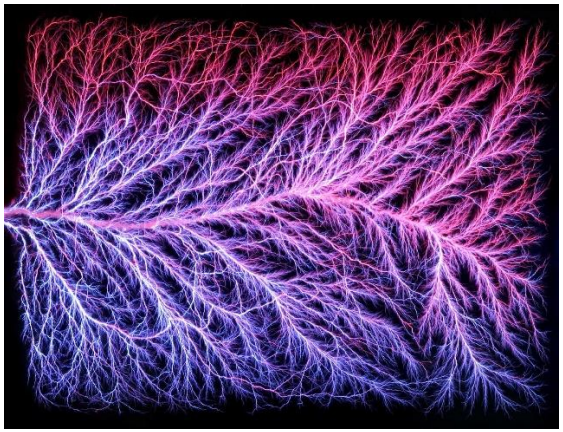


This is the Koch Star, explained in 1904, by Helge van Koch, from Sweden. The star starts life as an equilateral triangle and keeps adding smaller triangles on each of the outside sides.

Fractals in Nature

Romanesco Broccoli – repeating cone shapes

Unfolding fern – repeating spiral patterns



Electricity – repeating branching patterns

Christmas Craft Ideas for Classrooms

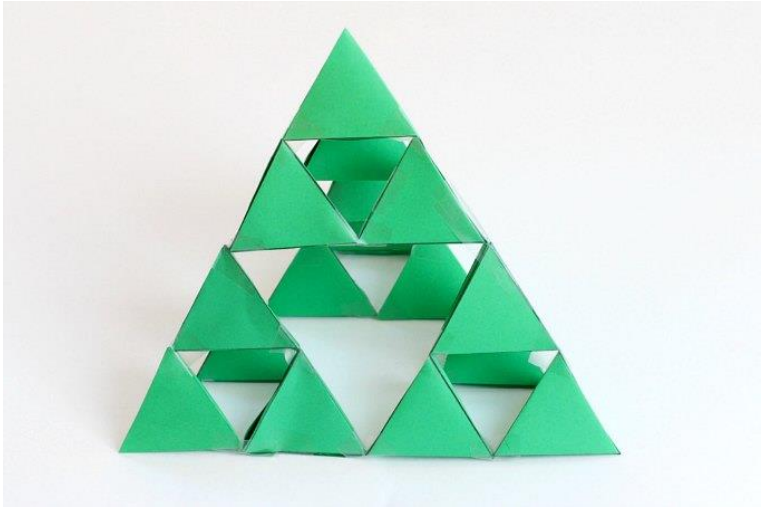
1. Colour in a fractal tree card. (Approx. age range: KS1/First Level+)
   Using the template on the penultimate page of this document, challenge your pupils to colour in the fractal shapes to make a Christmas card to take home.

2. Make your own fractal tree card. (Approx. age range: upper KS1/First Level+)
   Using the template on the last page of this doc, challenge your class to finish the Sierpiński Triangle. Using a ruler, children must measure halfway along each of the triangle's sides and make a small mark. Once they have done all three sides, join them together to make another triangle inside it. Keep repeating this process with all the upright triangles (△) until it gets too small and fiddly. (Downward triangles ▽ stay blank). Colour it in and fold to make a Christmas card to take home.

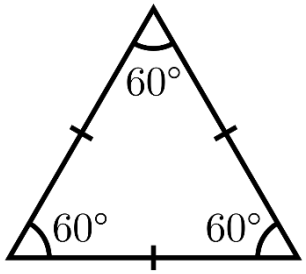
3. Make your own Koch Star snowflake (right). (Approx. age range: KS2/Second Level+)
   Using 2 sheets of A4 coloured paper and 6 sheets of A7 coloured paper (we suggest including green and red) fold equilateral triangles origami-style and arrange into a snowflake, or anything your pupils can imagine. A handy folding guide for an equilateral triangle can be found here: https://nrich.maths.org/5372. A video of us folding a triangle can be found here: https://youtu.be/yiOYilsyH-g.

4. Make your own pop-up 3D fractal tree card. (Approx. age range: upper KS2/Second Level+)
   Using two pieces of A4 coloured card (we suggest red and green), children must measure, cut, and fold various steps to make a pop-up fractal tree. A handy guide: https://fractalfoundation.org/resources/fractivities/fractal-cutout/ and a good video: https://www.youtube.com/watch?v=iL0yNV-AZAs&ab_channel=EmmaMorgan

5. Make a 3D festive fractal tree in class (right). (Approx. age range: KS3+)
   Make a 3D classroom Christmas tree using the Sierpiński Triangle tetrahedron net from *Think Maths* (https://www.think-maths.co.uk/sites/default/files/2018-01/think_maths_-_sierpinski_tetrahedron_worksheet.pdf). For a star, you might like to use the Koch snowflake net (https://www.think-maths.co.uk/sites/default/files/2018-01/think_maths_-_fractal_christmas_tree_worksheet.pdf).
   See examples of the finished article here: http://www.think-maths.co.uk/festive-fractal-trees



Follow-on Activities / Resources



With any of the equilateral triangles you have drawn, you can:
- reinforce what makes a triangle equilateral (all sides same length)
- task pupils to work out/measure the perimeter of the triangle (by addition or multiplication)
- task pupils to work out/measure the angle in each corner (60°)
- ask pupils to count how many triangles they can see
- task pupils to work out the area of the triangle
- compare the areas and the perimeters of different sized equilateral triangles.

Some mesmerising videos at high-speed delivery about maths and nature can be found on: https://www.youtube.com/watch?v=ahXIMUkSXX0&ab_channel=Vihart

Some fractal colouring sheets can be found on: https://coloringhome.com/fractal-coloring-pages-printable

Fancy putting on some festive music while you work in class? *'A Letter to Santa'* can be looped to create a festive atmosphere here - https://woodhorn-my.sharepoint.com/:u:/g/personal/rcooper_museumsnorthumberland_org_uk/ESOafH5xfaxEprS7MkibWBABo1OC7hO4Ztk-AAyM_eXDFA?e=xhHnKm

The repeating triangle pattern in this Christmas tree can go on forever. This is called a Sierpiński Triangle, named in 1915 by Wacław Sierpiński, from Poland. The triangles are all equilateral – all the sides are the same length – and at different sizes they fit inside each other perfectly. The snowflakes are the same. These are called Koch Stars, explained in 1904, by Helge van Koch, from Sweden. The star starts life as an equilateral triangle, too, and keeps adding smaller triangles on each outside side. They create a stunning snowflake which is similar to those in real life.

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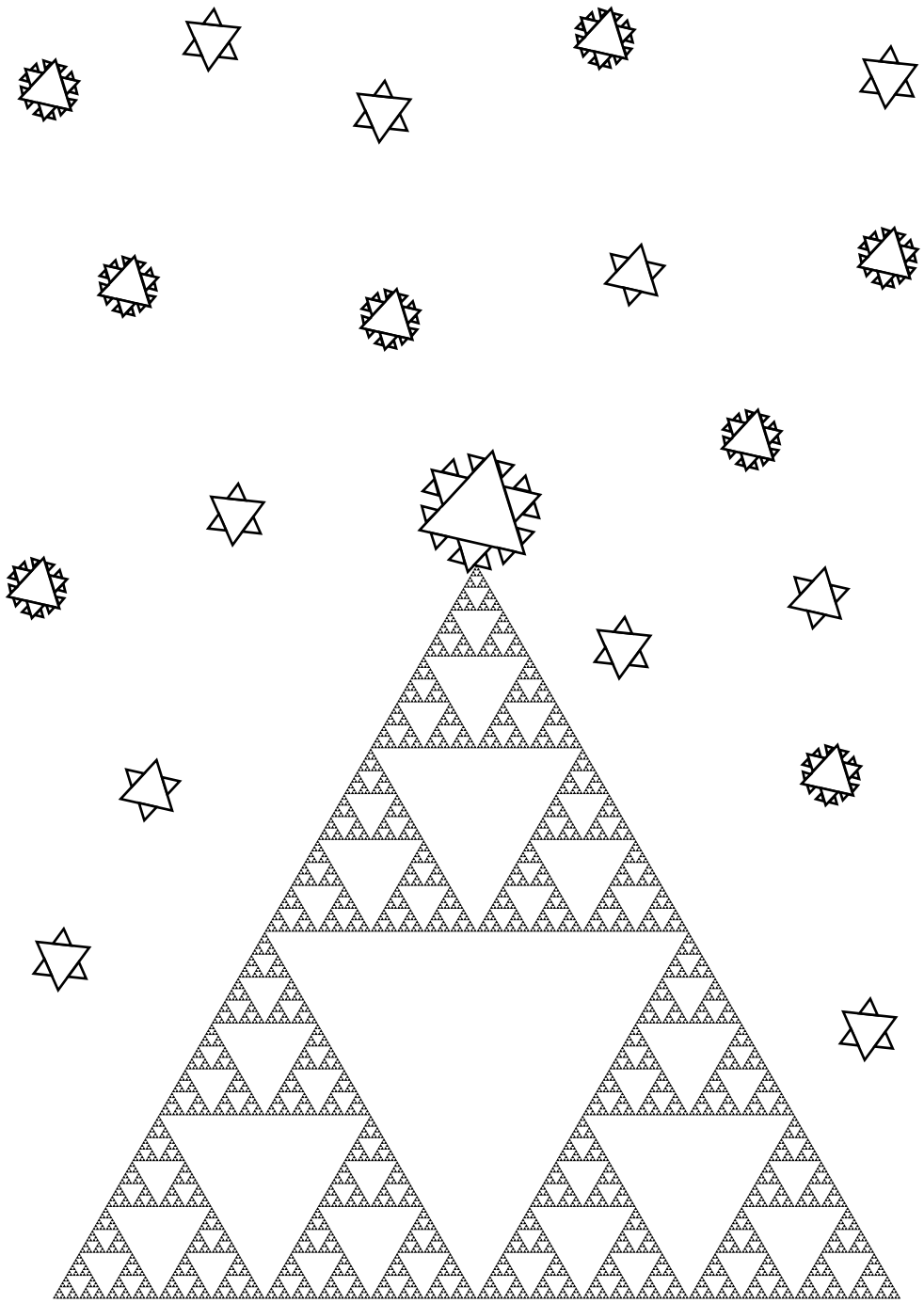

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