BIG AND SMALL ALIKE

Geometric figures that are composed of scaled-down versions of themselves are known as fractals. That means that if you enlarge a section of a fractal to any extent, its geometry remains unchanged (self-similarity). The Mandelbrot set, named after mathematician Benoit Mandelbrot, is a well-known fractal that appears here as a translucent background. However, fractals aren't simply a mathematical construct – in our environment, too, there are objects with fractal structures. Researchers from the Max Planck Institute for Terrestrial Microbiology in Marburg have now discovered that even proteins can have fractal structures.

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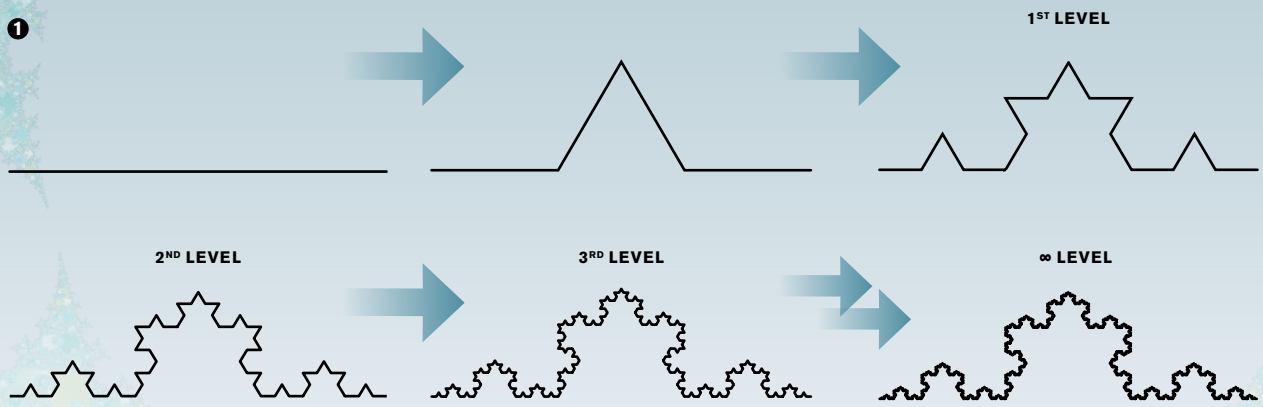

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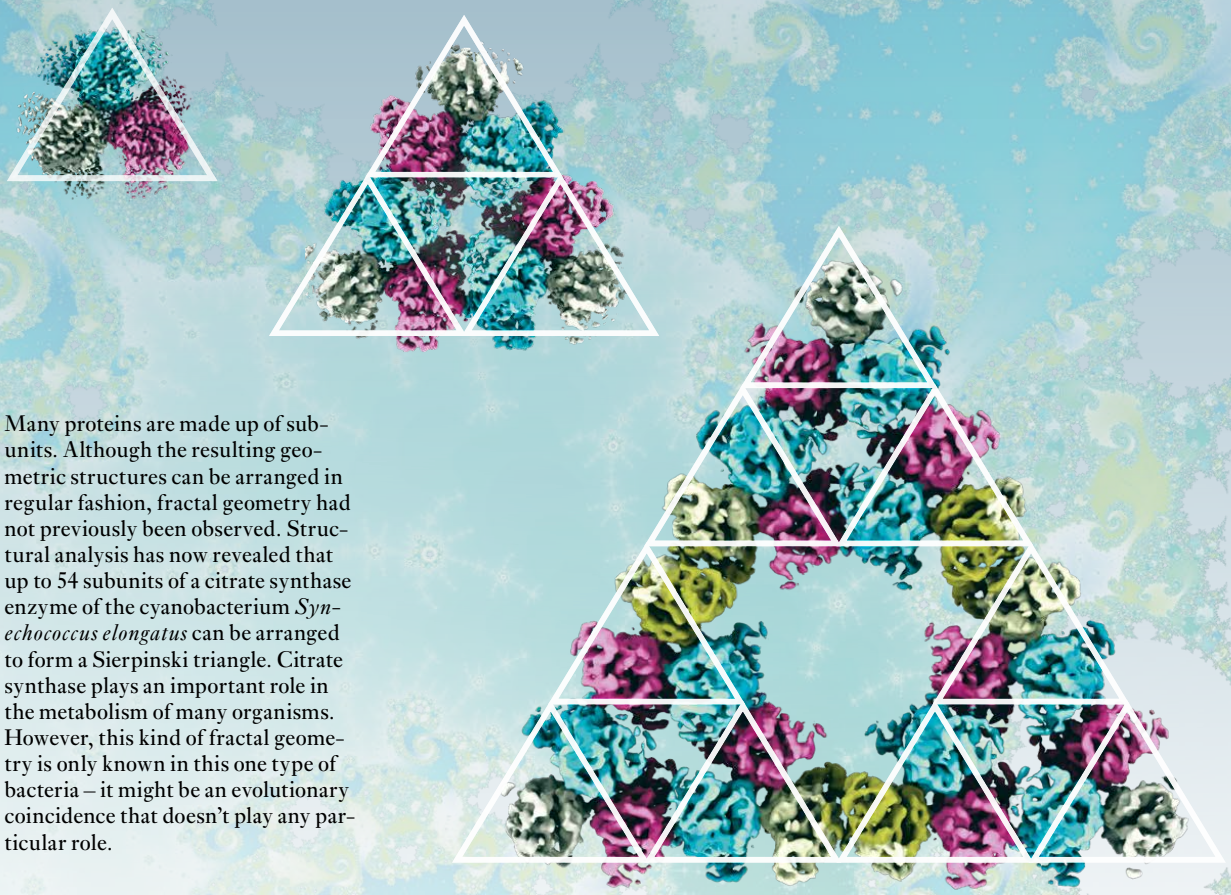
The Koch curve ❶ is based on a simple rule: the sides of an equilateral triangle are inserted into the middle third of a line. If this process is repeated again and again, you get a fractal that looks like a snowflake. The Sierpinski triangle ❷ is also a fractal. It is created when you connect the central points of the sides of a triangle with lines. The result is four smaller triangles, of which the central smaller triangle is then removed. This process can be applied as many times as you like to the remaining triangles as they get smaller and smaller.



Many proteins are made up of subunits. Although the resulting geometric structures can be arranged in regular fashion, fractal geometry had not previously been observed. Structural analysis has now revealed that up to 54 subunits of a citrate synthase enzyme of the cyanobacterium *Synechococcus elongatus* can be arranged to form a Sierpinski triangle. Citrate synthase plays an important role in the metabolism of many organisms. However, this kind of fractal geometry is only known in this one type of bacteria – it might be an evolutionary coincidence that doesn't play any particular role.

Other self-similar objects in nature include fern leaves and mountains, for example. In architecture, too, there may be fractal structures. Unlike mathematical fractals, however, natural fractals do not have an infinite number of self-similar levels.