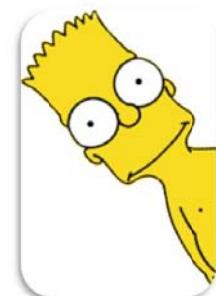
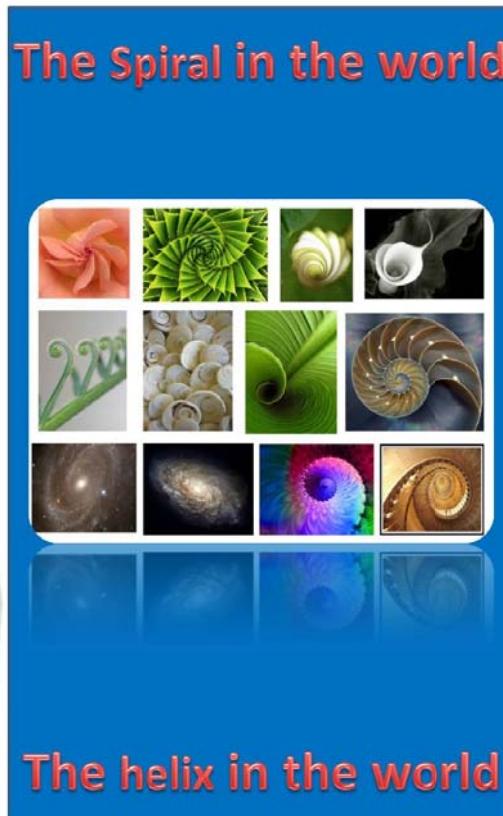


The Spiral and Helix Log book



Dr. Francisco José Serón Arbeloa

<http://webdiis.unizar.es/~seron/>

francisco.serón@gmail.com

Junio de 2015

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Introduction

The visual motif of the spiral and helix is one of the oldest and most enigmatic sacred images known. It is one of the earliest examples of human creative expression, appearing in nearly every society in the ancient world. The spiral and hélix has universal appeal and has a mysterious resonance with the human spirit, it is complex yet simple, intriguing and beautiful.

The spiral and hélix pattern is found extensively in nature – encoded into plants, animals, humans, the earth and galaxies around us.

Mathematics can explain the complex algorithms, sequences and equations that make up a spiral and helix pattern, but it can't explain the lure and fascination of the spiral to the human heart.

I always wanted to write a little **logbook** that focuses on my incomplete collection of images on “*spiral and hélix shapes*”. Today, I finally have time to do so.

For each image, I give the reference of website where I have found.

If someone send me references about unknown images to me, I will be very grateful and I will add in subsequent versions of this document.

This document does not have any commercial purpose. If someone believes I should remove his image, so just ask.

Enjoy the experience.

Francisco José Serón Arbeloa
Junio 2015

Here are some beautiful examples of spirals and helix from the natural world.

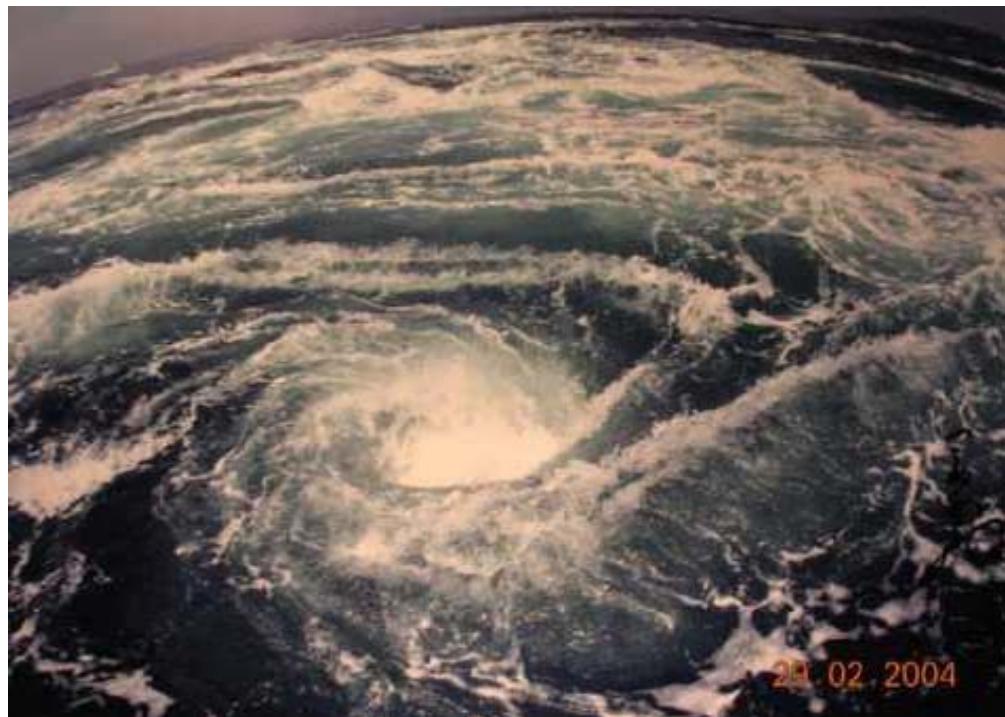
<https://originalbeauty.wordpress.com/2009/06/27/spirals-in-nature/>



Millipede Spiral
(www.magickcanoe.com/millipede/narceus-spiral-sm.jpg)



Weather pattern over Iceland
http://en.wikipedia.org/wiki/File:Low_pressure_system_over_Iceland.jpg



Whirlpool
(www.unoriginal.co.ok/gallerymisc58.html)



Goat with Spiral Horns
(www.bukisa.com/articles)



Spiral Mollusc Fossil
(from http://www.xahlee.org/xamsi_calku/fossil/fossil.htm)



Garden Snail Spiral shell
(xahlee.org/xamsi_calku/snail/snail.html)



*Fern Spiral - archimedes pattern
(by lopolis on Flickr)*



Human Fingerprint - whorl
(at<http://www.ridgesandfurrows.com>)



Human hair, double crown.



Romanesco brassica (wikipedia)



Red Cabbage, compound spiral (photo: Ian Alexander <http://www.easyweb.easynet.co.uk/~iany>)



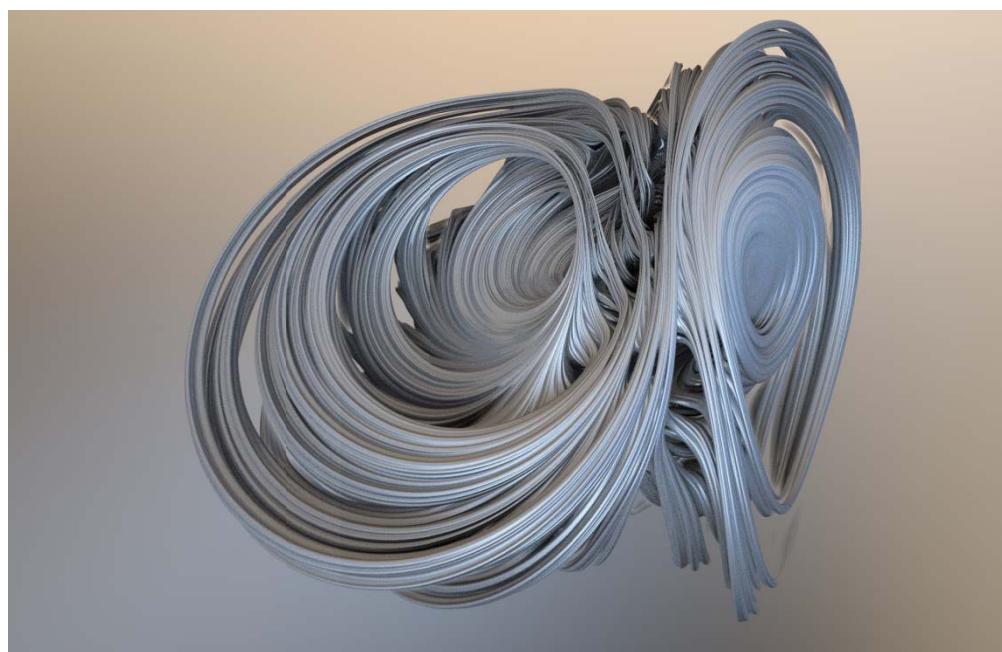
<http://www.livescience.com/24997-spiral-galaxy-ngc-1232.html>



https://www.nasa.gov/mission_pages/chandra/multimedia/spiral-galaxy-m51.html



<http://astronomy.swin.edu.au/~gmackie/MAG/chap1.html>

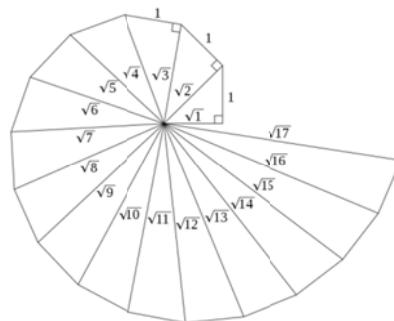


<http://blog.hvidtfeldts.net/media/ibl1.jpg>

In mathematics, a **spiral** is a curve which emanates from a central point, getting progressively farther away as it revolves around the point.

Two major definitions of "spiral" are:

- A curve on a plane that winds around a fixed center point at a continuously increasing or decreasing distance from the point.



spiral of Theodorus

- A three-dimensional curve that turns around an axis at a constant or continuously varying distance while moving parallel to the axis; a helix.



<https://en.wikipedia.org/?title=Spiral>

The spirals in the world

In mathematics, a **spiral** is a curve which emanates from a central point, getting progressively farther away as it revolves around the point.

Two major definitions of "spiral" in a respected American dictionary are:

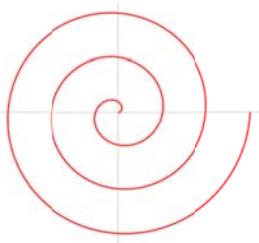
- a. A curve on a plane that winds around a fixed center point at a continuously increasing or decreasing distance from the point.
- b. A three-dimensional curve that turns around an axis at a constant or continuously varying distance while moving parallel to the axis; a helix.

Two-dimensional spirals

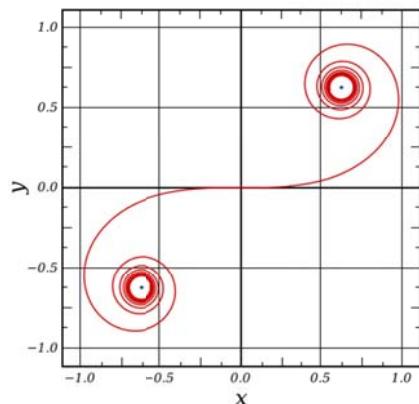
A two-dimensional spiral may be described most easily using polar coordinates, where the radius r is a monotonic continuous function of angle θ .

The circle would be regarded as a degenerate case (the function not being strictly monotonic, but rather constant).

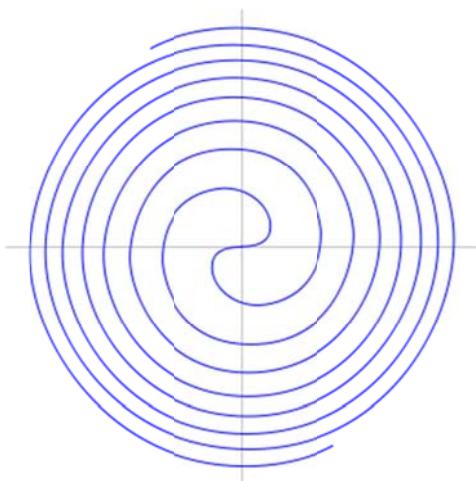
Some of the more important sorts of two-dimensional spirals include:



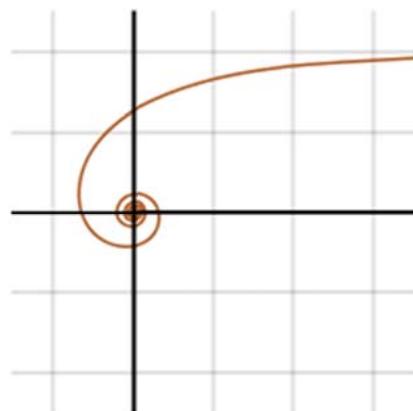
Archimedean spiral $r = a + b \cdot \theta$



Cornu Euler spiral

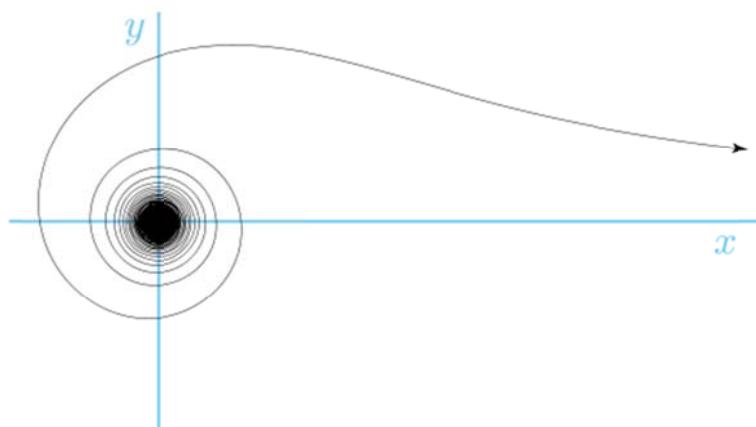


Fermat's spiral $r = \theta^{1/2}$



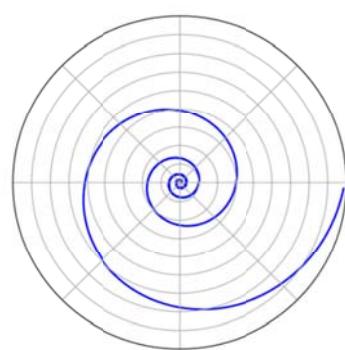
hyperbolic spiral

$$r = a/\theta$$



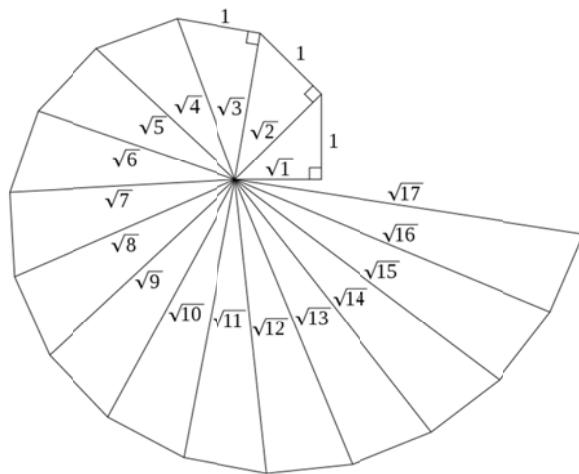
lituus spiral

$$r = \theta^{-1/2}$$



logarithmic spiral

$$r = a \cdot e^{b\theta}$$



spiral of Theodorus; an approximation of the Archimedean spiral composed of contiguous right triangles

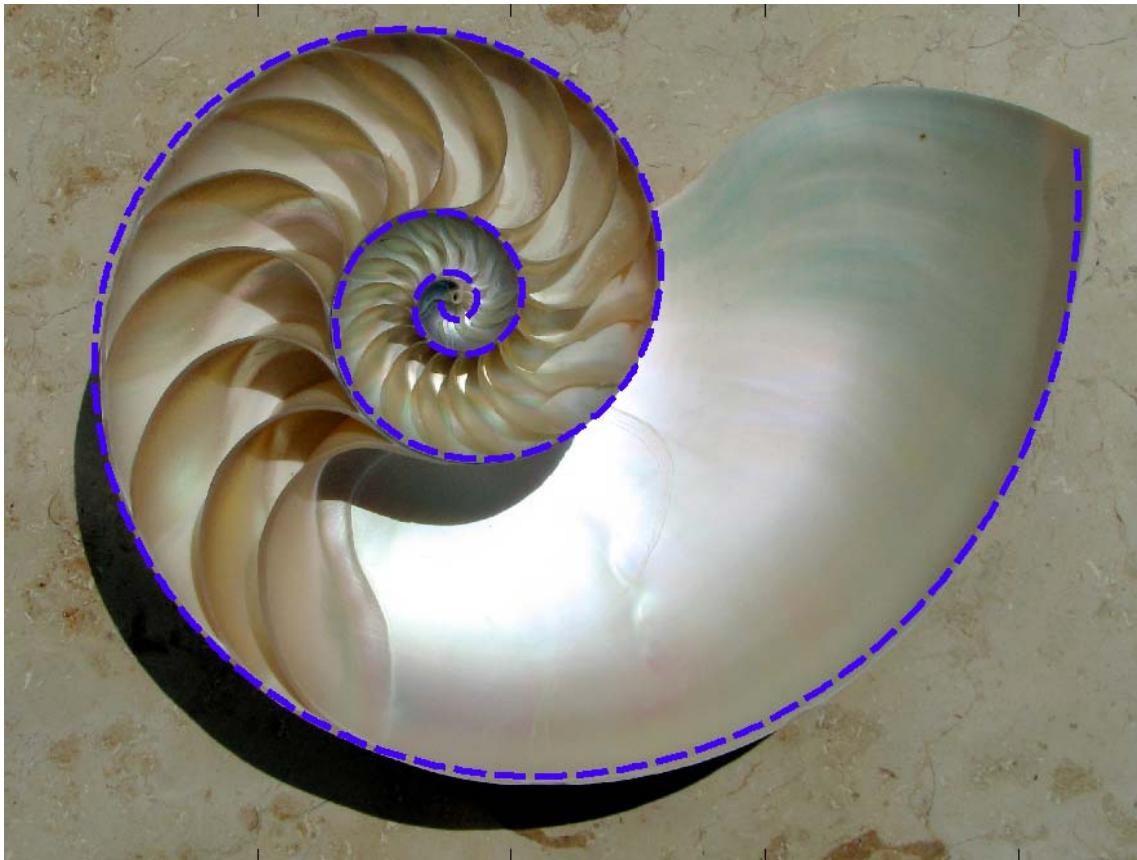
A **logarithmic spiral, equiangular spiral or growth spiral** is a self-similar spiral curve which often appears in nature. The logarithmic spiral was first described by Descartes and later extensively investigated by Jacob Bernoulli, who called it *Spira mirabilis*, "the marvelous spiral".

In polar (r, θ) coordinates the logarithmic curve can be written as

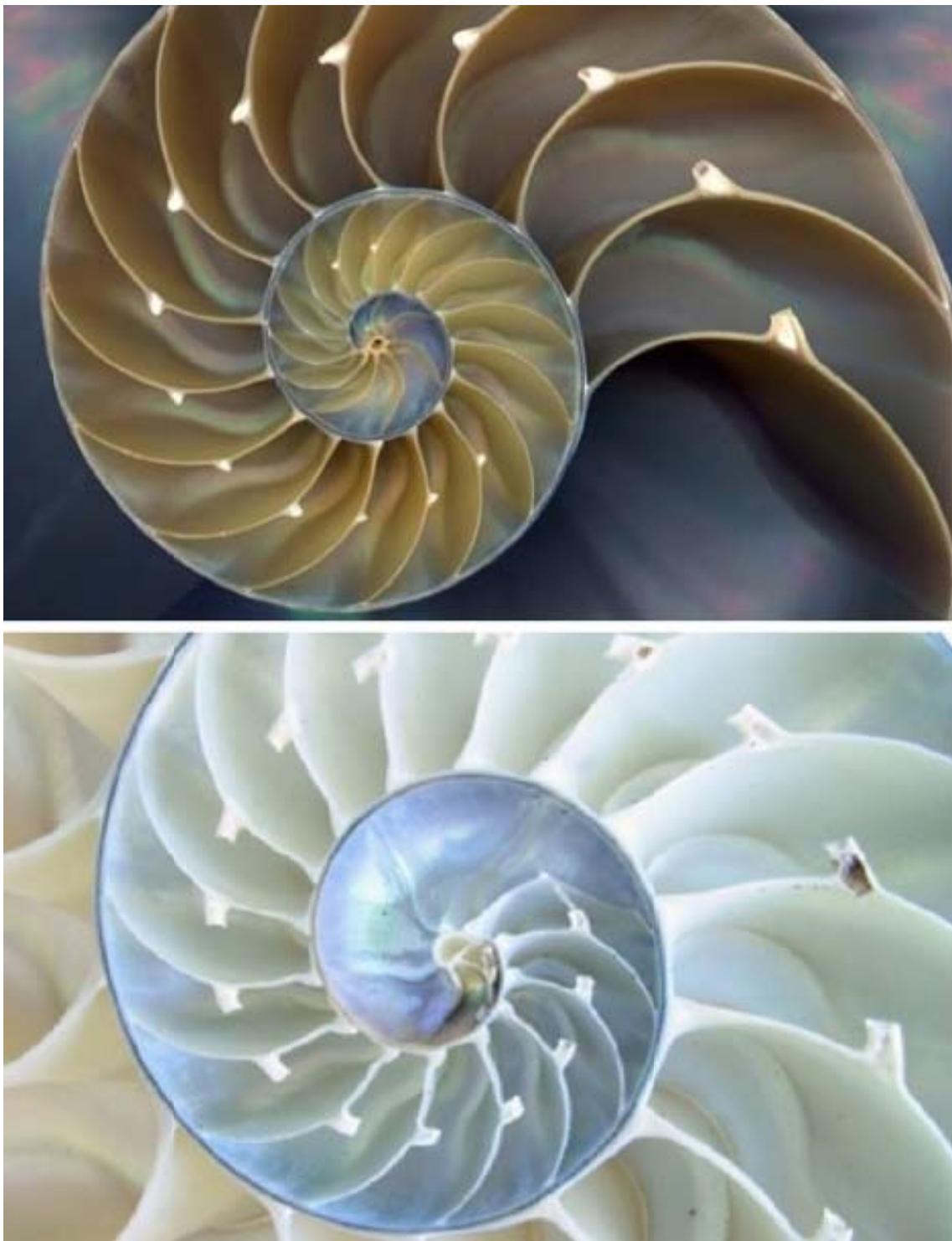
$$r = ae^{b\theta}$$

with real numbers **a** and **b**. Changing the parameter **a** will turn the spiral, while **b** controls the distance between successive turnings.

https://en.wikipedia.org/?title=Logarithmic_spiral



Cutaway of a nautilus shell showing the chambers arranged in an approximately logarithmic spiral. The plotted spiral (dashed blue curve) is based on growth rate parameter $b = 0.1759$.

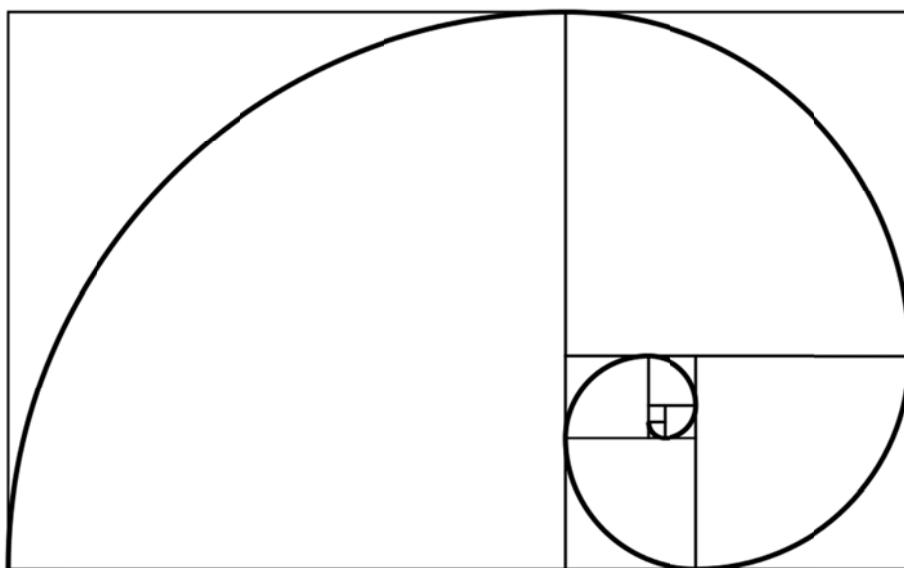


<http://heroesolvidados.foroes.org/t1232p60-cosas-curiosas-1-parte-aviso-18>

The golden ratio also is called the **Golden mean** or **Golden section** (Latin: *sectio aurea*). Other names include **extreme and mean ratio**, **medial section**, **divine proportion**, **divine section** (Latin: *sectio divina*), **golden proportion**, **golden cut**, and **golden number**.

$$\varphi = \frac{1 + \sqrt{5}}{2} = 1.6180339887\dots$$

In geometry, a golden spiral is a logarithmic spiral whose growth factor is φ , the golden ratio.



A Fibonacci spiral approximates the golden spiral using quarter-circle arcs inscribed in squares of integer Fibonacci-number side, shown for square sizes 1, 1, 2, 3, 5, 8, 13, 21, and 34.

*Note: In mathematics, the **Fibonacci numbers** or **Fibonacci sequence** are the numbers in the following integer sequence:*

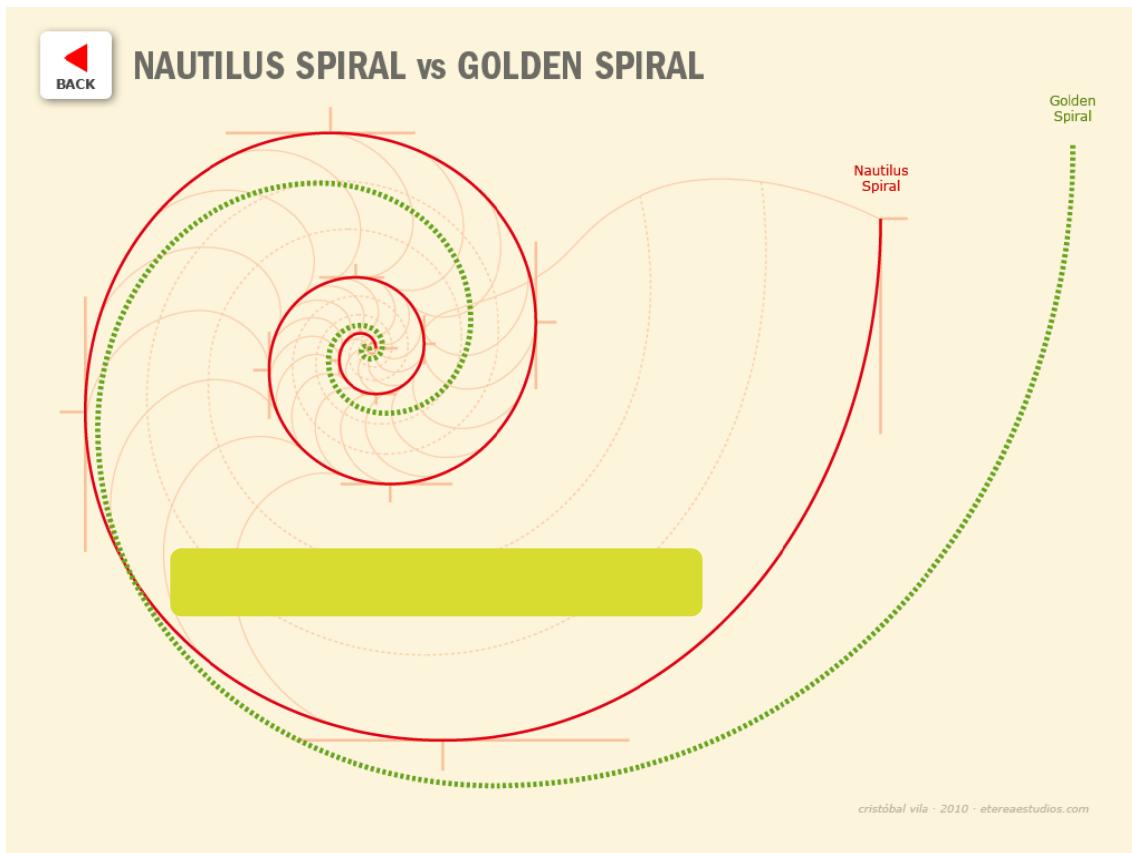
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, ...

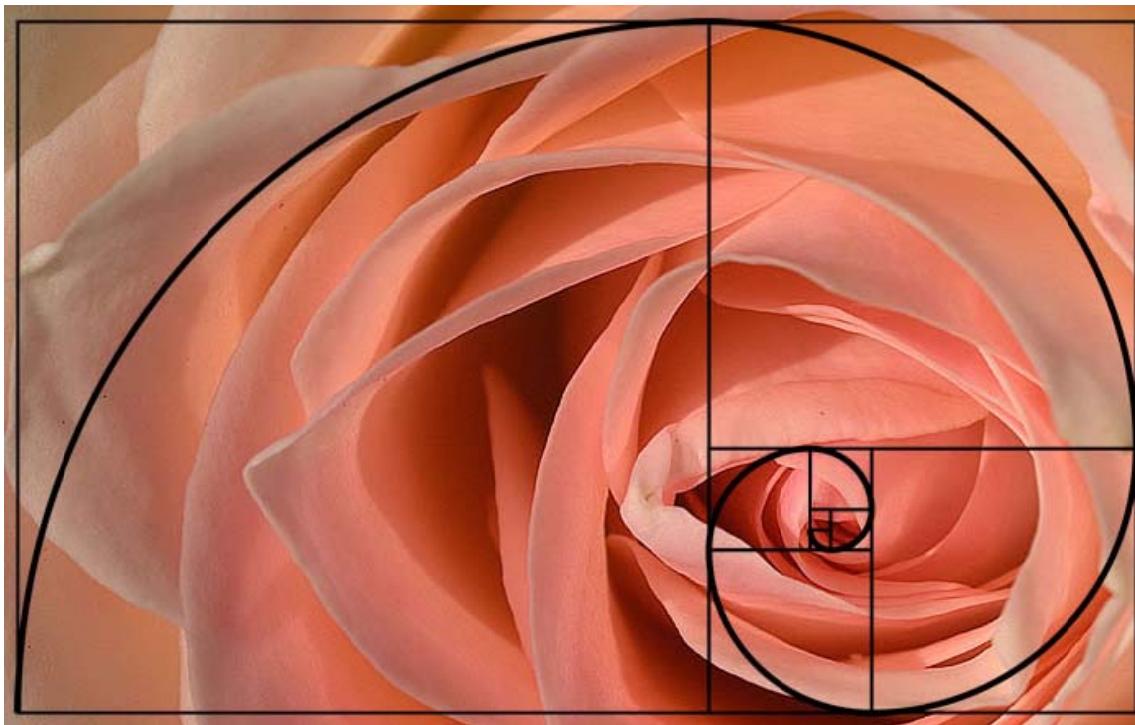
In mathematical terms, the sequence F_n of Fibonacci numbers is defined by the recurrence relation

$$F_n = F_{n-1} + F_{n-2},$$

with seed values

$$F_1 = 1, F_2 = 1$$





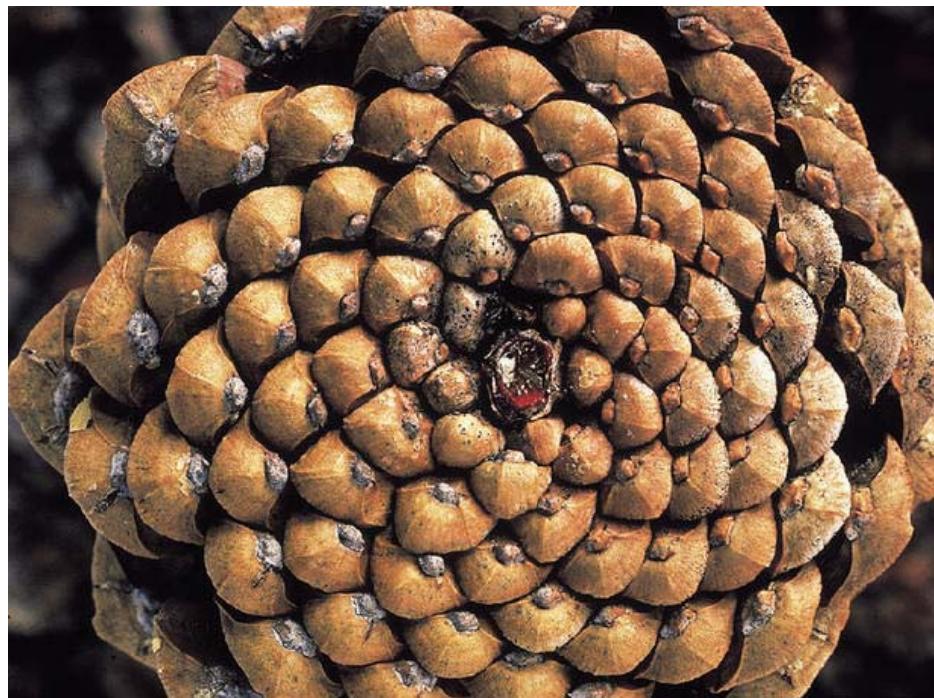
<http://imgarcade.net/1/fibonacci-spiral-in-plants/>

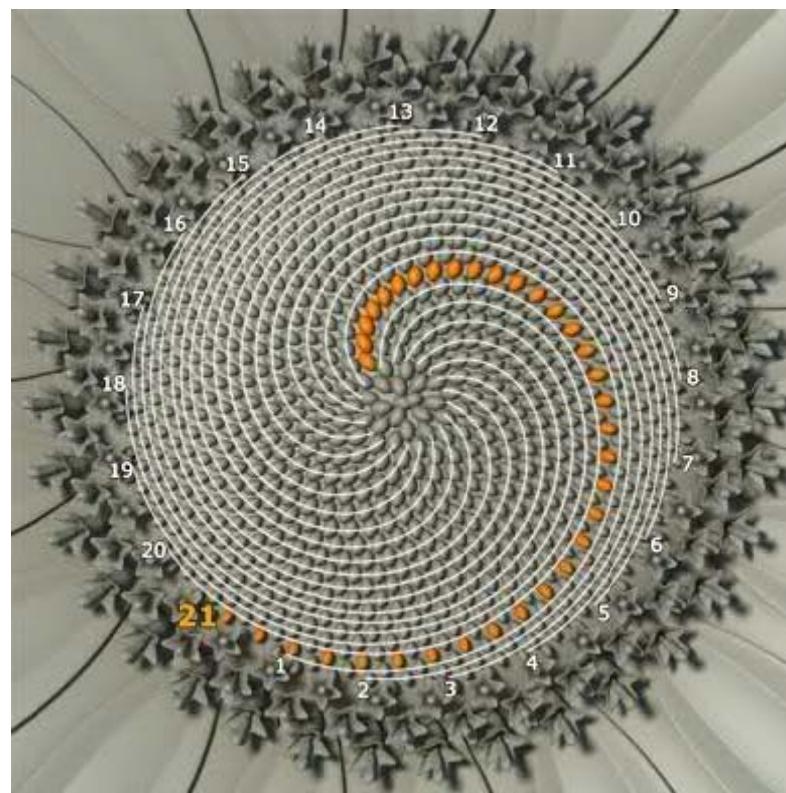


<http://sumpics.com/photo/blog/golden-spiral-rule-of-composition/>



<https://ovnisyfenomenosparanormales.wordpress.com/category/espiral-aurea/>

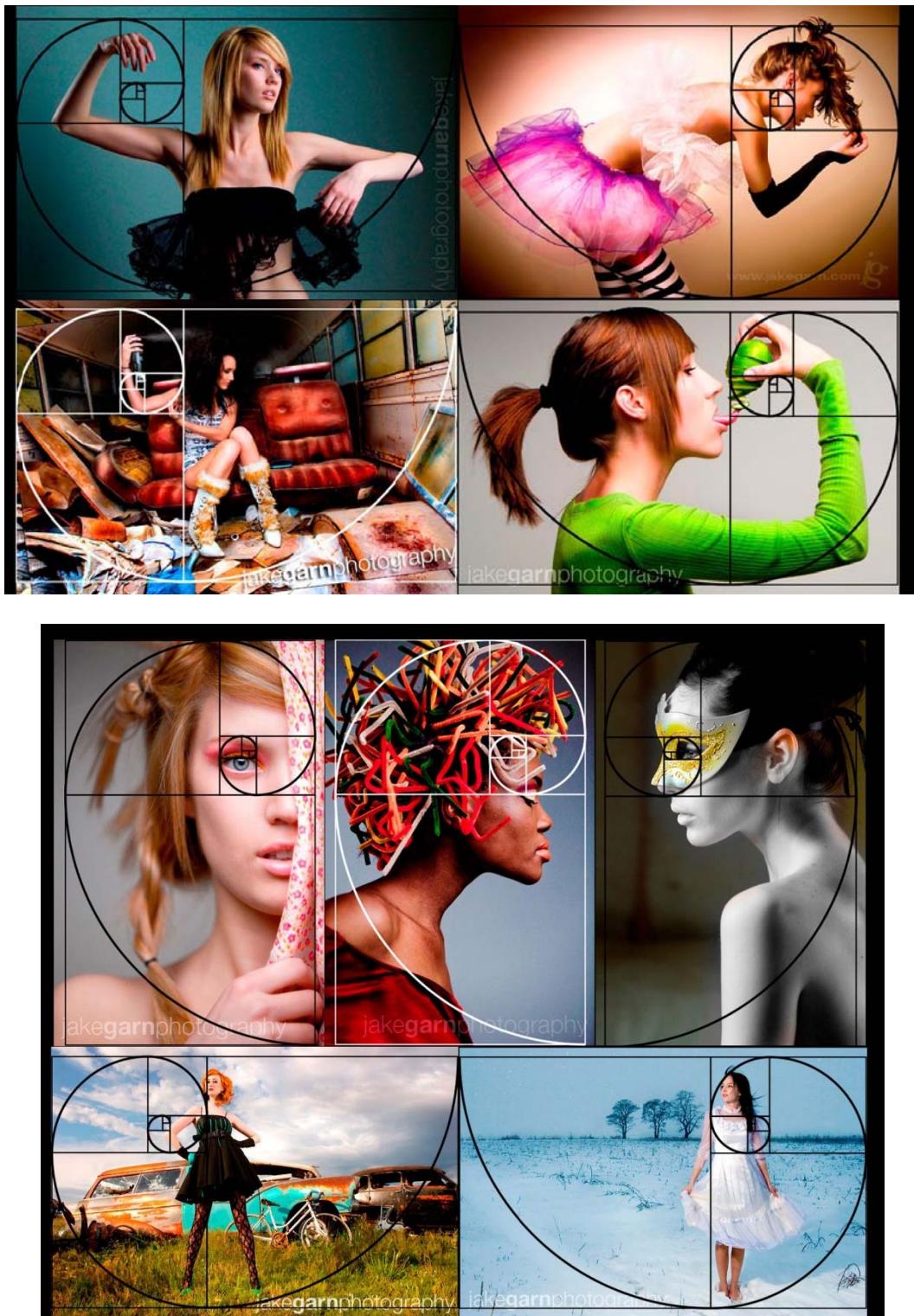




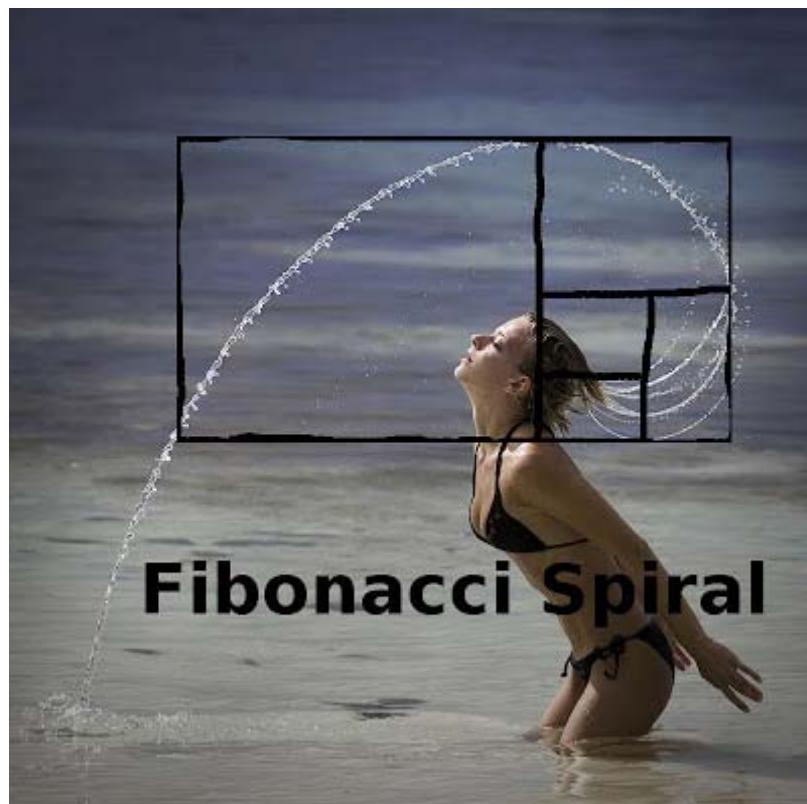
<http://www.3djuegos.com/comunidad-foros/tema/3783236/0/phi-proporcion-divina/>



http://arquyma.blogspot.com.es/2014_10_01_archive.html



<http://davidpalpacuer.free.fr/anciensite/imagesperso/Fractals/nature/>



<http://mitosytimos.blogspot.com.es/2012/08/la-desproporcion-aurea.html>



<https://ppcarretero.files.wordpress.com/2012/07/reloj-espiral.jpeg>



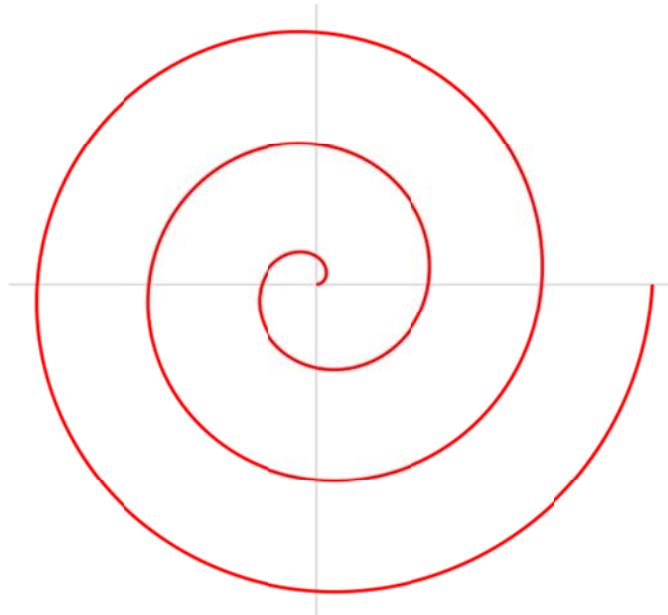
$$r = ae^{b\theta}$$

<https://dlaczegoniebog.wordpress.com/>

The **Archimedean spiral** (also known as the **arithmetic spiral** or **spiral of Archimedes**) is a spiral named after the 3rd century BC Greek mathematician Archimedes. It is the locus of points corresponding to the locations over time of a point moving away from a fixed point with a constant speed along a line which rotates with constant angular velocity. Equivalently, in polar coordinates (r, θ) it can be described by the equation

$$r = a + b\theta$$

with real numbers **a** and **b**. Changing the parameter **a** will turn the spiral, while **b** controls the distance between successive turnings.



Three 360° turnings of one arm of an Archimedean spiral

Archimedean
(arithmetic) spiral



Logarithmic spiral



<http://graphicdesign.stackexchange.com/questions/29622/how-can-i-create-a-tight-spiral-shape-archimedean-spiral>

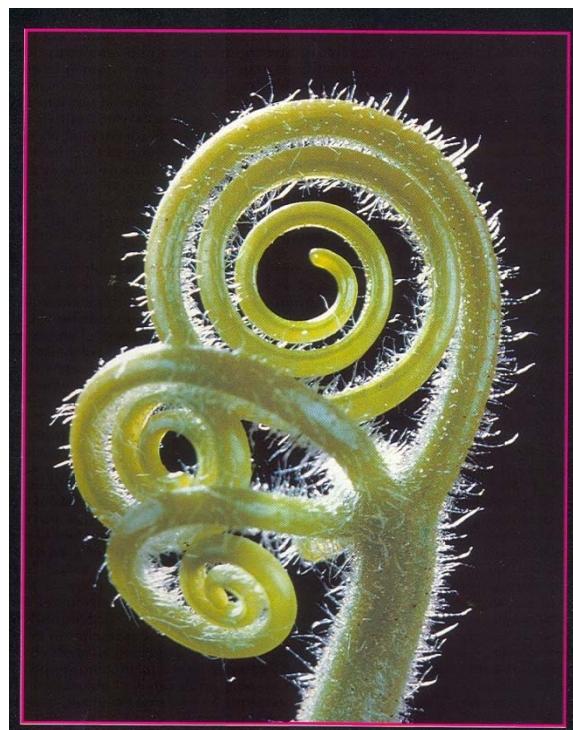


<http://www.delderfield.nl/textures/pages/coiled%20rope.htm>



A Hawaiian fern

http://xahlee.info/SpecialPlaneCurves_dir/Spiral_dir/spiral.html



Tendril of a *citrullus colocynthis*

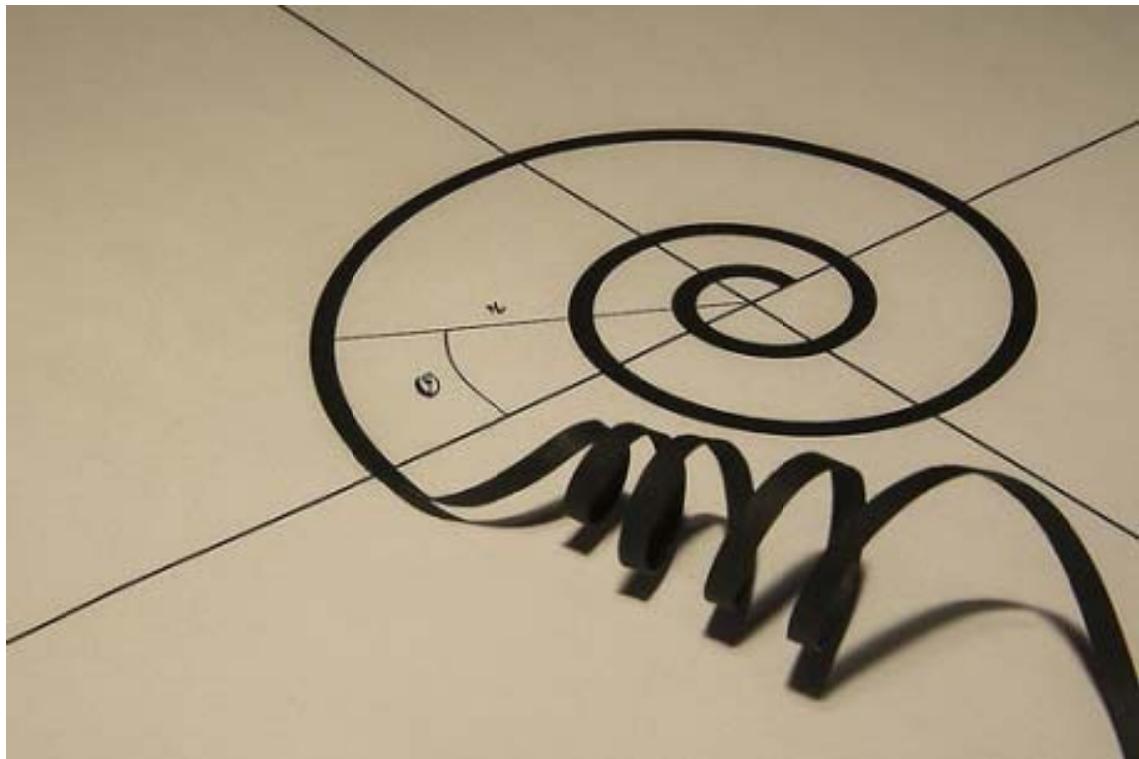


Celtic symbol inside Newgrange tumulus

<http://plasticando.blogspot.com.es/2010/12/la-espiral.html>



<http://misterios.loquenosabias.com/ultimos-crop-circles-reportados-en-inglaterra>



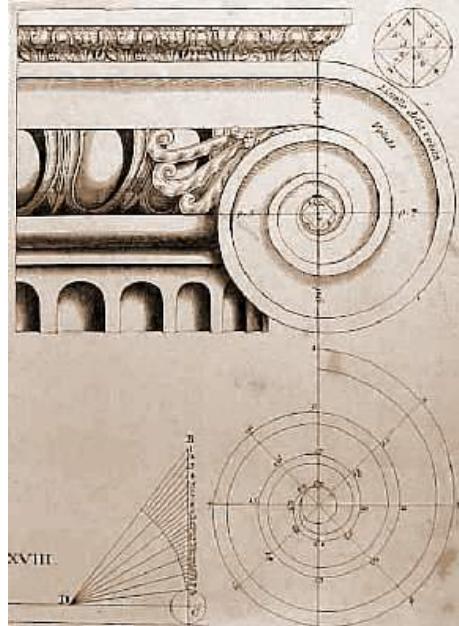
<https://www.flickr.com/photos/clubmanchegodefotografia/16855844427/in/photostream>
/



<https://www.flickr.com/photos/clubmanchegodefotografia/16875448748/in/photostream>
/



<https://www.flickr.com/photos/27906589@N05/5189874885/>



<http://www.unav.es/teohistarq/histarq/HAc/vign/im/5-VIG-18-JONICO-VOLUTA.jpg>



<http://arsnatura.blogspot.com.es/2009/06/la-red.html>





School of barracuda and Butterfly tongue

<http://adictamente.blogspot.com.es/2012/10/naturaleza-retorcida-y-geometricamente.html>



The helix in the world

A helix (pl: helices or helices) is a type of smooth space curve, i.e. a curve in three-dimensional space. It has the property that the tangent line at any point makes a constant angle with a fixed line called the axis.

Helices can be either right-handed or left-handed. With the line of sight along the helix's axis, if a clockwise screwing motion moves the helix away from the observer, then it is called a right-handed helix; if towards the observer, then it is a left-handed helix. Handedness (or chirality) is a property of the helix, not of the perspective: a right-handed helix cannot be turned to look like a left-handed one unless it is viewed in a mirror, and vice versa.

A circular helix of radius a and pitch $2\pi b$ is described by the following parametrisation:

$$\begin{aligned}x(t) &= a \cos(t), \\y(t) &= a \sin(t), \\z(t) &= bt.\end{aligned}$$

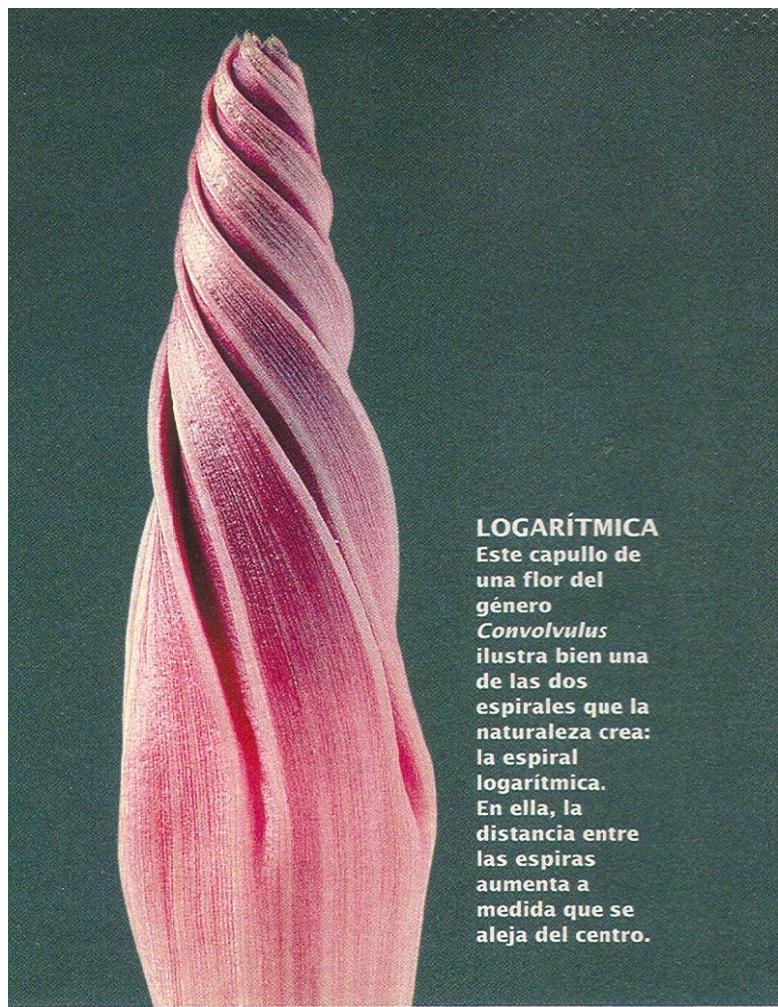
<https://en.wikipedia.org/?title=Helix>



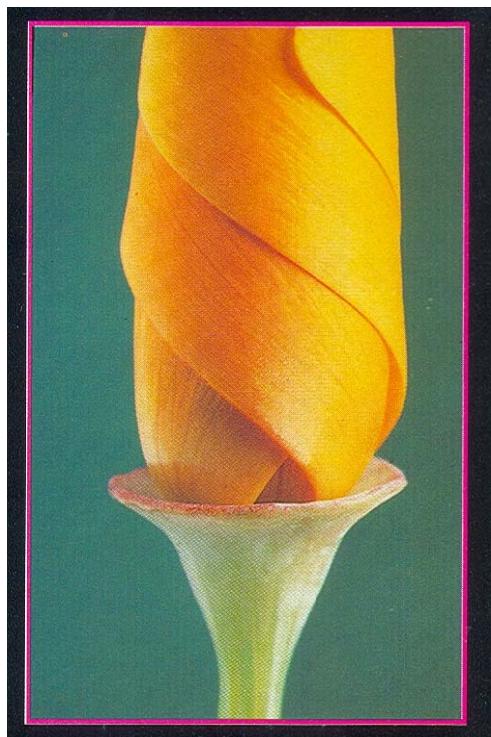
<https://en.wikipedia.org/?title=Helix>



<https://en.wikipedia.org/?title=Helix>

**LOGARÍTMICA**

Este capullo de una flor del género *Convolvulus* ilustra bien una de las dos espirales que la naturaleza crea: la espiral logarítmica. En ella, la distancia entre las espiras aumenta a medida que se aleja del centro.





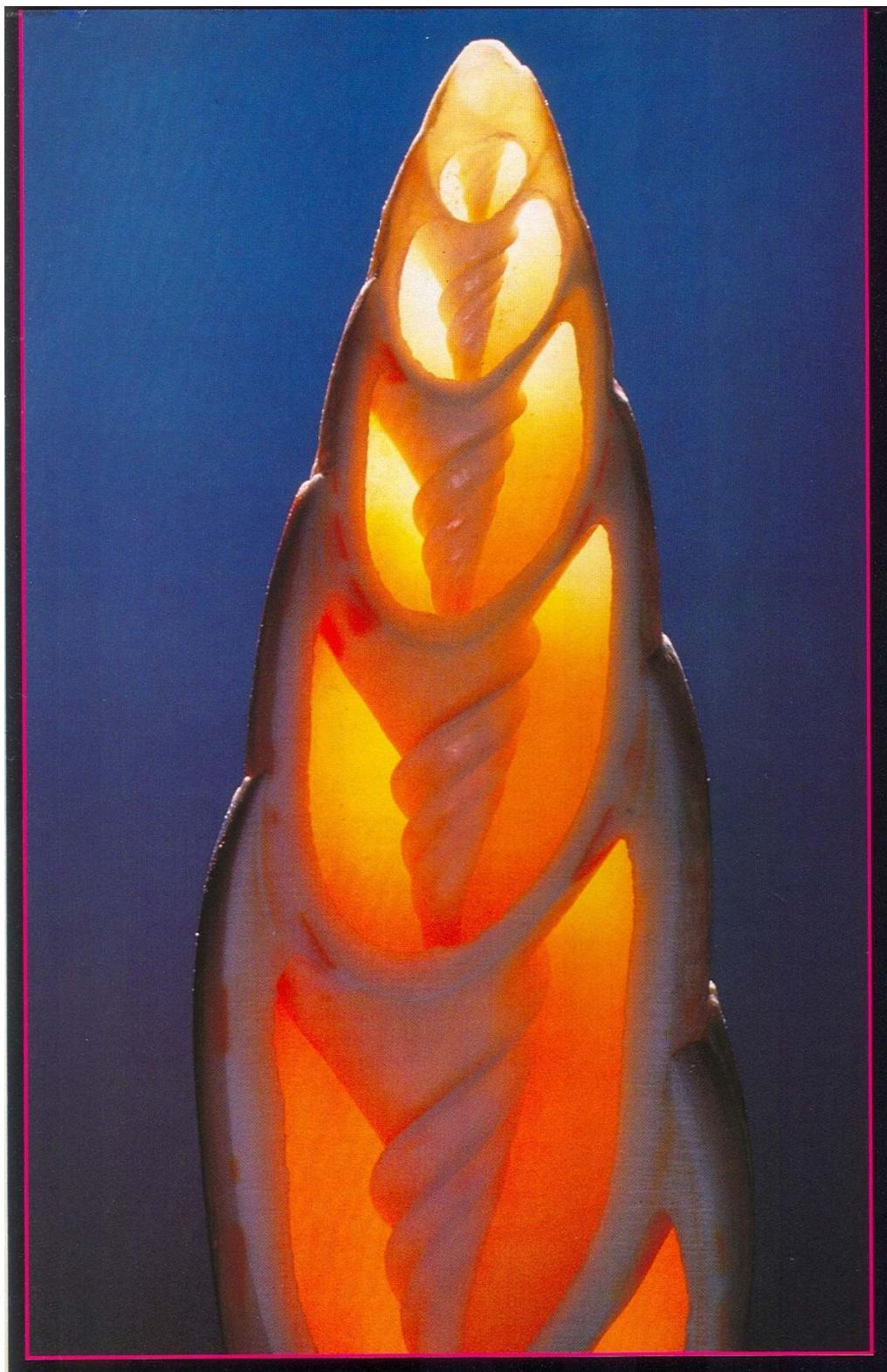


**SOMOS MUY RETORCIDOS**

La estructura de doble hélice cilíndrica más famosa en estos días es la del ADN humano –también la de la cola de los espermatozoides tiene forma de hélice-. A lo largo de la espiral helicoidal se distribuyen los cuatro elementos fundamentales para la vida: adenina, citosina, guanina y timina.

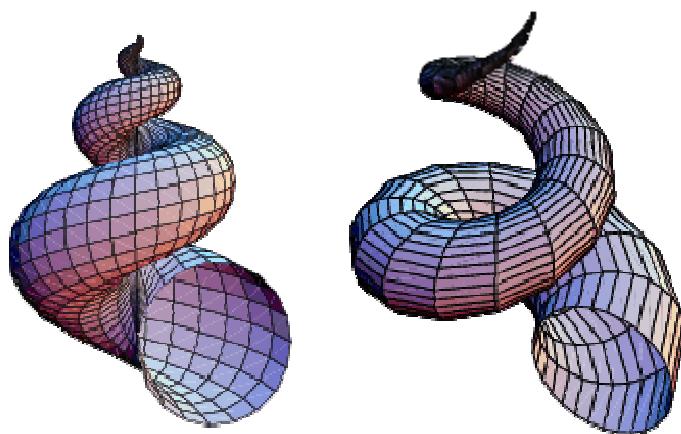


<http://www.itsokaytobesmart.com/post/39243979585/dna-helix-clouds>

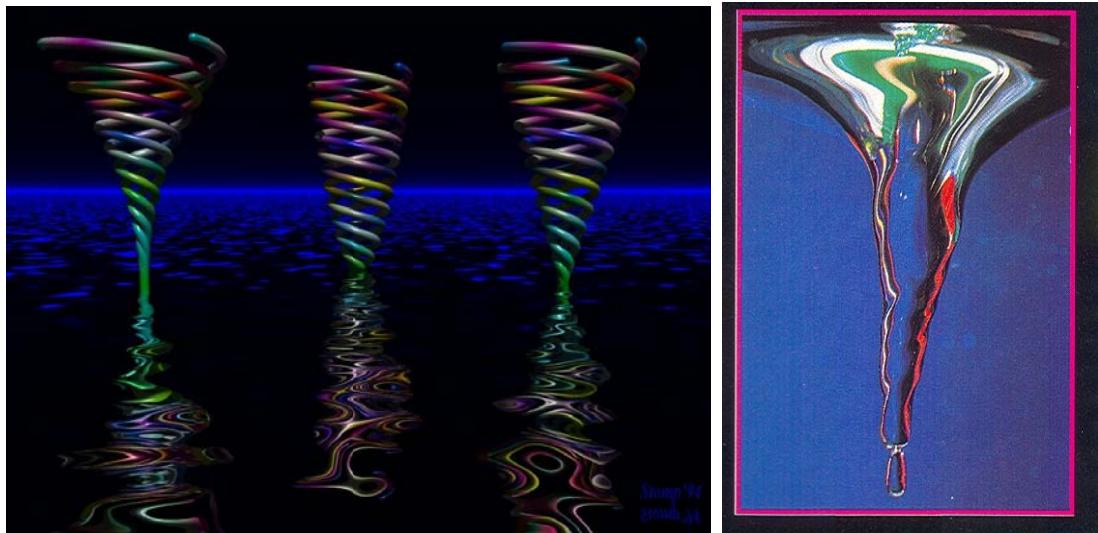




A conic helix may be defined as a spiral on a conic surface, with the distance to the apex an exponential function of the angle indicating direction from the axis.



<http://archive.lib.msu.edu/crcmath/math/math/c/c583.htm>

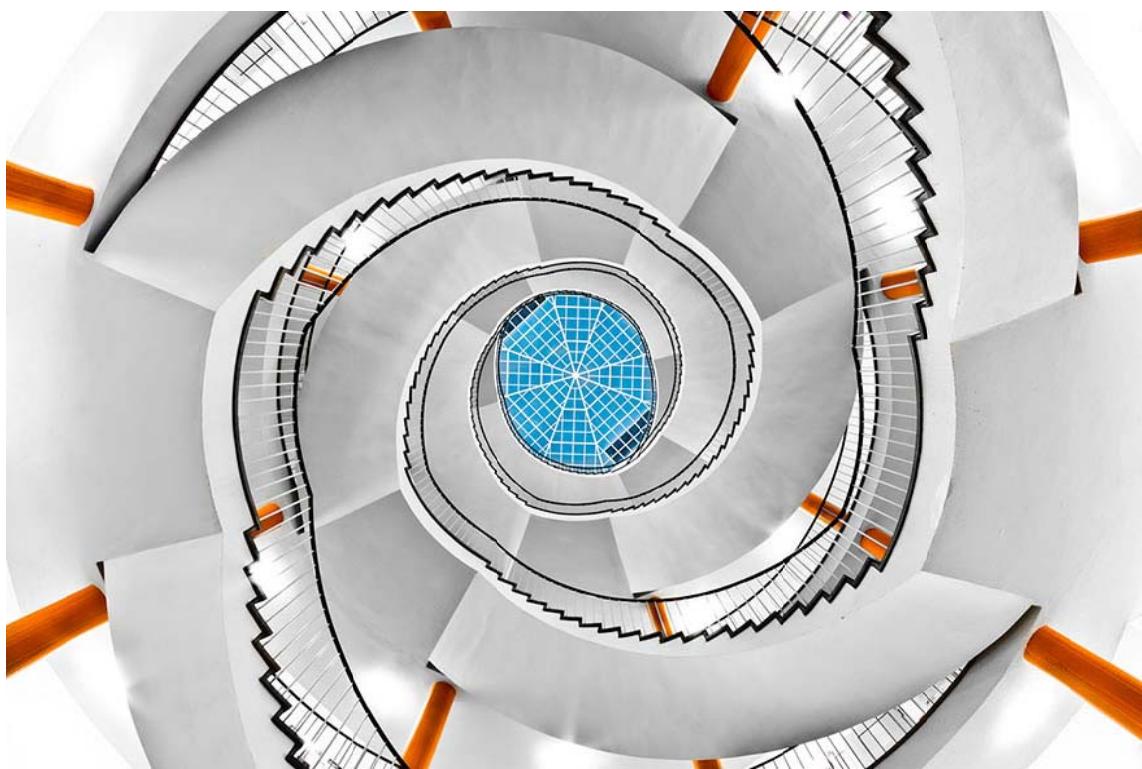
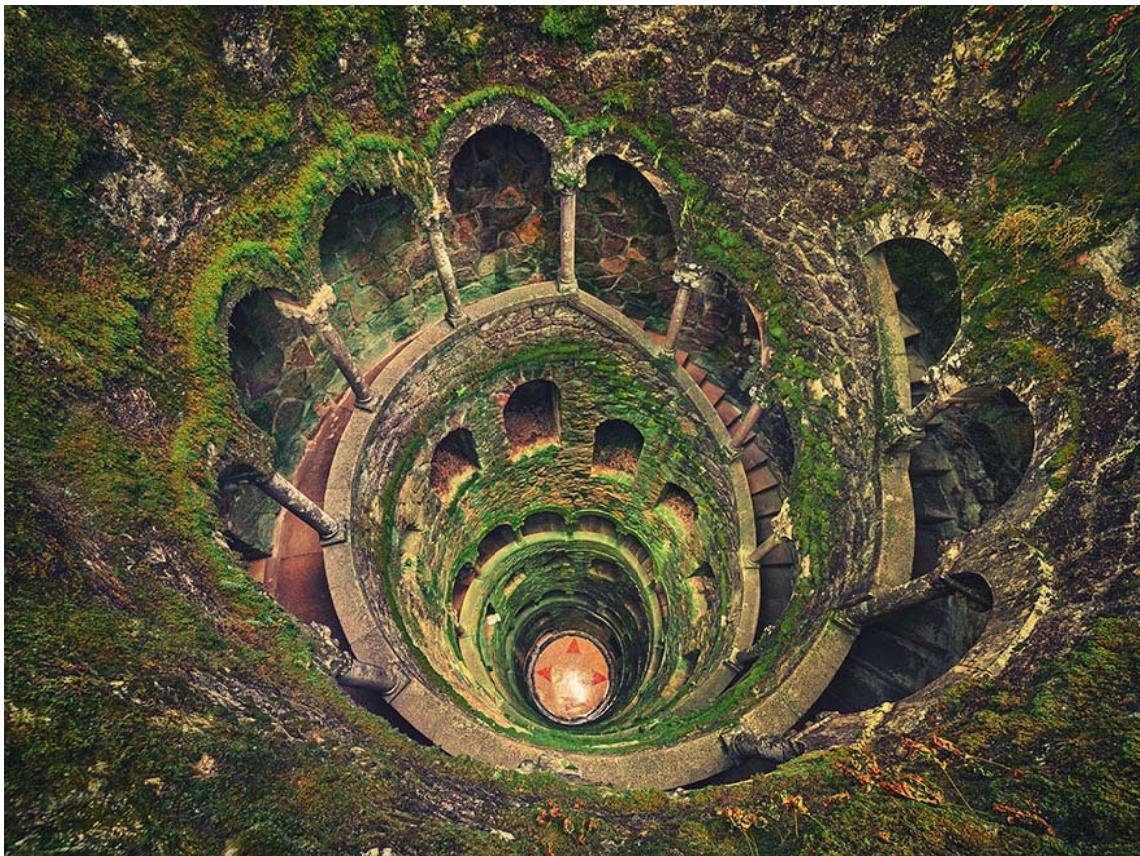


<http://stomp.hobby-site.com/HouseOfStomp/infogal2.html>

Stairs inspired in hélix

<http://www.blogdehumor.com/espectaculares-escaleras-de-caracol/escaleras-de-caracol/>

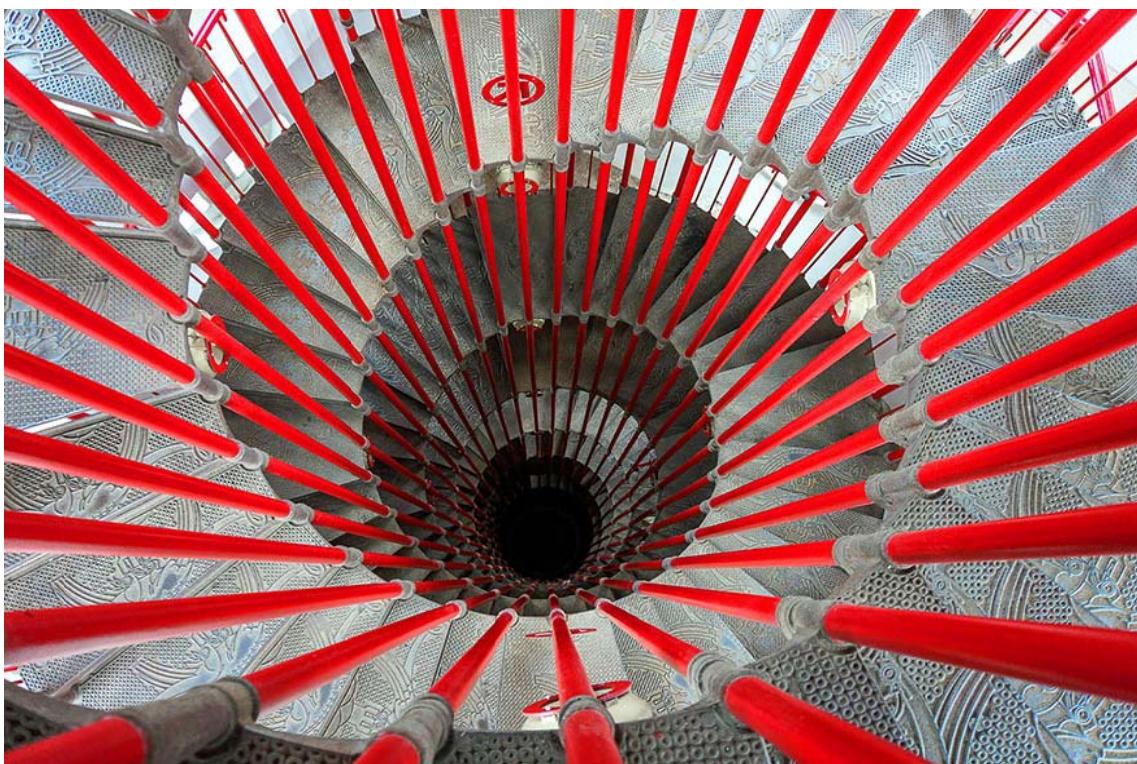


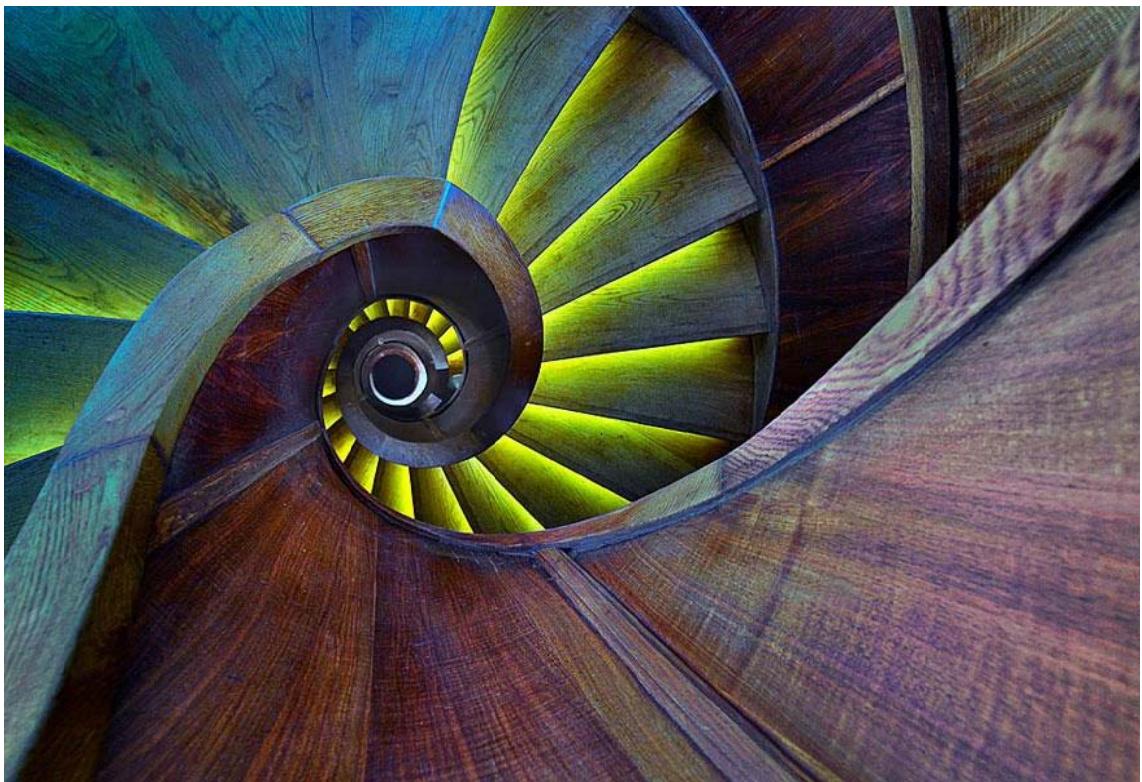


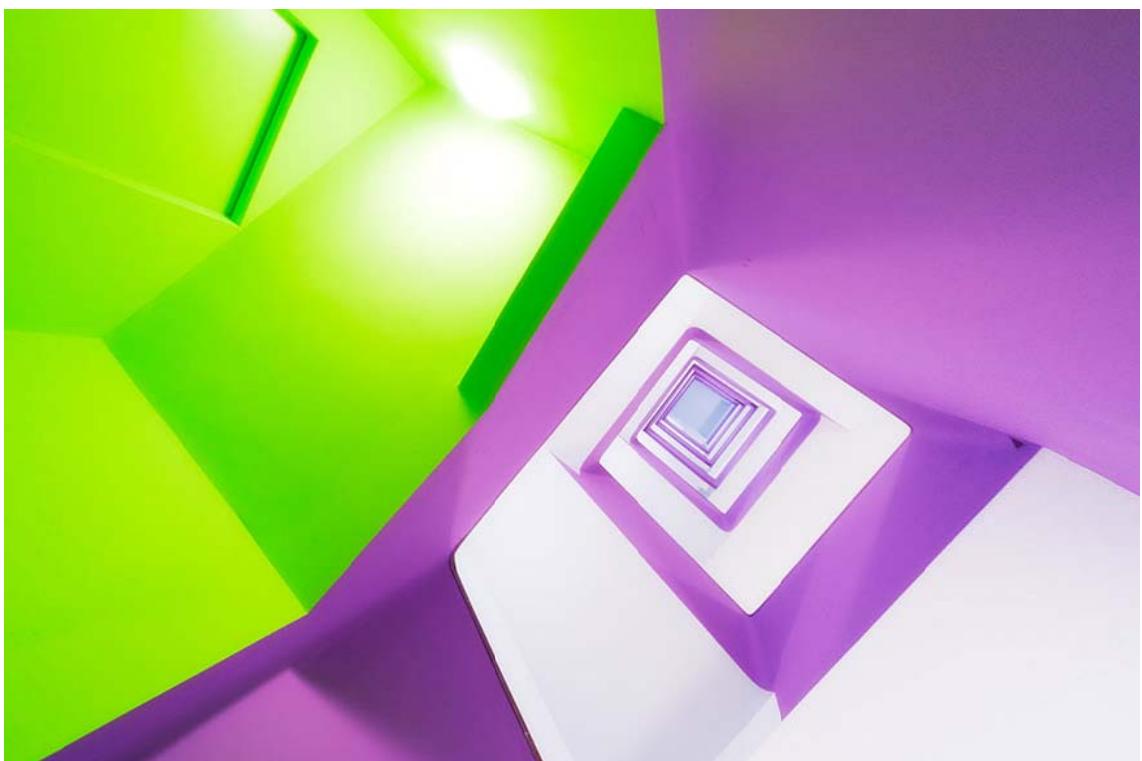




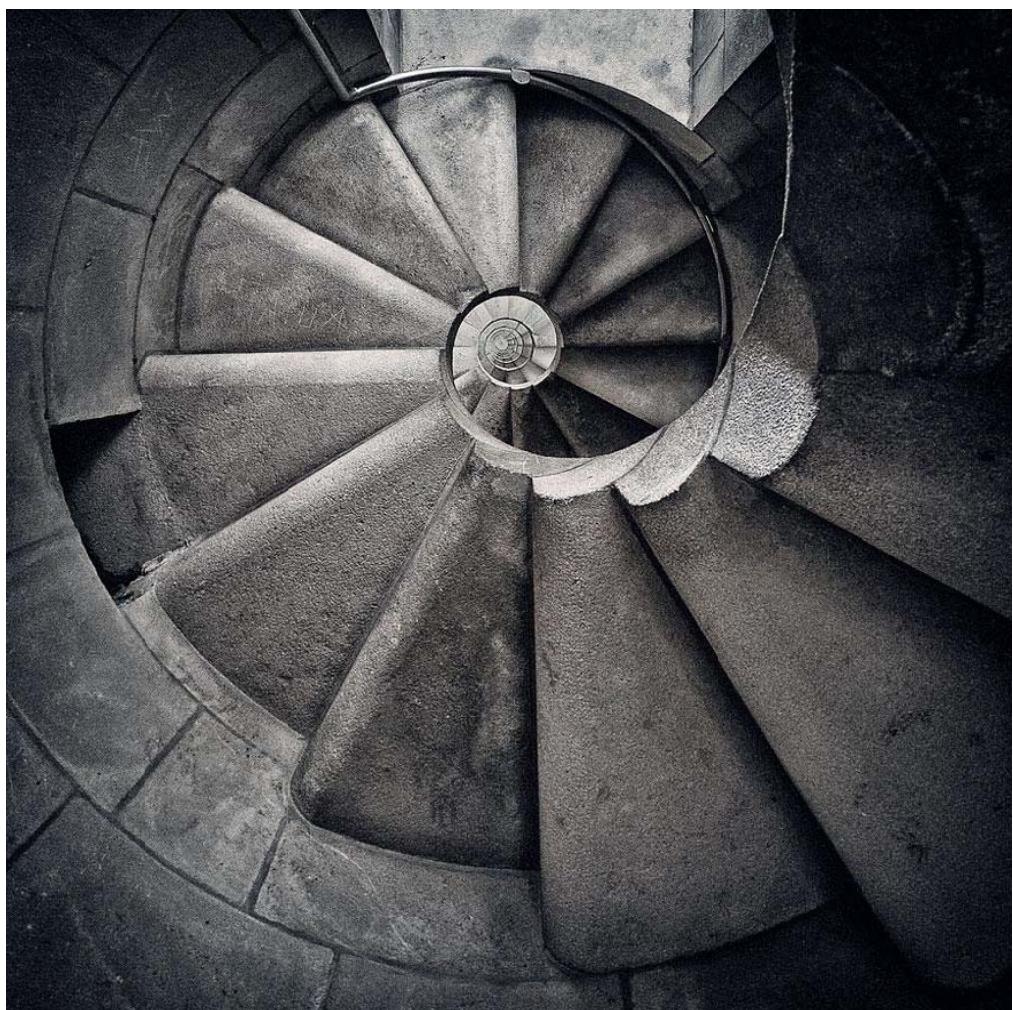
©2013 NATTAPOL PORNSAKULWAT
www.FIVEOCLOCKSTUDIO.COM

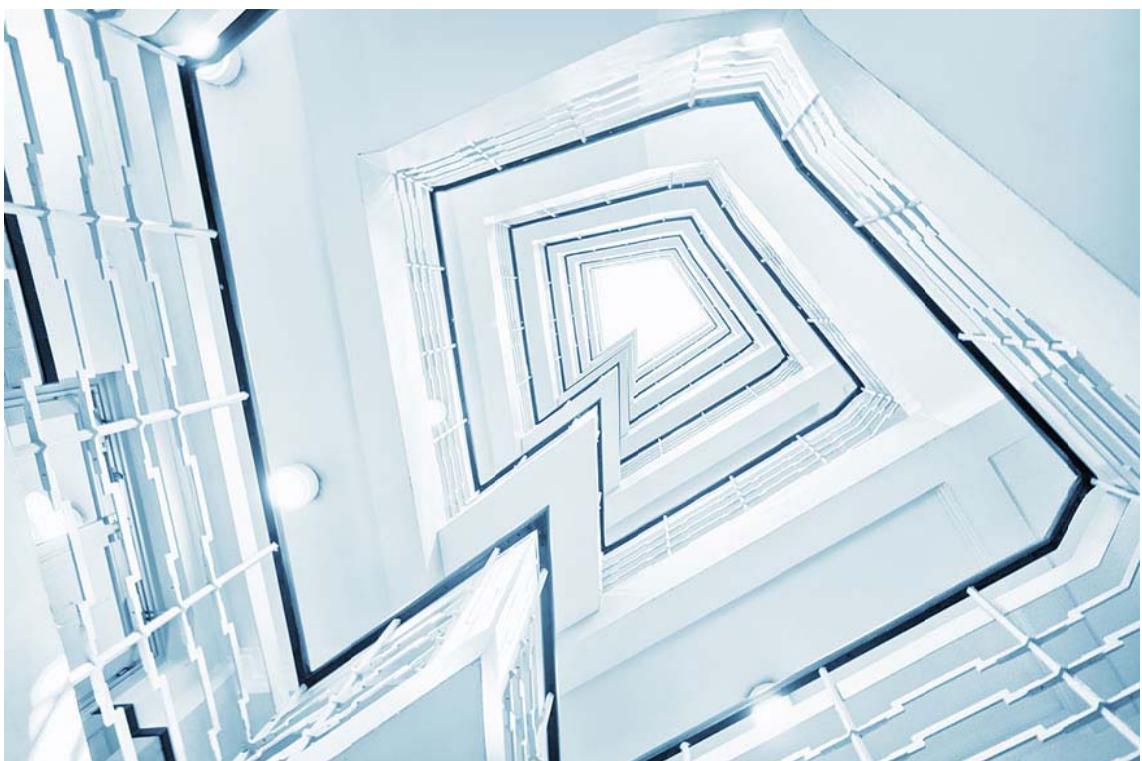


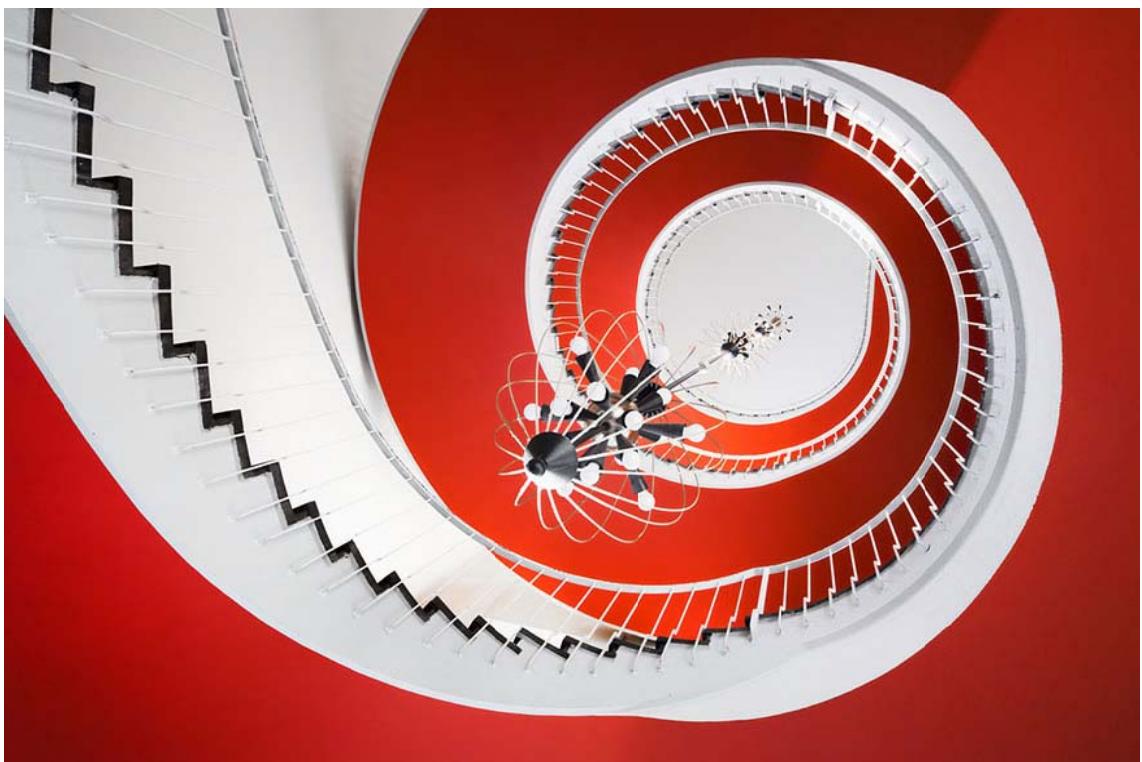


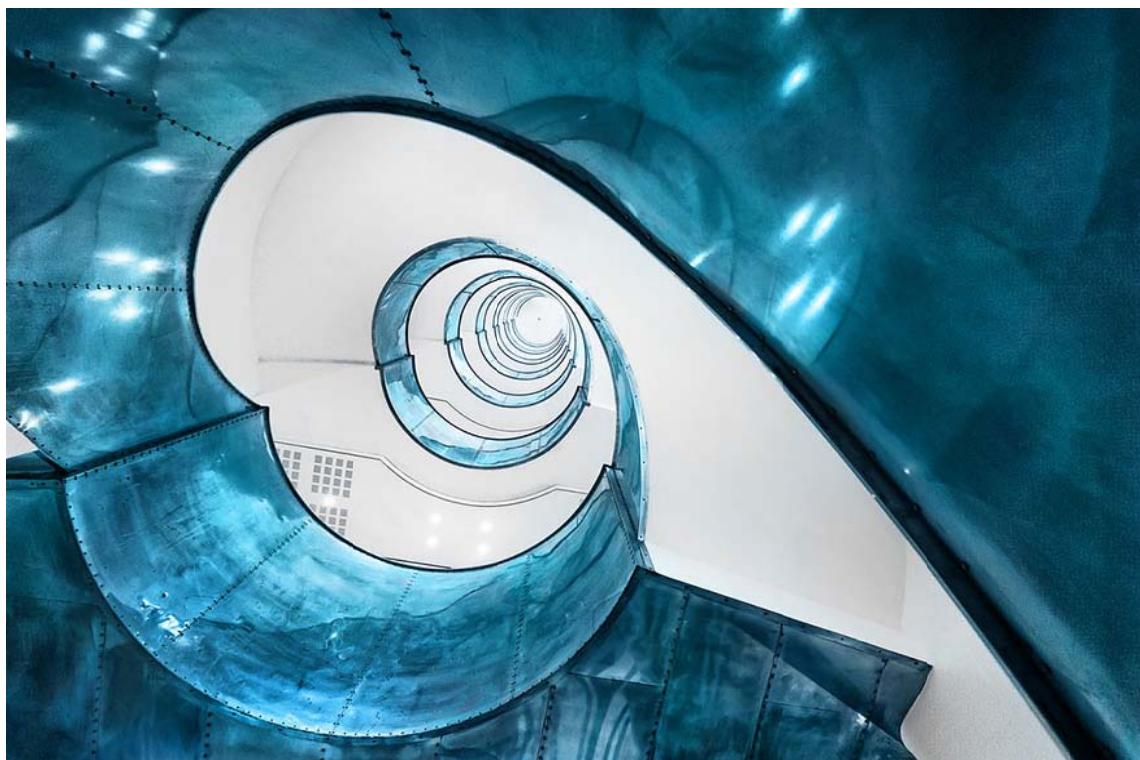


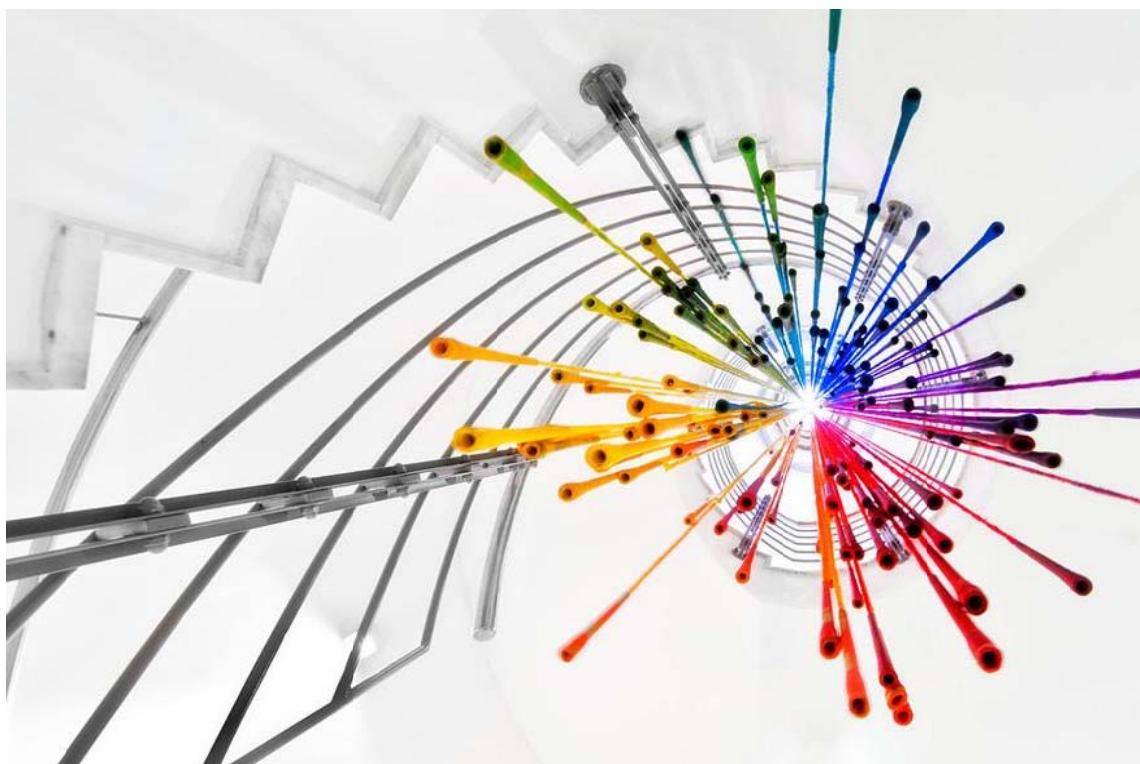


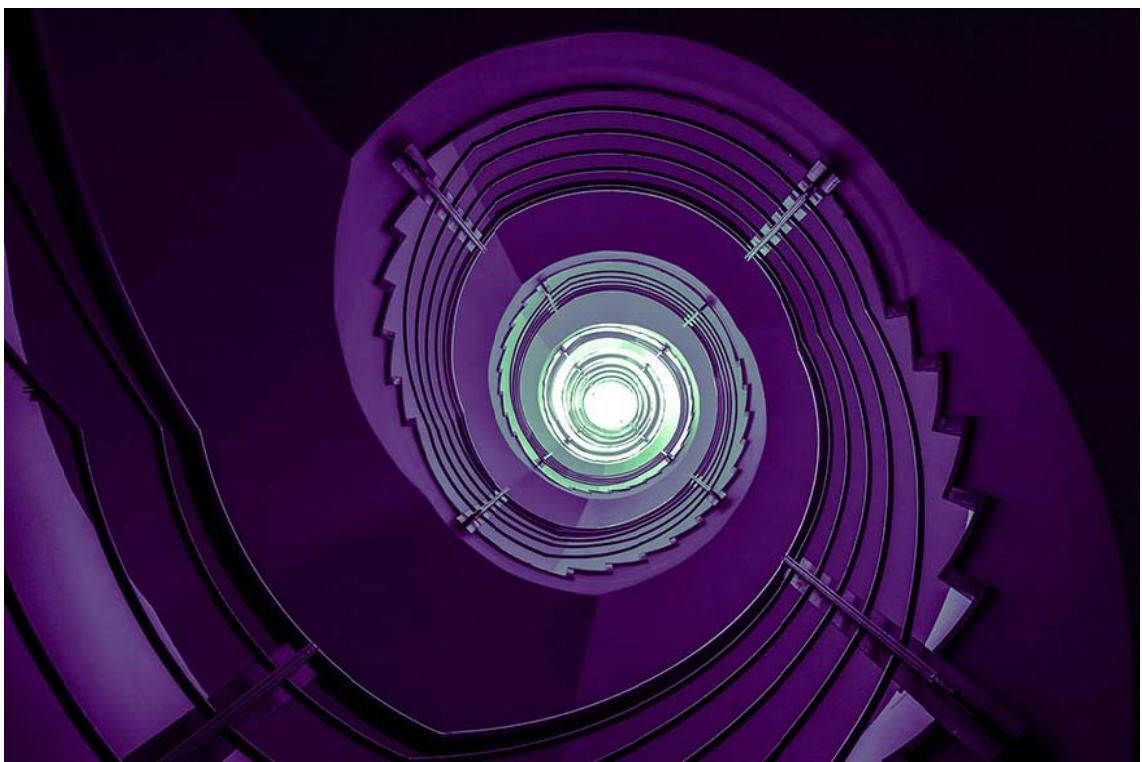


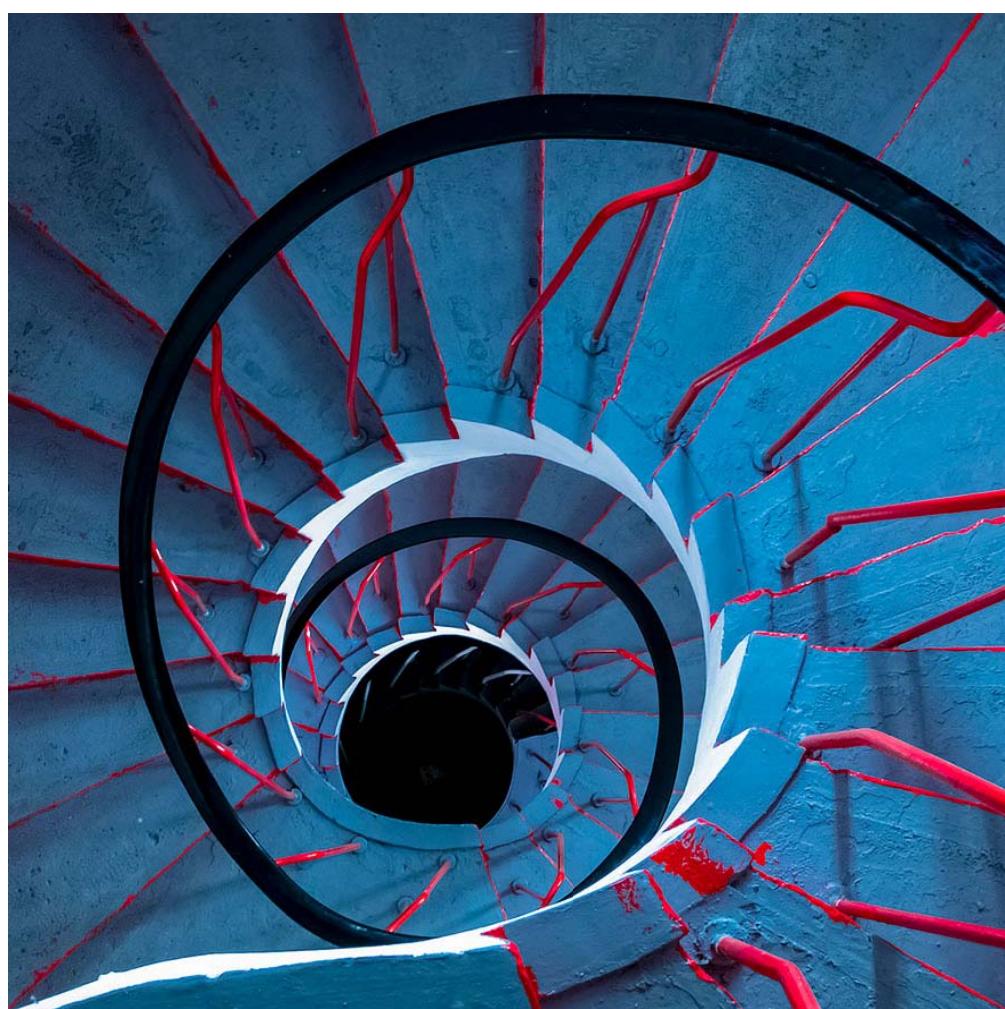














Stairs inspired in hélix

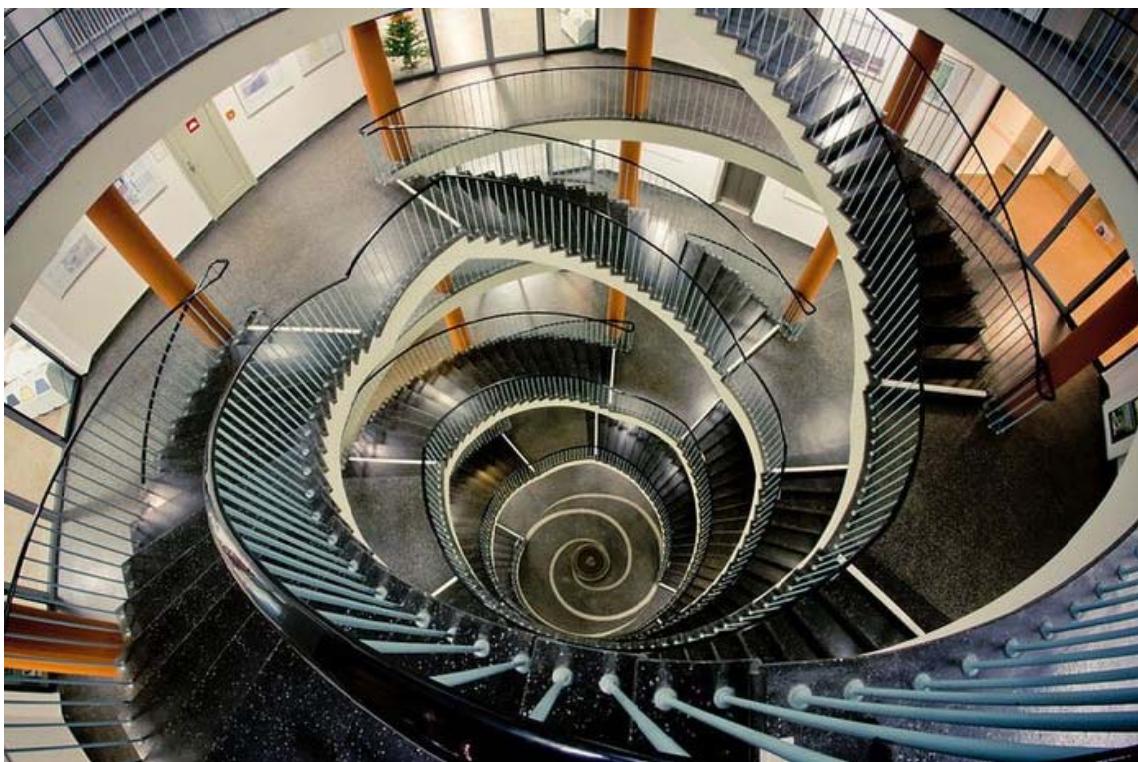
<http://fotoimpactantes.blogspot.com.es/2013/01/wonderful-spiral-staircases.html>

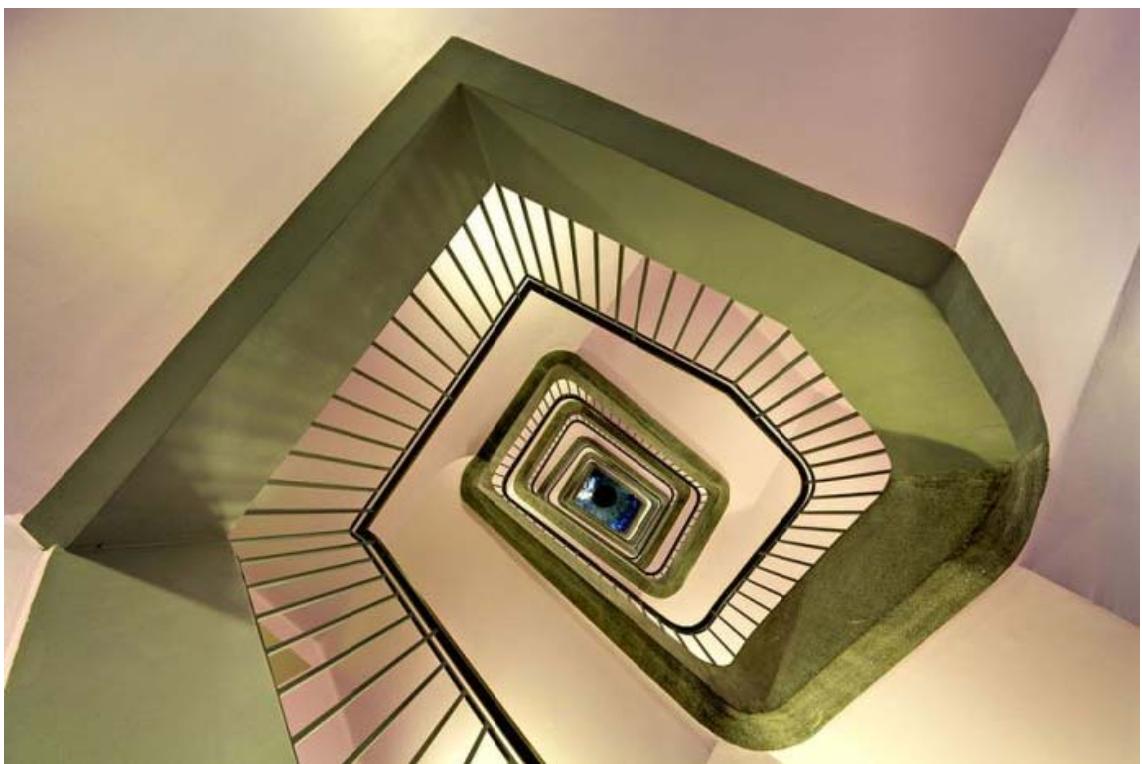




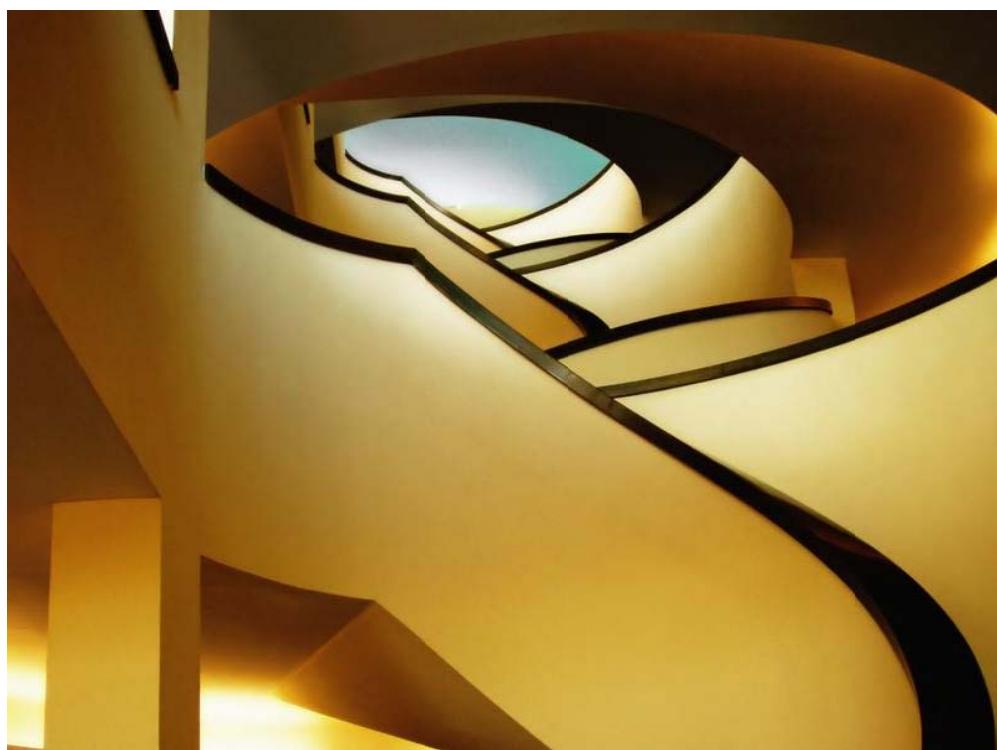








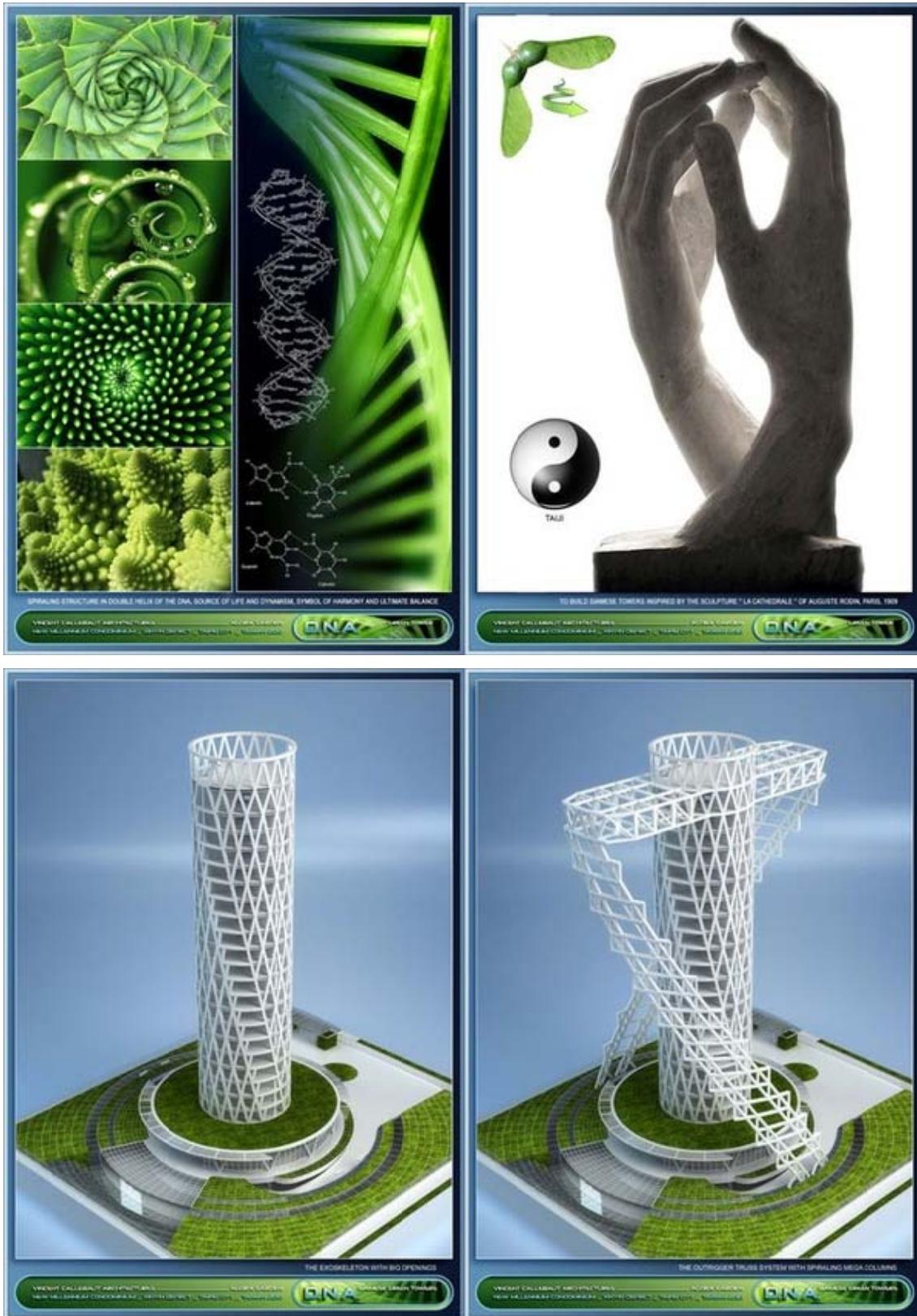




<http://www.drake-photos.com/top-50/>



Helix Building and Spiraling Towers







http://vincent.callebaut.org/planche-taipei_pl17.html

10 most stunning and sustainable spiraling towers

<http://www.greendiary.com/10-most-stunning-and-sustainable-spiraling-towers.html>

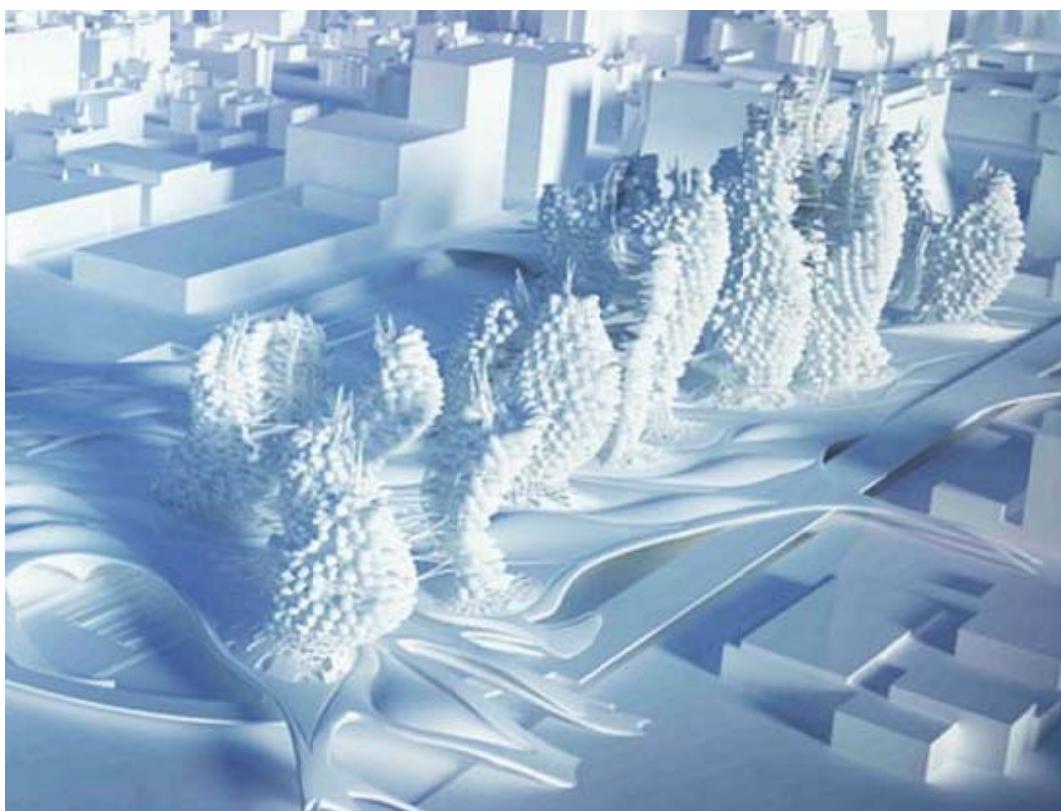


Strata Tower, Abu Dhabi, UAE

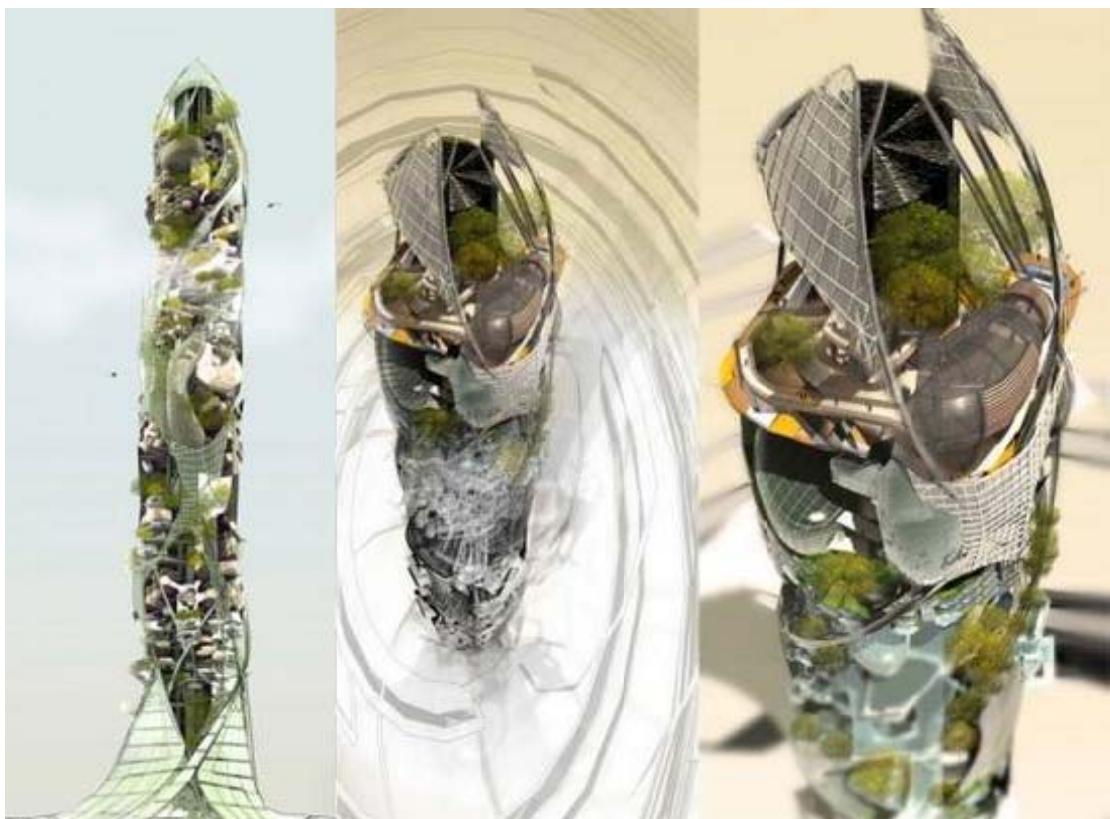
Designer: [Asymptote Architecture](#)



Mode-Gakuen Spiral Towers, Nagoya City, Japan
Architects: [Nikken Sekkei Ltd.](#)



Mangal City Spiraling Skyscraper, London, UK
Architect: Chimera



Solar Powered Skyscraper
Architect: [Kenneth Loh](#) and Michelle Lim.



Spiral Tower, Berlin, Germany

Architect: Philipp von Bock.



Edgar Street Towers, Lower Manhattan, New York City, US

Architect: [IwamotoScott](#).



Oasis Tower, Zabeel Park, Dubai

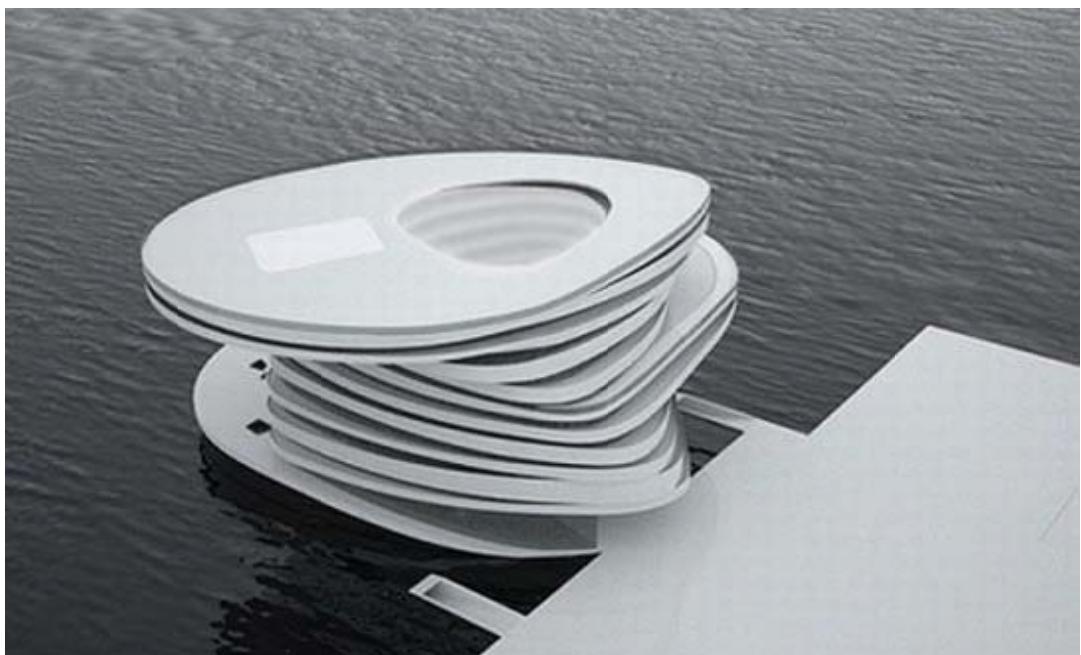
Designer: Rahul Surin.

**Za'abeel Park Observation Tower**Architect: [XTEN Architecture](#)



Fog Tower, Atacama Desert, Chile

Designers: Alberto Fernandez and Susana Ortega.



Helix Hotel, Abu Dhabi

Architect: Leeser Architecture

**Helix Hotel, Abu Dhabi**

Architect: Leeser Architecture.



Chicago Spire Chicago Santiago Calatrava

<https://www.pinterest.com/pin/553028029220600957/>



Swiss Re office building, a.k.a. Gherkin in London
Lord Norman Foster
<http://houseofanais.onsugar.com/date/2011/2/24>