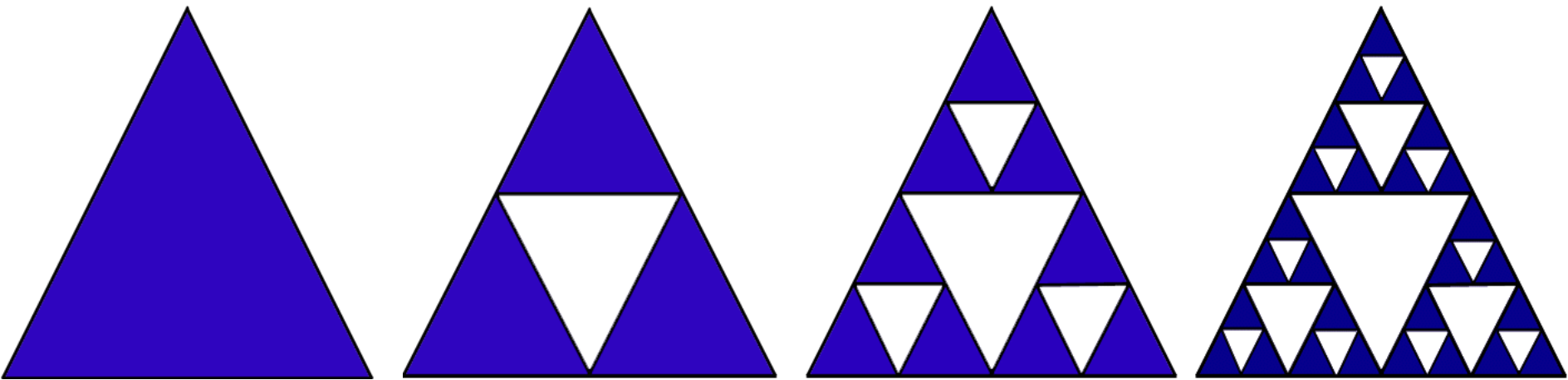


Qué son los fractales?

- Objetos que tienen dimensión fraccionaria
- Objetos que son auto-similares
- Objetos que son auto-afines
- Objetos que presentan invarianza de escala

Qué es la dimensión fraccionaria?



ε	N
---------------	---

1/2	3
-----	---

1/4	9
-----	---

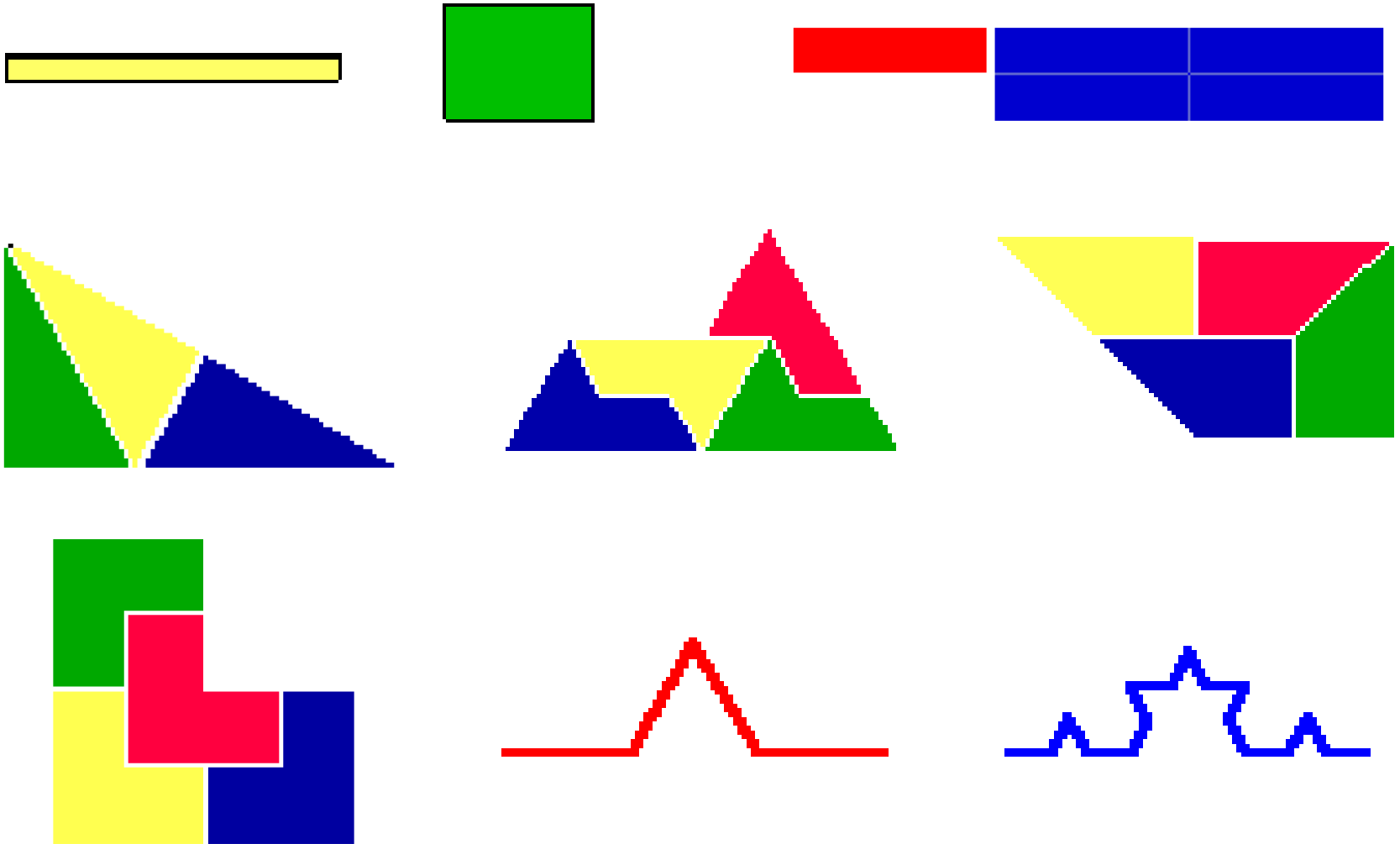
1/8	27
-----	----

$$\text{Log}(N) \approx D \text{Log}(1/\varepsilon)$$

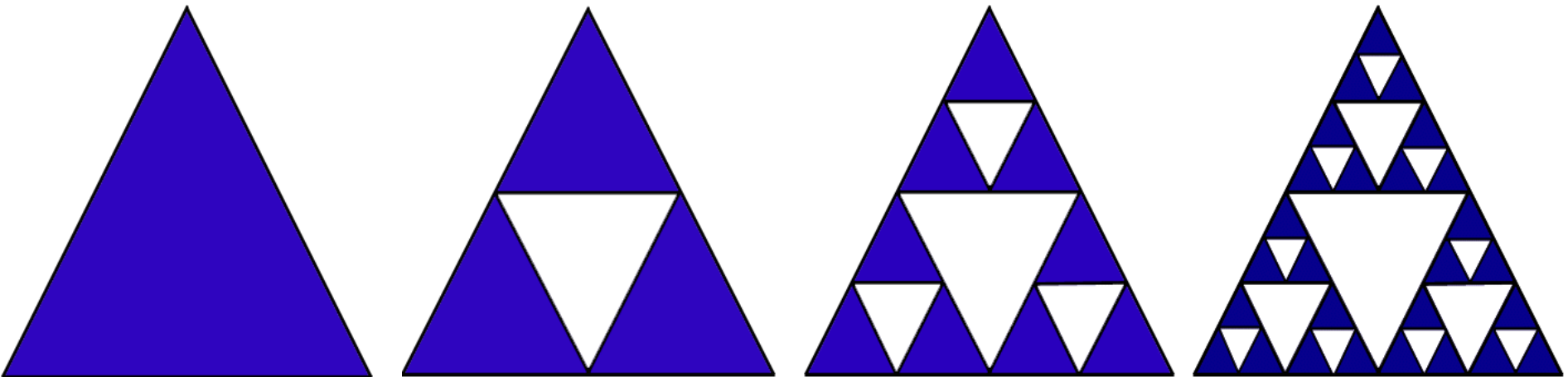
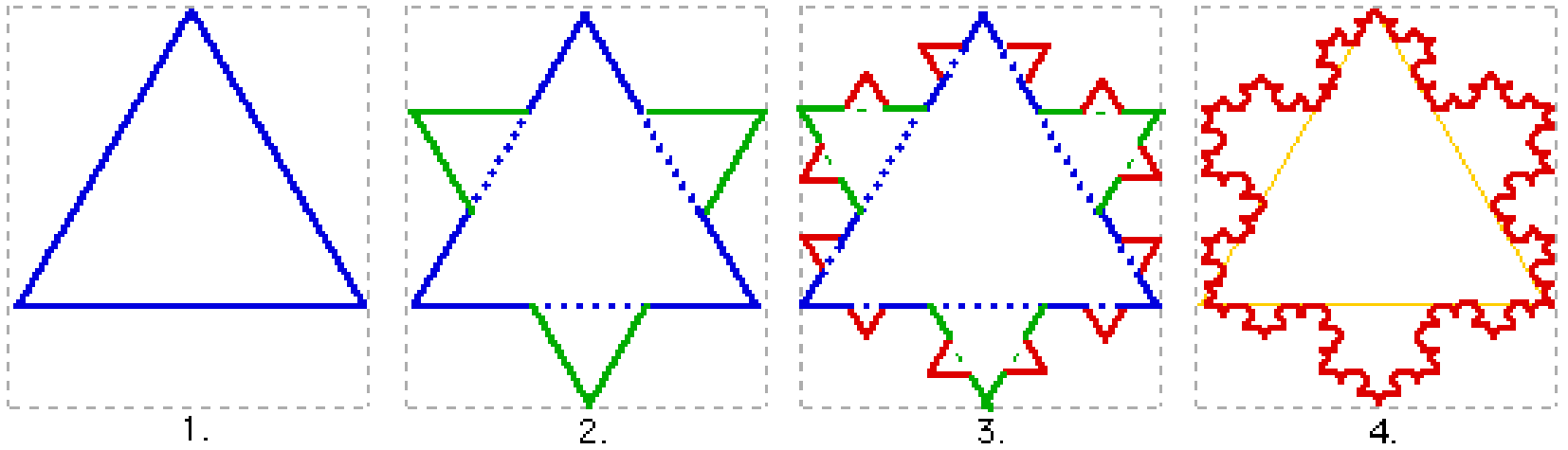
$$D = \text{Log}(N) / \text{Log}(1/\varepsilon)$$

$$D = \log 3 / \log 2 = \log 9 / \log 4 = \dots = 1.584\dots$$

Qué es la autosimilitud?



Cómo se construye un fractal?



Curva de Koch

Para la construcción de " La curva de Koch " aplicamos 4 semejanzas:

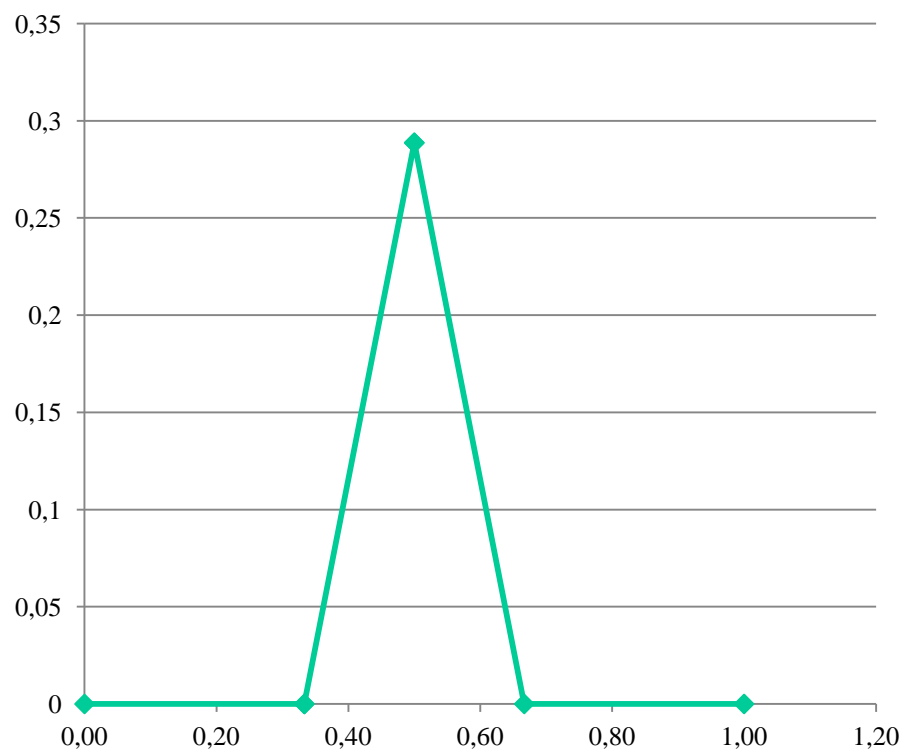
$$f_1(x,y) = (x/3, y/3)$$

$$f_2(x,y) = ((x * \cos(60^\circ) - y * \sin(60^\circ) + 1) / 3, (x * \sin(60^\circ) + y * \cos(60^\circ)) / 3)$$

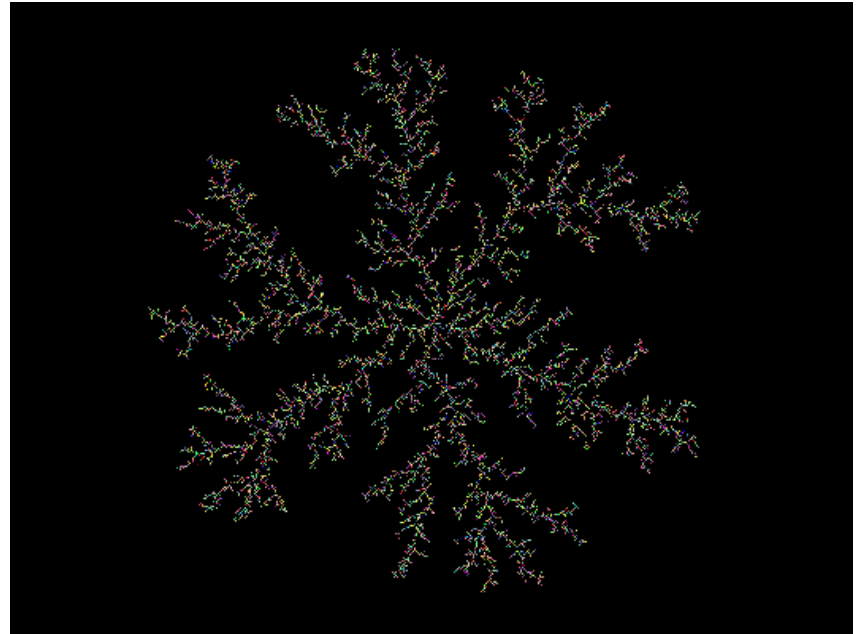
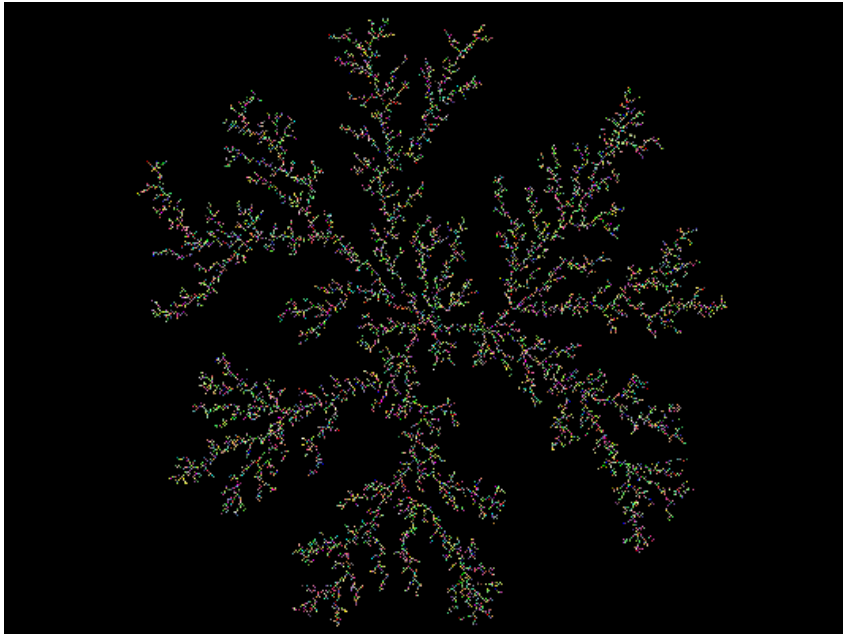
$$f_3(x,y) = ((x * \cos(60^\circ) + y * \sin(60^\circ)) / 3 + 1/2, ((-x) * \sin(60^\circ) + y * \cos(60^\circ)) / 3 + \sqrt{3}/6)$$

$$f_4(x,y) = ((x + 2) / 3, y / 3)$$

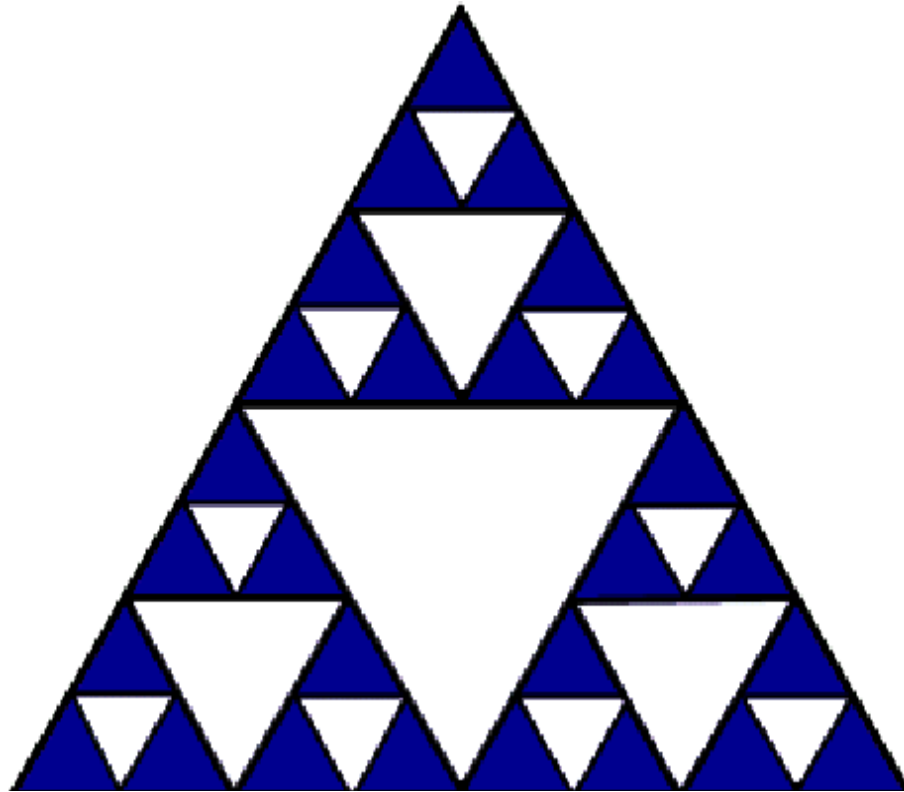
Curva de Koch



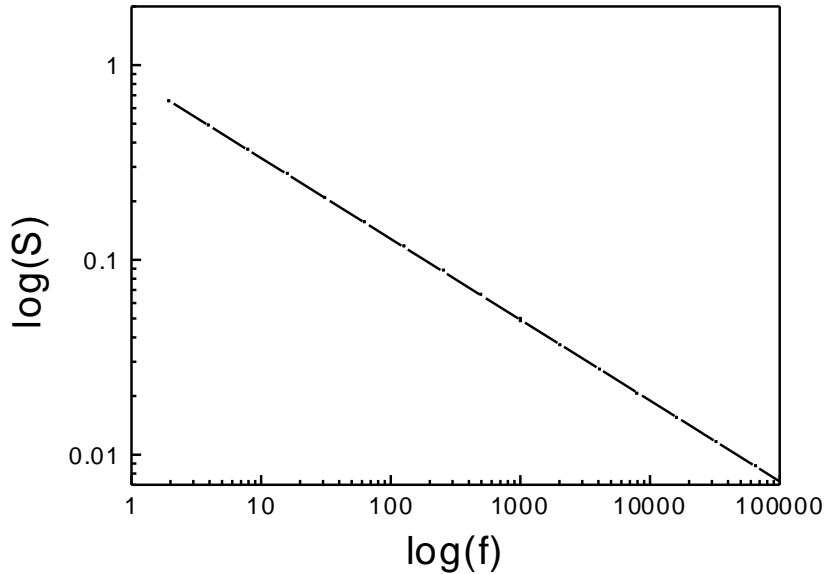
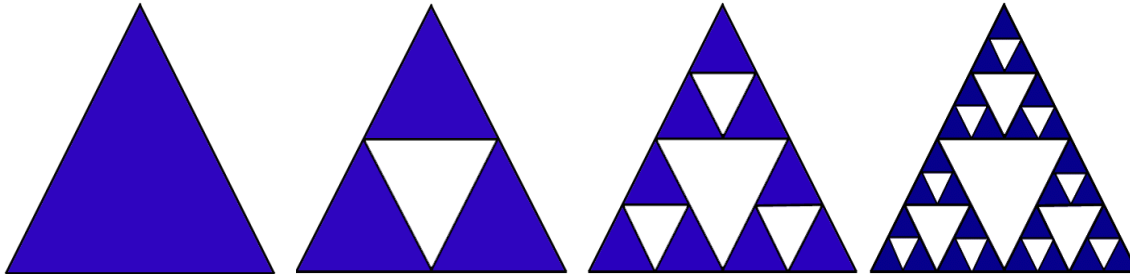
Qué es la autoafinidad?



Que es la invarianza de escala?



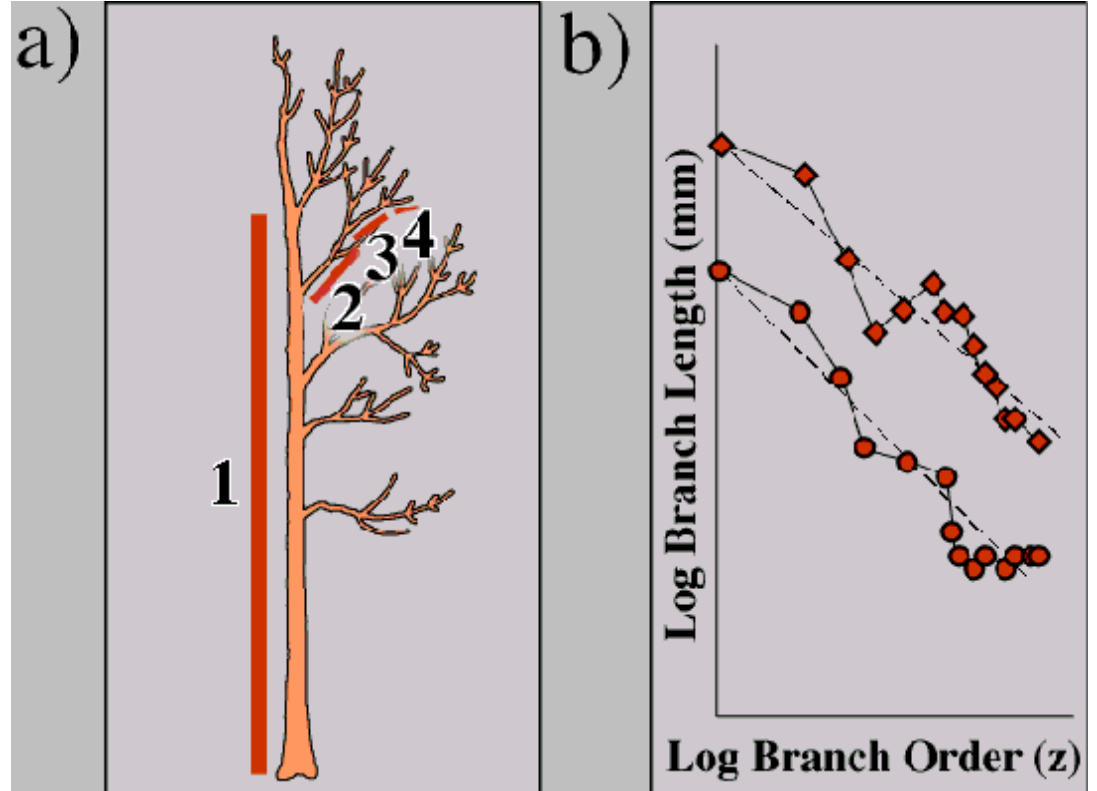
Cómo se manifiesta la invarianza de escala?

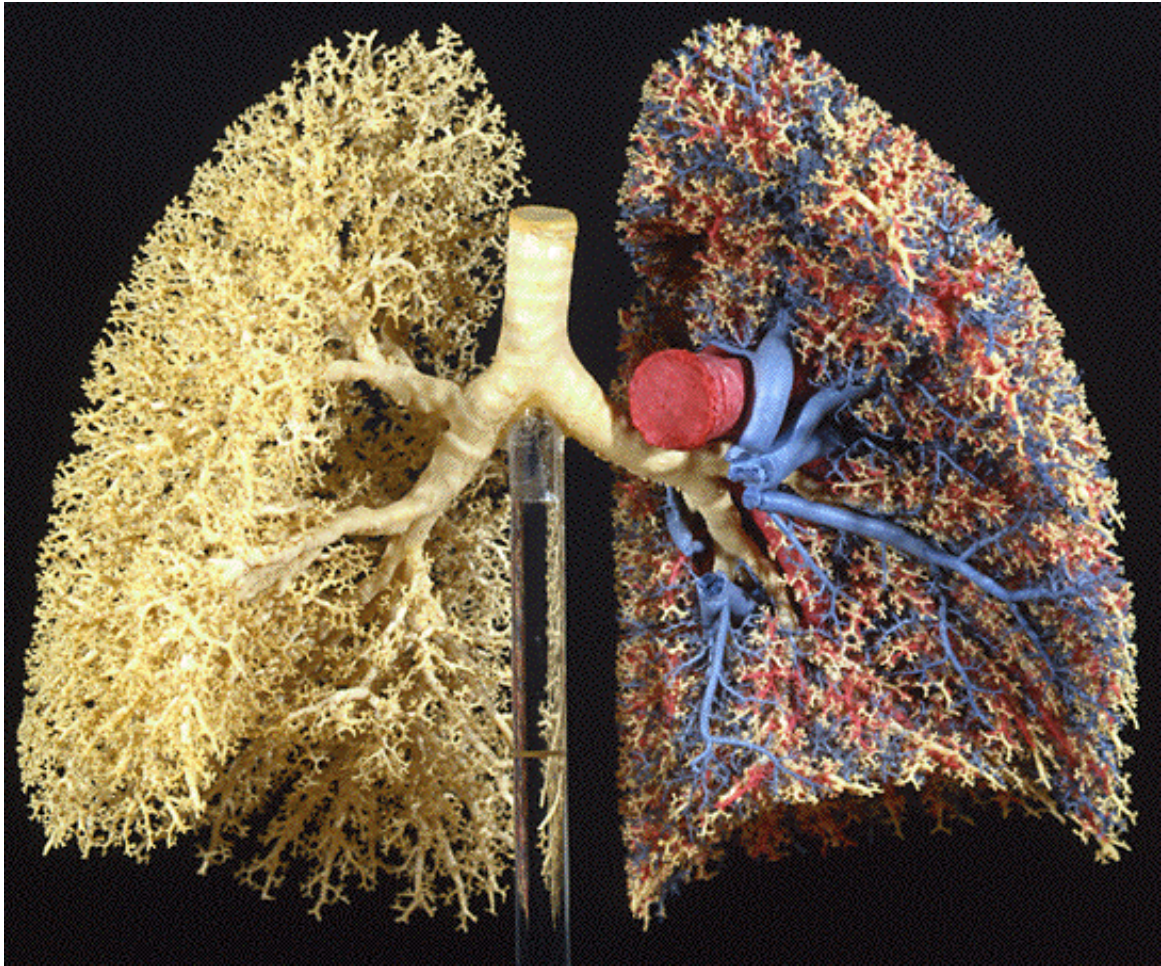


Espectro de potencias

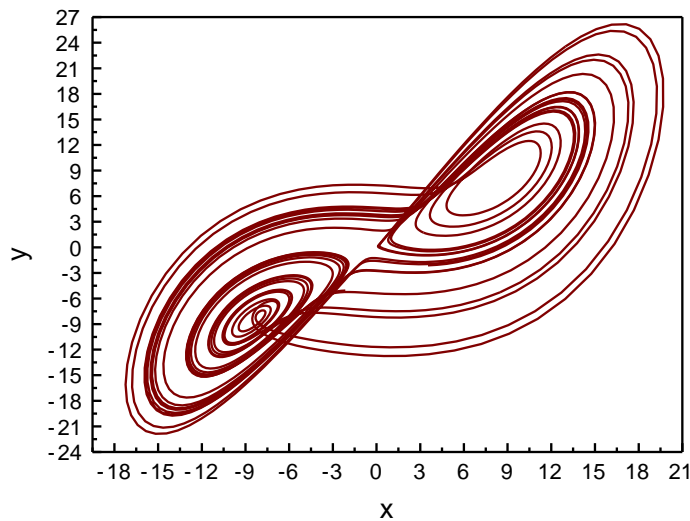
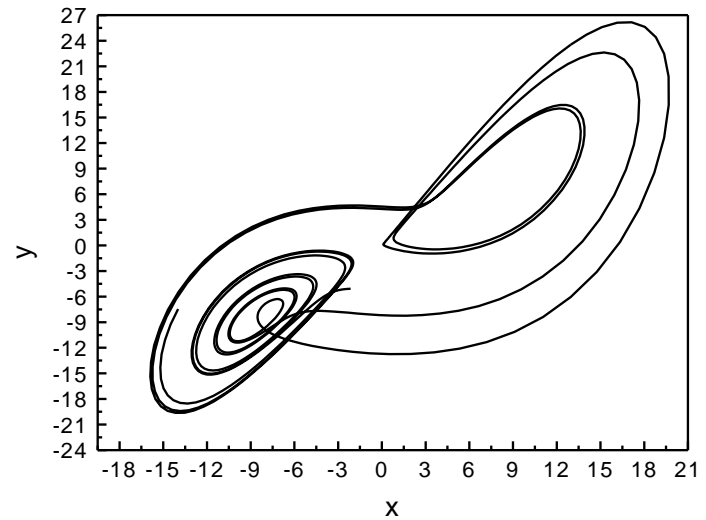
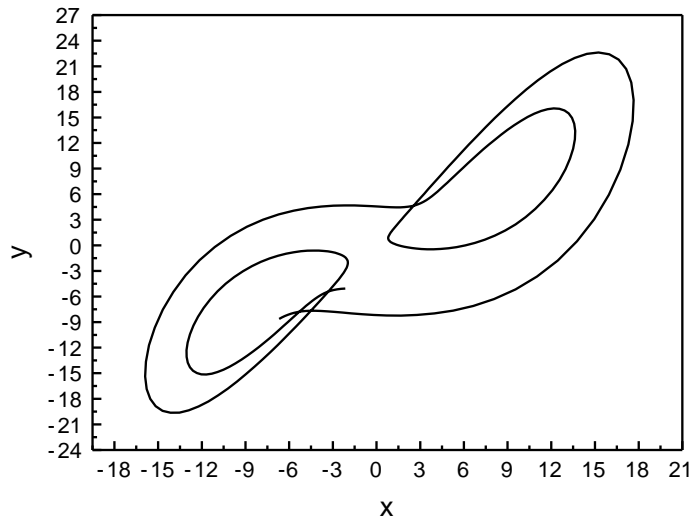
$$S=(3/4)^k$$

$$f=1/\varepsilon=2^k$$





Fractales Temporales



$$dx/dt = \sigma(y-x)$$

$$dy/dt = -xz + rx - y$$

$$dz/dt = xy - bz$$

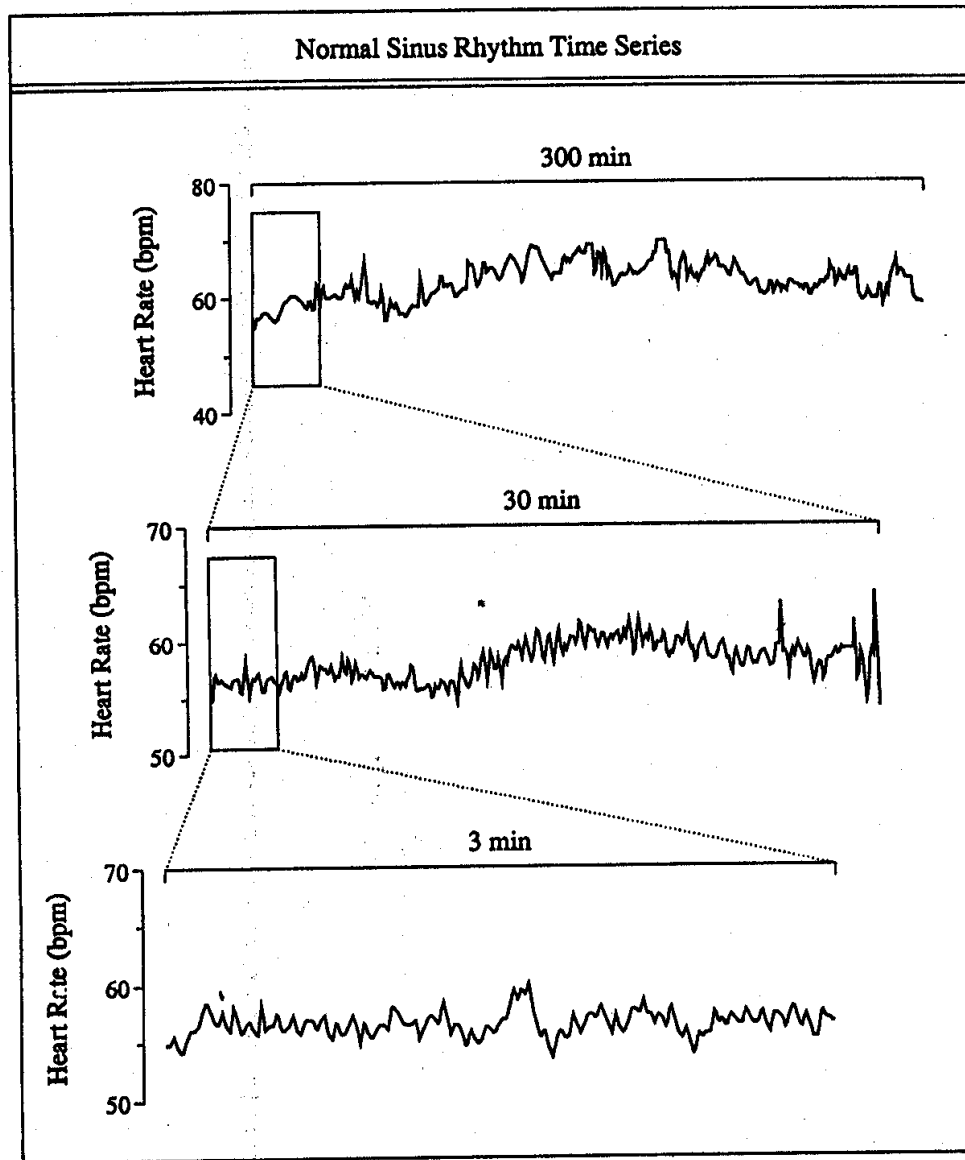


Figure 5 The normal heartbeat fluctuates in an apparently irregular fashion; furthermore, these fluctuations, when examined at different temporal resolutions, show a similar type of “rough” surface or landscape. See also Figure 6. (Adapted from Goldberger, A. L., Rigney, D. R., and West, B. J., *Sci. Am.*, 262, 42, 1990.)

La Variabilidad del Ritmo Cardíaco.

