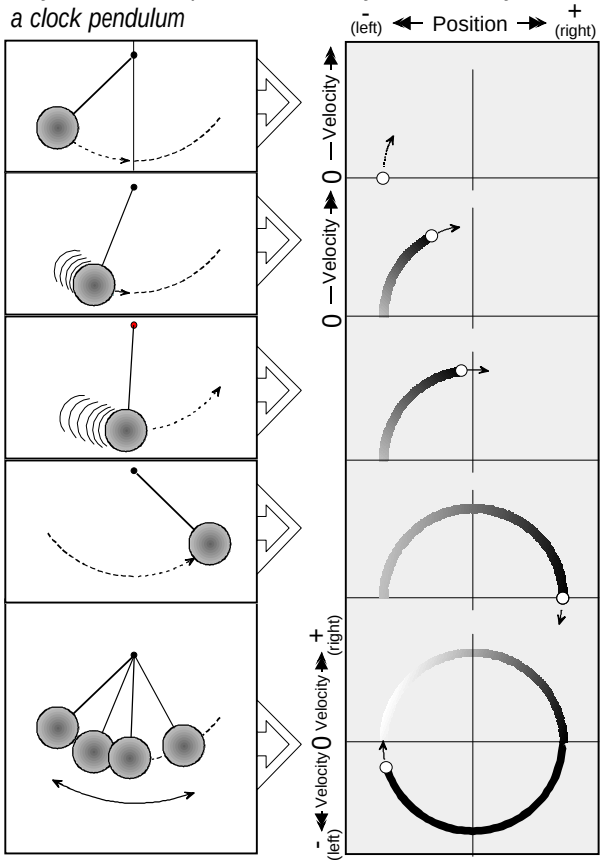
ATTRACTORS: STRANGE AND OTHERWISE

Attractor - In mathematics, an attractor is a region of phase space that "attracts" all nearby points as time passes. That is, the changing values have a trajectory which moves across the phase space toward the attractor, like a ball rolling down a hilly landscape toward the valley it is attracted to.

PHASE SPACE - imagine a standard graph with an x-y axis; it is a phase space. We plot the position of an x-y variable on the graph as a point. That single point summarizes all the information about x and y. If the values of x and/or y change systematically a series of points will plot as a curve or trajectory moving across the phase space. Phase space turns numbers into pictures. There are as many phase space dimensions as there are variables. The strange attractor below has 3 dimensions.

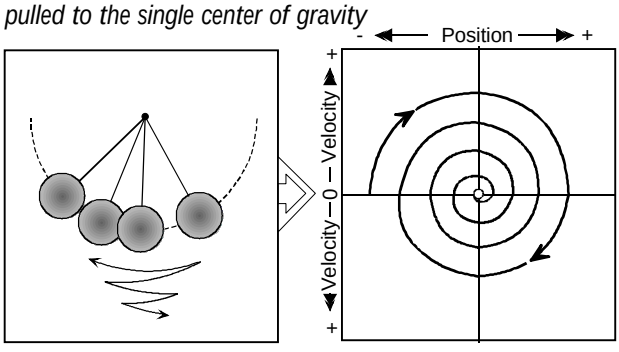
LIMIT CYCLE (OR PERIODIC) ATTRACTOR

A system which repeats itself exactly, continuously, like a clock pendulum



FIXED POINT (OR STEADY STATE) ATTRACTOR

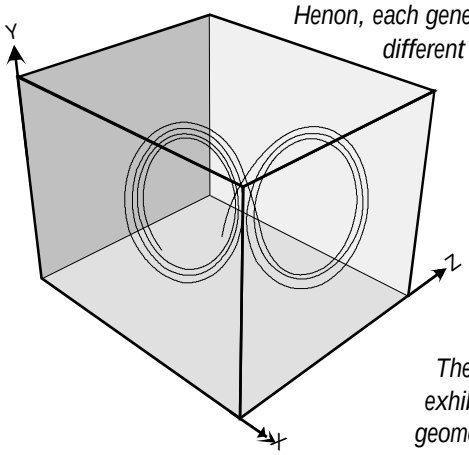
The attractor is a single point; all trajectories spiral in toward it, like a pendulum slowing down and coming to rest, pulled to the single center of gravity



STRANGE (OR COMPLEX) ATTRACTOR

A strange (or chaotic) attractor is one in which the trajectory of the points circle around a region of phase space, but never exactly repeat their path. That is, they do have a predictable overall form, but the form is made up of unpredictable details.

More important, the trajectory of nearby points diverge rapidly reflecting sensitive dependence. Many different strange attractors exist, including the Lorenz, Julian, and Henon, each generated by a different equation.

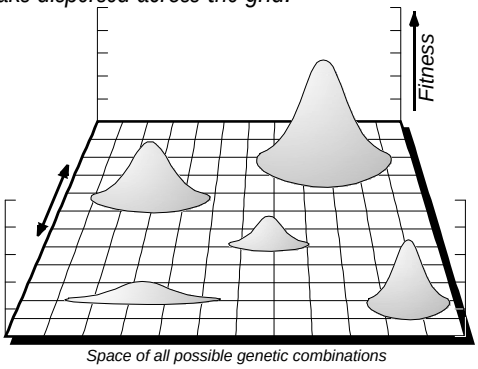


The attractors exhibit fractal geometry.

ATTRACTORS IN GENERAL

We can generalize an attractor as any state toward which a system naturally evolves. For example, biological fitness is an attractor toward which species evolve,

Biological fitness can be graphed by the Sewell Wright fitness landscape diagram below, where different character states are the horizontal axes, and fitness is measured by the vertical axis. Different levels of fitness are indicated by the peaks dispersed across the grid.



Space of all possible genetic combinations