

Physics 26 Syllabus

(1) Chaos (3 wks)

- Dynamic systems and chaos**
- Logistic map**
- Time series and Phase space**
- Attractors, basins and limit cycles**
- Return maps**
- Lyapunov exponents**
- Bifurcation diagrams**
- Sensitivity to initial conditions**
- Onset of chaos**
- Real physical system - the damped-driven oscillator**
- Poincare plots**
- Strange attractors**
- Self-similarity**

(2) Fractals (1 wk)

- Fractal dimension**
- Examples**
- Complex maps - Mandelbrot set**
- Basins and attractors**
- First thoughts about complexity**

(3) Self-Organized Criticality, Complexity and Emergence (8 wks)

- General thoughts and history (1/2 wk)**
- Computer modeling and simulation (1 wk)**
 - Sand piles and rice piles**
 - Experiments with real systems**
 - The Game of Life and other simulations**
- The crust of the earth and landscapes (1 wk)**
- Life, evolution and punctuated equilibrium (4 wks)**
 - A Case Study: Evolution as a SOC phenomena**
 - Model for macroevolution**
 - Fitness landscapes**
 - Multi-species interactions**
 - Agreement with data**
 - Avida Simulation System**
 - Fitness landscapes in avida**
 - Experiments with the avida system**
- The brain, economics and traffic jams (1-1/2 wks)**