
SOE 13: Economic Growth and Longevity II (Invited Talk Geoffrey West)

Time: Tuesday 12:00–12:45

Location: H37

Invited Talk

SOE 13.1 Tue 12:00 H37

The Complexity, Simplicity, and Unity of Living Systems from Cells to Cities; A Physicist's Search for Unifying Theories of Biological and Social Structure and Dynamics —
•GEOFFREY WEST — Santa Fe Institute, Santa Fe, NM, USA

Despite its extraordinary complexity, many of Life's most fundamental phenomena scale with size in a surprisingly simple and universal fashion. For example, metabolic rate scales approximately as the $3/4$ -power of mass over 27 orders of magnitude from complex molecules to multicellular organisms. Time-scales (such as lifespans and growth-rates) and sizes (such as genome lengths and RNA densities) scale with exponents which are typically simple multiples of $1/4$. These "universal" scaling laws follow from dynamical and geometrical prop-

erties of space-filling, fractal-like, branching networks presumed optimised by natural selection. This leads to a quantitative framework that captures many essential features of diverse biological systems, including vasculature, growth, cancer, aging and death, sleep and DNA nucleotide substitution rates. Cities and companies also scale: wages, profits, patents, crime, disease, pollution, road lengths scale similarly across the globe, reflecting underlying social network dynamics and principles of organization that transcend their individuality. Are cities and companies "just" large organisms? Why then do almost all cities persist, yet all companies die? Why does the pace of life continue to accelerate and how is this related to innovation and wealth creation that fuel socio-economic systems? Answers to such questions have potentially dramatic implications for growth, development and global sustainability.