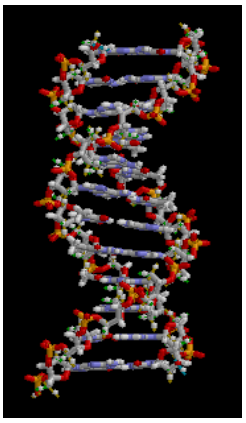
Complex system biology

Complex systems biology (**CSB**) is a branch or subfield of mathematical and theoretical biology concerned with complexity of both structure and function in biological organisms, as well as the emergence and evolution of organisms and species, with emphasis being placed on the complex interactions of bionetworks[1] , and on the fundamental relations and relational patterns that are essential to life[2] [3] [4] [5] [6] . **CSB** is thus a field of theoretical sciences aiming at discovering and modeling the relational patterns essential to life that has only a partial overlap with complex systems theory, and also with the systems approach to biology called systems biology because the latter is restricted primarily to simplified models of biological organization and organisms, as well as to only a general consideration of philosophical or semantic questions related to complexity in biology[7] . Moreover, a wide range of abstract theoretical complex systems are studied as a field of applied mathematics, with or without relevance to biology.

Topics in complex systems biology

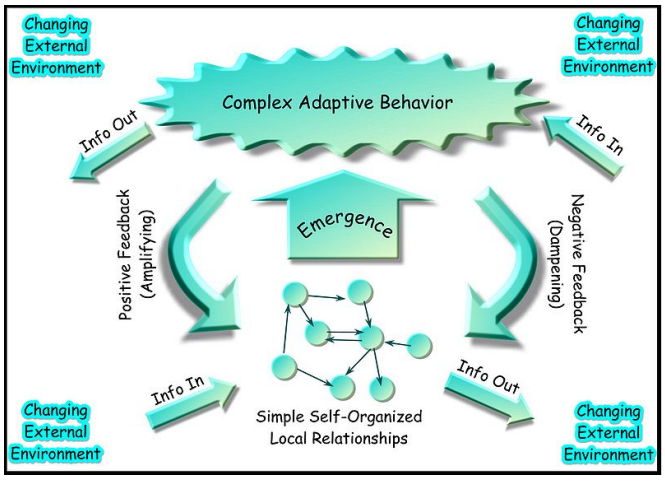
The following is only a partial list of topics covered in complex systems biology:

- Evolution theories and Population Genetics
  - Population genetics models
  - Molecular evolution theories
- Quantum biocomputation
- Quantum genetics
- Relational biology[8]
- Self-reproduction[9] (also called self-replication in a more general context)
- Computational gene models
  - DNA topology
  - DNA sequencing theory



Animated Molecular Model of a DNA double helix

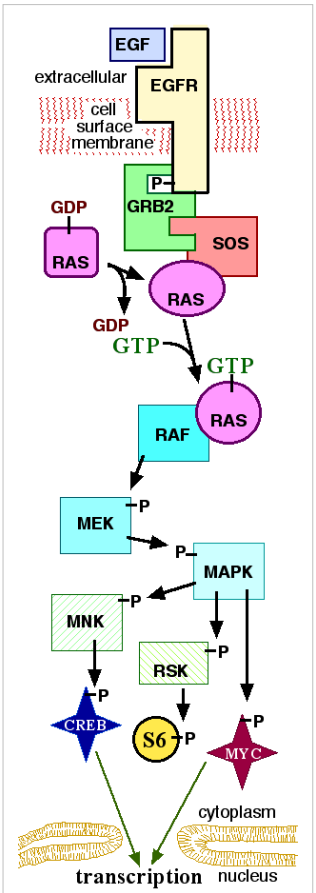
- Evolutionary developmental biology
- Autopoiesis
- Protein folding
- Telomerase conformations and functions *in vivo*
- Cell signaling
- Signal transduction networks
- Complex neural nets
- Genetic networks
- Morphogenesis
- Digital morphogenesis
- Complex adaptive systems
- Topological models of morphogenesis
- Population dynamics of fisheries
- Epidemiology



Network Representation of a Complex Adaptive System

Related journals

- Acta Biotheoretica [10]
- Bioinformatics [11]
- Biological Theory [12]
- BioSystems [13]
- Bulletin of Mathematical Biology [14]
- Ecological Modelling [15]
- Journal of Mathematical Biology [16]
- Journal of Theoretical Biology [17]
- Mathematical Biosciences [18]
- Medical Hypotheses [19]
- Theoretical and Applied Genetics [20]
- Theoretical Biology and Medical Modelling [21]
- Theoretical Population Biology [22]
- Theory in Biosciences [23] (formerly: Biologisches Zentralblatt)



A Complex Signal Transduction Pathway

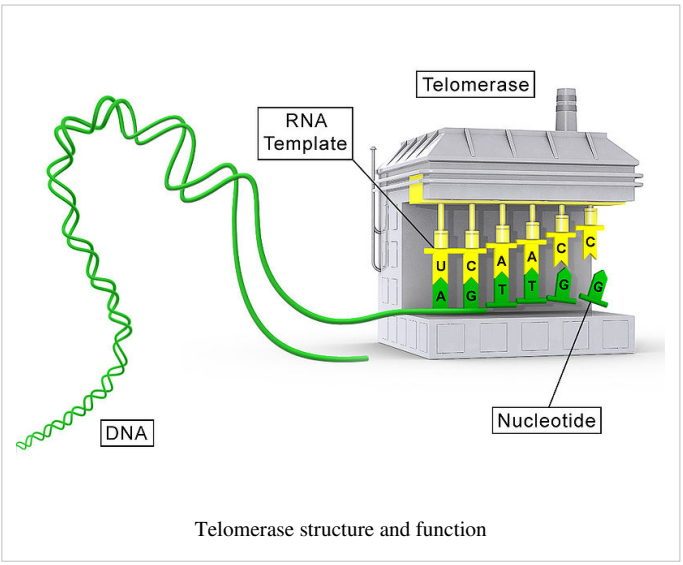
CBS Societies and Institutes

- Society for Mathematical Biology
- ESMTB: European Society for Mathematical and Theoretical Biology [24]
- Division of Mathematical Biology at NIMR [25]
- The Israeli Society for Theoretical and Mathematical Biology [26]
- Société Francophone de Biologie Théorique [27]

- International Society for Biosemiotic Studies [28]

See also

- Pattern oriented modeling
- Volatility, uncertainty, complexity and ambiguity
- blue Gene
- folding@home
- Telomerase
- What Is Life?



Telomerase structure and function

- Mathematical and theoretical biology
- Abstract relational biology [29][30] [31]
- Complexity
- Complex system
- Biological system
- Systems theory
- Dynamical system
- Dynamical systems theory
- Systems biology
- Systems theory in anthropology
- Self organization
- Nonlinearity
- Generative sciences
- Emergence
- DNA
- Quantum biology
  - Quantum Genetics
  - Quantum Biochemistry
- Protein folding
- Interactomics [32] [33]
- Genomics
- Proteomics
- Epigenetics
- Digital morphogenesis
- Complex adaptive system
- Multi-agent systems
- Cognitive Science

Biographies

- Charles Darwin
- D'Arcy Thompson
- William Ross Ashby
- Ludwig von Bertalanffy
- Ronald Brown
- Joseph Fourier
- Brian Goodwin
- George Karreman
- Charles S. Peskin
- Nicolas Rashevsky [34]
- Robert Rosen
- Anatol Rapoport
- Rosalind Franklin
- Francis Crick
- René Thom
- Vito Volterra
- Norbert Wiener

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Further reading

- A general list of Theoretical biology/Mathematical biology references, including an updated list of actively contributing authors [35].
- A list of references for applications of category theory in relational biology [36].
- An updated list of publications of theoretical biologist Robert Rosen [37]
- Theory of Biological Anthropology (Documents No. 9 and 10 in English) [38]
- Drawing the Line Between Theoretical and Basic Biology (a forum article by Isidro T. Savillo) [39]
- Semantic Systems Biology [40]
- Synthesis and Analysis of a Biological System [41], by Hiroyuki Kurata, 1999.

External links

- Center for Complex Systems and Brain Sciences at Florida Atlantic [42]
- Santa Fe Institute
- Bulletin of Mathematical Biology [14]
- European Society for Mathematical and Theoretical Biology [24]
- Journal of Mathematical Biology [16]
- Biomathematics Research Centre at University of Canterbury [43]
- Centre for Mathematical Biology at Oxford University [44]
- Mathematical Biology at the National Institute for Medical Research [45]
- Institute for Medical BioMathematics [46]
- *Mathematical Biology Systems of Differential Equations* [47] from EqWorld: The World of Mathematical Equations
- Systems Biology Workbench - a set of tools for modelling biochemical networks [48]
- The Collection of Biostatistics Research Archive [49]
- Statistical Applications in Genetics and Molecular Biology [50]
- The International Journal of Biostatistics [51]
- Theoretical Modeling of Cellular Physiology at Ecole Normale Superieure, Paris [52]
- Theoretical and mathematical biology website [35]
- Complexity Discussion Group [53]
- UCLA Biocybernetics Laboratory [54]
- TUCS Computational Biomodelling Laboratory [55]

- Nagoya University Division of Biomodeling [56]
- Technische Universiteit Biomodeling and Informatics [57]
- New England Complex Systems Institute
- Northwestern Institute on Complex Systems (NICO) [58]
- Complexity Digest [59]
- Centro de Ciencias de la Complejidad [60], UNAM
- Complexity Complex at the University of Warwick [61]
- Southampton Institute for Complex Systems Simulation [62]
- Center for the Study of Complex Systems at the University of Michigan [63]
- ARC Centre for Complex Systems, Australia
- (European) Complex Systems Society [64]
- (Australian) Complex systems research network. [65]
- Complex Systems Modeling [66] based on Luis M. Rocha, 1999.
- CRM Complex systems research group [67]

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[8] http://planetmath.org/?op=getobj&from=objects&id=10921

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[10] http://www.springerlink.com/link.asp?id=102835

[11] http://bioinformatics.oupjournals.org/

[12] http://www.mitpressjournals.org/loi/biot/

[13] http://www.elsevier.com/locate/biosystems

[14] http://www.springerlink.com/content/119979/

[15] http://www.elsevier.com/locate/issn/03043800

[16] http://www.springerlink.com/content/100436/

[17] http://www.elsevier.com/locate/issn/0022-5193

[18] http://www.elsevier.com/locate/mbs

[19] http://www.harcourt-international.com/journals/mehy/

[20] http://www.springerlink.com/content/100386/

[21] http://www.tbiomed.com/

[22] http://www.elsevier.com/locate/issn/00405809

[23] http://www.elsevier.com/wps/product/cws_home/701802

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[37] http://www.people.vcu.edu/~mikuleck/rosen.htm

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[46] http://www.imbm.org/

[47] http://eqworld.ipmnet.ru/en/solutions/syspde/spde-toc2.pdf

[48] http://sbw.kgi.edu

[49] http://www.biostatsresearch.com/repository/

[50] http://www.bepress.com/sagmb/

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