Biological Models and Abstractions for Studying Contrasts with Experimental Biology

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Description

Mathematical and theoretical biology, or biomathematics, is the branch of biology that uses theoretical analysis, mathematical models, and abstractions of living things to study the principles that govern the structure, evolution, and behaviour of systems. , as opposed to experimental biology, which involves conducting experiments to prove and validate scientific theories. The field is sometimes called mathematical biology or biomathematics because it emphasizes the mathematical aspects and theoretical biology because it emphasizes the biological aspects. Theoretical biology focuses on developing theoretical principles of biology, whereas mathematical biology focuses on using mathematical tools to study biological systems. The two terms are sometimes confused. Mathematical biology aims at the mathematical representation and modeling of biological processes using the techniques and tools of applied mathematics. It is useful for both theoretical and practical research. A quantitative description of a system means that the behaviour of the system can be better simulated, allowing us to predict properties that may not be apparent to the experimenter. This requires an accurate mathematical model. Due to the complexity of living systems, theoretical biology has addressed several branches of mathematics and contributed to the development of new techniques. Theoretical biology is a branch of biology that uses mathematical and computational tools to model and represent biological processes. The complexity of real biological systems stems from the number and heterogeneity of interacting parts. These interactions can span timescales from picoseconds photochemical reactions to billions of years of evolution. Length scales range from molecules to cells, organisms to ecosystems. This complexity requires sophisticated mathematics that is not readily accessible to empirical biologists, creating a divide between theoretical and empirical biologists. Theoretical biologists can make trade-offs between abstraction and realism, or between qualitative and quantitative. Theoretical biology is a term often used in conjunction with the term mathematical biology. Molecular Set Theory (MST) is a mathematical formulation of the long-range chemical dynamics of biomolecular reactions in terms of molecular assemblies and their chemical transformations, represented by set-theoretical mappings between molecular assemblies. Introduced by Anthony Bartholomay, its applications have been developed in mathematical biology, especially in mathematical medicine. In a more general sense, MST is a theory of molecular categories defined as categories of sets of molecules and their chemical transformations represented as set-theory maps of sets of molecules. This theory also contributes to the formulation of biostatistical and clinical biochemical problems in physiology, clinical biochemistry, and the mathematical formulation of pathological and biochemical changes important to medicine. Biomathematics was created to support the development of analytical and predictive models for biological and medical systems. Biomathematics differs from mathematics, biostatistics, bioinformatics, and traditional biology programs in that students are expected to have a strong background in both biology and applied mathematics. Mathematics and statistics programs typically do not train students to become familiar with empirical data about measurements and biological significance or to develop deep biological knowledge. Biostatistics and bioinformatics programs typically focus on statistical and algorithmic analysis of large data sets, but not on building mechanistic prediction models. Mathematical modeling techniques are becoming increasingly important in all areas of biology.

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Conflict of Interest

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