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Briefly Discussion about Systems Biology Graphical Notation and Synthetic Biology Studies

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Description

Glaucoma is an eye disease characterized by progressive damage to the optic nerve, often associated to high intraocular pressure, which causes vision impairment and vision loss in long term at the terminal phase. Glaucoma is a multifactorial disease because polymorphisms and deregulation of multiple genes are involved in the onset and development of the disease. However, deregulated genes do not act in isolation but are integrated into large networks of molecular entities. Systems and network biology are emerging disciplines in biomedicine in which mathematical modeling and computational biology tools are employed to integrate and analyze high-throughput quantitative biological data. In this article we discuss how these two new methodologies can be used to reconstruct the networks of deregulated genes behind glaucoma, networks that can be used to obtain mechanistic insights about the pathogenesis of the disease, and eventually to design molecular evidence-based therapies.

Systems and Synthetic Biology Studies

Bone is a dynamic tissue whose remodeling throughout life is orchestrated by repeated cycles of destruction mediated by osteoclasts and rebuilding by osteoblasts. The phenotypic analysis of knockout mice exhibiting abnormal bones has largely contributed to our current understanding of bone biology and its pathology. During the last decade, a number of mass spectrometry-based quantitative methods have been developed to investigate the complexity of biological systems. Such methods can provide an integrated view onto protein networks and posttranslational modifications that might be important for bone cell differentiation and function. This review summarizes how such approaches can contribute to understand bone biology.

Scientific research is reproducible when the findings can be independently verified. Reproducibility is crucial for the integrity of science. Unfortunately, scientific studies, including computational studies, are often not reproducible. We believe there are two primary causes for the frequent lack of reproducibility of computational systems and synthetic biology studies. First, the information needed to reproduce a result is often not communicated clearly. This issue can be addressed by improving and expanding the existing standards, the support for the standards, and the communication of the standards. Second, the computational environment needed to reproduce a result is often not shared. This issue can be partly addressed with virtual machines. Here, we outline the status of the reproducibility of computational systems and synthetic biology by reviewing the existing standards and software tools. As part of this review, we highlight some of the most common standards and software tools. Additionally, we discuss the shortcomings of the current standards and software tools, highlighting several gaps which continue to make computational systems and synthetic biology studies challenging to reproduce.

Systems Biology Graphical Notation

The Systems Biology Graphical Notation (SBGN) is a community standard developed to reduce ambiguity in the visual representation of bimolecular networks by providing a standardized description of sets of symbols to use. It is of utmost importance that conservation efforts are supported by both the public and policymakers. A mismatch between governance and public opinion might occur because of flawed information or biases that are held by people or governmental decision-makers. Despite over a century of scientific support for species conservation, there are many misunderstood or even feared organisms that are overlooked by society at large and may receive less attention and potentially less support for conservation than charismatic mega fauna. For centuries, society has shunned or even persecuted animals which provoke strong emotional feelings, like wolves, alligator, bats, or snakes because of fear, hate, incorrect assumptions about perceived threats or risk of harm to themselves or their livelihoods.

Public perceptions of wildlife attitudes likely represent complex factors informed by stakeholder experience, occupation, level of education, location (rural versus urban), or social identity. Moreover, scientists and conservation managers may not have utilized emerging forms of dissemination of information, as some of the myths and misconceptions of wildlife may be the result of inaccessible natural history knowledge, where only academic institutions hold primary literature, representing limited communication between scientists and stakeholders creating a knowledge gap and disconnect between researchers and the public. Media often perpetuates commonly held beliefs and can reflect societal views on conservation issues. Consequently, fears may come from media stories that transcend generations through books, movies, television, and even printed news media. The scientific community works to protect some of the most socially unaccepted organisms because research shows that they are more important to us alive and may provide ecological services. As a predator, wolves positively support environments by controlling elk populations to minimize overgrazing; bats control insect pests and pollinate agricultural plants providing a large economic benefit to society; and alligators are ecosystem engineers that create small wetland depressions that support the survival of many species. However, despite decades of scientific data, outreach, and education, many species continue to lack positive support for conservation from society at large.

In particular, we highlight the need for expanded standards for describing the provenance and verification of computational systems biology models. Church's Thesis is a meta-mathematical hypothesis that says the concepts of effective calculability and computability is coextensive. It is reasonable to consider everything that happens in the material world to be ‘effective’. If church thesis were true in the natural world, then it would mean that all material processes could be expressed in purely syntactic terms. A corollary in relational biology is that a living system must have non computable models. Thus the existence of living systems implies that church thesis is false as a physical proposition. The paper begins with a review of the tenets of relational biology, which is the standpoint from which this exposition on the foundations of mathematics and theoretical biology is composed.