Universitat Autònoma de Barcelona

2017/2018

Systems Biology

Code: 101950
ECTS Credits: 6

Degree	Type	Year	Semester
2500890 Genetics	OB	3	2

Contact

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Use of languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

Fundamental pre-grade knowledge in Algebra, Differential Calculus, Chemistry and Biochemistry.

Good comprehension of English written scientific publications and textbooks

Basic computer user skills (Windows, Word, Excel,...).

Be enrolled or have passed the Systems Biology module included in Integrated Laboratory VI.

Objectives and Contextualisation

Systems biology is a rapidly evolving field which fosters a new approach to solve biological problems through a combination of experimental data and the use of computer models with both predictive and explanatory power. The systems biology approach is centered in the integrated study of the network components (genes, enzymes, metabolites,…) and their interactions, revealing key emerging properties and complex dynamic behavior.

Historically, although it might be argued that the concept is much older, the systems biology approach evolves as a response to the enormous data accumulation from genomics, proteomics, transcriptomics, metabolomics,... and also due to the exponential increase in computer power allowing to go further in the analysis, interpretation and deeper understanding of the 'omics' data.

The first objective of the course will be to review the motives and origins of the discipline while offering a perspective of its relevance in the near future.

The second objective is to introduce the student to the tools and methods most commonly used. Thus the course will evolve from the mathematical description of the system, through the alternative methods of solution, towards the analysis of the resulting behavior. As a result the student will know and be able to use the most frequent basic tools used nowadays in the field.

The third objective will be to apply the acquired knowledge to model systems of the three most studied subsystems, namely metabolic, genetic and signal transduction networks. The emerging dynamics of those systems allows to see the main traits that arise in complex systems and understand the necessity of the 'systems' approach. An important part of this objective is performed as practical computer simulation sessions included in the Integrated Laboratory VI.

The fourth objective includes a firsthand appreciation of how this new approach is being applied in present day research. To this purpose the students will review real examples from scientific literature. Part of this objective will be fulfilled as a team work including the presentation of a reviewed paper to the rest of the students. This activity will favor a deeper understanding of the concepts learned, foster a wider view of its real impact as well as promoting the development of the student communication skills.

The subject is presented gradually, advancing from the basic concepts towards the description of more complex systems allowing for a thorough understanding of the necessity to study systems as integrated units.

The general objective is to allow the student to acquire the systems perspective of today's biology.

Content

1.- Introduction and definitions

- 1.1 The 'systems' perspective
- 1.2 Key general concepts. Emergence and robustness.

2.- Systems description and study

- 2.1 Top-down vs bottom-up approximations
- 2.2 Timescales
- 2.2 Deterministic vs. stochastic approaches
- 2.3 Dynamics vs steady state
- 2.4 Review of fundamental mathematical concepts
- 2.5 Introduction to system dynamics
- 2.6 Parameter determination
- 2.7 Structure, kinetics and thermodynamics

3. Networks and biological systems

- 3.1 Metabolic networks in steady state
- 3.2 Metabolic control analysis
- 3.3 Networks and genetic circuits
- 3.4 Signal transduction networks