



BioSys - Biological Systems - Functional & Integrative Genomics PhD in Biology/Biochemistry

PhD Program Director: Margarida D Amaral, Full Professor
Chair of the Training Board: Carlos M Farinha, Assistant Prof. with Habilitation

Program Overview

The BioSys-PhD program begins with one semester intensive training course organized in five modules (each with 3-week duration) covering key topics in Systems Biology and Functional Genomics. Students will be exposed to the principles of the field in lectures by reputed national and international researchers (mornings) and will develop "hands-on" experimental and tutorial activities (in the afternoons). A weekly cycle of "open-to-all" research seminars where BioSys faculty will present their research will run within each module, allowing all academic community to contact with the state-of-the-art in the field.

Module 1 - Basics & Gene Expression (3 weeks; 6 ECTS)

Responsible Faculty: Carlos Farinha, Luísa Romão & Margarida Carvalho

Biological systems: molecules, cells & tissues. An introduction
Gene expression. mRNA transcription, processing & splicing. Translation & regulation. miRNAs.
mRNA decay & surveillance. RNA & disease: RNA-based therapeutics.
Protein biosynthesis & folding; Membrane structure & proteins: topology & insertion. Secretory traffic.

Faculty:

M Gama-Carvalho, University of Lisboa (Portugal); CM Farinha, University of Lisboa (Portugal); L Romão, INSA - National Institute of Health Lisboa (Portugal); C Gomes, University of Lisboa (Portugal); A Moreira, University of Porto (Portugal); M Ramos, University of Lisboa (Portugal).

Module 2 - Bioinformatics & Computational Modelling (6 ECTS)

Responsible Faculty: Francisco Pinto & André Falcão

Bioinformatics: Intro to data problem in biology; Management of large-scale datasets; Data mining; Transcriptome & NGS data analysis; Functional annotation: GOs, enrichment analysis & networks
Modelling: static network models. Mathematical modelling of biological systems; Graph & Networks; Models to handle complexity in living systems at various levels: gene, protein, metabolic, signalling, physiological & population systems. Systems biology in medicine & drug development. Molecular modelling. Stochastic modelling.

Faculty:

A Falcão, University of Lisboa (Portugal); P Faísca, University of Lisboa (Portugal); A Nunes, University of Lisboa (Portugal); M Antunes, University of Lisboa (Portugal); L Sousa, University of Lisboa (Portugal); L Gouveia, University of Lisboa (Portugal); F Couto, University of Lisboa (Portugal); E Voit, Georgia Institute of Technology, Atlanta (USA); P Hussey, University of Durham (UK).

Module 3 - Biological Systems & Genomics (6 ECTS)

Responsible Faculty: José Pedro Gil & Astrid Vicente

Part 1 – Systems medicine & genomics

Human Genetics & genomics: Genetic epidemiology & mathematical genetics; Human genetic variation; Linkage & association studies; Whole genome studies.

Exome sequencing; Epigenomics; Translational & personalized medicine; Public health genomics.

Part 2 – Host-pathogen interactions in infectious diseases

Immunology: basic concepts. Dynamics of host-pathogen interactions. Infectious agents and strategies to colonize the host- Model organisms: Bacteria (B. cepacia, H. pyloris...), virus, plasmodium. Pharmacogenomics.

Faculty:

JP Gil, Karolinska Institute, Stockholm (Sweden); A Moura Vicente, INSA-Portuguese National Institute of Health Lisboa (Portugal); M Bourbon, INSA-Portuguese National Institute of Health Lisboa (Portugal); L Mota Vieira, Hospital Div Esp Santo, Ponta Delgada (Portugal); M Telhada, FCUL (Portugal); Rogério Tenreiro, FCUL, Lisboa (Portugal); Ricardo Dias, FCUL, Lisboa (Portugal).

Module 4 - Cell Signalling, Differentiation & Physiology (3 weeks;6 ECTS)

Responsible Faculty: Peter Jordan, Solveig Thorsteinsdottir & Karl Kunzelmann

Week 1

Signalling & signal transduction; Modulation of cell behaviour through signal integration; Omics to study signal transduction; Signal transduction in human disease; Small GTPases signalling; NF-kappaB signalling.

Week 2

Differentiation & morphogenesis: Epithelium & epithelial glands: Clinical significance; Epithelial-mesenchymal transitions; TGFβ signalling; Patterning during development; Cell-to-cell communication; Morphogenetic processes.

Week 3

Physiology of epithelia; Assessing ion transport: Ussing chamber, Patch-clamp, DEVC, & fluorescence methods; Single-channel recording; Ion transport & disease.

Faculty:

F Antunes, University of Lisboa (Portugal); P Jordan, INSA- National Institute of Health Lisboa (Portugal); P Matos, University of Lisboa (Portugal); S Thorsteinsdottir, University of Lisboa (Portugal); G Rodrigues, University of Lisboa (Portugal); M Chanson, University of Geneva (Switzerland); P Aspenström, Karolinska Institute, Stockholm (Sweden); M Hug, University of Freiburg (Germany); K Kunzelmann, University of Regensburg (Germany); M Gray, University of Newcastle.

Module 5 - Functional Genomics. Advanced Light Microscopy. (3 weeks;6 ECTS)

Responsible Faculty: Margarida Amaral & Rui Malhó

Week 1

Transcriptomics: Microarrays and NG Sequencing; High-throughput technologies for characterizing coding & non-coding RNAs. Proteostasis & protein folding; Dissecting human proteomes.

Week 2/3

Fluorescence microscopy methods & applications; State-of-the-art imaging detectors; TIRF, FRAP & FRET. Micropilot - Automatic Imaging. Image processing & analysis; High-throughput RNAi screening.

Faculty:

MD Amaral, University of Lisboa (Portugal); B Neumann, EMBL, Heidelberg (Germany); R Malhó, University of Lisboa (Portugal); R Pepperkok, EMBL, Heidelberg (Germany); L Clarke, University of Lisboa (Portugal); R Matthiesen, INSA- National Institute of Health Lisboa (Portugal); M Fortes, University of Lisboa (Portugal); G Martins, IGC/FCUL (Portugal); C Tischer, EMBL, Heidelberg (Germany); H Botelho, University of Lisboa (Portugal).

During the next 3 years the student will attend the following transferrable (soft) skills courses:

- **Science ethics** (FCUL Discipline nº 541122): Biomedical ethics; Main ethical issues & principles in research with humans/animals; Publishing ethics; Academic freedom.
- **Effective communication in science:** Convincing presentations; How to create clarity and how to structure your talk; Body language; Visual mastery.
- **Scientific writing:** How scientific journals work. Scientific writing: papers & grants.
- **Career development in academia & industry.** Gender issues. Moving from academia to industry; Working towards a tenure; The European Charter for Researchers.
- **Entrepreneurship & IP issues:** Legal aspects; Building a business plan; Protecting intellectual property
- **Languages courses** (optional).