



## Molecular Evolution

**Lecturers:** Rita Ponce and Teresa Nogueira (Ce3C-FCUL)

**Calendar:** 16-21 February 2015

**Duration:** 36 hours

**Schedule:** 9.30-12.30 and 14.00-17.00, everyday

**Objectives:** In this course we will explore evolutionary change at the molecular level. We will focus on the origin of genomic variability and the forces that drive the evolutionary process at molecular level, as well as origin of novel gene functions and genome organization. We will integrate the knowledge from molecular evolution to other levels, such as cell biology, physiology and the relationship of genotype to phenotype and will address several applications. Part of the course will involve the discussion of both classical and recent papers and hand-on analysis of case studies.

### General Plan:

#### 1. Evolution at molecular level - variability and mechanisms of evolution

Mutation and mutation rates

Genetic drift and coalescence theory

Neutral theory

Natural selection

Role of Migration, and Nonrandom Mating

Detection of natural selection, tests of neutrality

#### 2. Gene and genome evolution

Rates and patterns in protein evolution

Gene duplications and evolution of multigene families

Mobile genetic elements, horizontal gene transfer

Evolution of novel gene functions

Evolution of genome organization and content

Relationship between molecular evolution and phenotypic evolution

Case study: Comparative genomics: determining core and pan genome of bacterial genomes

#### 3. Resources and methods of analysis

Databases and database searches

Alignments

Phylogenies - gene trees and species trees

Analysis of gene trees

Assigning biological function to genome sequences

Case studies: Inferring history from DNA sequences, examples of molecular evolution in human lineage and of evolution of novel gene functions

#### 4. Examples and applications

Evolution of HIV

Evolution of resistances

Genes involved in reproductive isolation and speciation

Development of vaccines

Finding sources of epidemics

This course can have recognition of 6 ECTS for FCUL PhD students enrolling in it as part of their first doctoral year. For students only requiring 5 ECTS recognized in their specific PhD programs the last 6 hours of the course are not mandatory and the certificate will be on 'Topics in Molecular Evolution'.

**Location:** Faculdade de Ciências, Universidade de Lisboa

**Nº (min, max) students:** 5 – 15

**Minimal formation of students:** bachelor degree in Biology or related areas.

**Fee:** free for 1st year PhD students in the Doctoral program in Biology (FCUL), Biodiversity, Genetics and Evolution (UL; UP) and Biology and Ecology of Global Changes (UL, UA); 20 € for PhD students from institutions of the PEERS network (Ce3C, CFE); 100 € for FCUL Master students and unemployed; 150 € for BTI, BI and other PhD students; 200 € for professional and postdocs.

**Deadline for applications:** January 19<sup>th</sup>, 2015

Candidates should send a short CV and motivation letter to Rita Ponce ([anaritaponce@gmail.com](mailto:anaritaponce@gmail.com))