Universitat Autònoma de Barcelona

2017/2018

Instrumental Techniques

Code: 101966
ECTS Credits: 6

Degree	Type	Year	Semester
2500890 Genetics	FB	2	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: No
Some groups entirely in Spanish: No

Teachers

Inmaculada Ponte Marull
Alicia Roque Cordova

Prerequisites

There are no official prerequisites, but it is assumed that the student has previously acquired enough solid knowledge on the following subjects to follow this subject correctly:

- Basic concepts of Biochemistry, specially the physico-chemical characteristics of macromolecules
- Basic concepts of "Genètica molecular d'eucariotes"
- Basic computer user skills (Internet, office IT)
- Good comprehension of English written publications and textbooks

Objectives and Contextualisation

In this subject, instrumental foundations that are required to carry out genetic research will be taught. There are two distinct topics that will be treated as two independent modules: the computer tools to manage genetic data (Module of Databases and programming principles) and the methods and experimental techniques for the manipulation of biomolecules (Module Techniques in biochemistry).

MODULE I: DATABASES AND PROGRAMMING PRINCIPLES

Nowadays, research in genetics and genomics is carried out with huge amounts of data from DNA sequences. In order to process this information, researchers must know and use computer tools. How is this information stored in databases? How can we extract information in a flexible way? It is also important to know the programming principles that allow researchers to create programs to manage and analyze the genetic data.

The goal of this module is to explain the theoretical and practical principles of computer science, placing special emphasis on creating and consulting databasases and on programming. Perl will be learnt, the most popular programming language among bioinformaticians. It is versatile, ease to learn and it was designed to manage sequences. Theoretical classes will be complemented with the corresponding module from "Laboratori Integrat IV".

MODULE II: INSTRUMENTAL TECHNIQUES IN BIOCHEMISTRY

The general objective is the students learn the instrumental techniques that are developed in a laboratory and that they may need throughout their studies and professional activity.

This objective can be specified in:

-Acquire and understand the theoretical basis of the main instrumental techniques
-Application of these techniques in the field of genetics
-Strengthen the self-learning ability of the student. The student must learn to obtain information and acquire the habit of using this information critically.
-Increase student interest in the technical aspect of science.

Content

Module I: DATABASES AND PROGRAMMING PRINCIPLES

Unit 1. Introduction to the use of computer tools to the study of genetics. Basic concepts of computer science. Operating systems. Networks and Internet.
Unit 2. Databases I. What is a database. Database management systems. Relational databases.
Unit 3. Databases II. SQL language: creating, consulting and editing databases.
Unit 4. Programming. Basic concepts of programmation. The importance of knowing how to program. Programming languages.
Unit 5. Programming with Perl I. Why Perl?: characteristics, installation and programming tools. Programming strategis. How a program works.
Unit 6. Programming with Perl II. Types of variables in Perl: scalars, matrices and hashes. Basic operations. Input and Output: commands and basic operations. Reading and writing files.
Unit 7. Programming with Perl III. Flow control: conditional instructions, operators and loops.
Unit 8. Programming with Perl IV. Regular expressions: pattern matching, metacharacters, extraction and replacement of patterns.
Unit 9. Programming with Perl V. Subroutines and modules. Bioperl: tools for manipulating and annotating sequences.
Unit 10. Perl and databases. Connection to local databases from Perl.

Module II: INSTRUMENTAL TECHNIQUES IN BIOCHEMISTRY

Unit 1: Basic Principles of absorption spectroscopy. Lambert-Beer Law. Spectrophotometers. Spectroscopic analysis of biopolymers. Fundamentals of spectrofluorimetry. Spectrofluorimeter. Applications.
Unit 2: Centrifugation. Fundamentals.Sedimentation Coefficient. Factors on which the sedimentation coefficient depends. Instrumentation: preparative and analytical ultracentrifuge. Preparative centrifuge rotors: floating, angular, vertical. Cell fractionation by centrifugation. Centrifugation with density gradients.
Unit 3. Chromatographictechniques. Introduction. Fundamentals and characteristics. Chromatography type: gel filtration, ion exchange, hydrophobic, affinity. High Performance Liquid Chromatography (HPLC). Gas chromatography.
Unit 4: Purification Strategies of macromolecules. Stages of purification. Optimization of each stage. Preparative techniques of nucleic acids: plasmid DNA, bacteriophage DNA, genomic DNA, total RNA and messenger RNA.
Unit 5: Electrophoretic techniques. Protein Electrophoresis: SDS-PAGE, Two-dimensional gel electrophoresis, native electrophoresis. Nucleic acid electrophoresis: native, denaturing, pulsating field, thermal gradient, electroelution.
Unit 6. Hybridization techniques: Western-blot, Southern-blot, Northern-blot, Southwesthern, Microarrays, FISH, in situ hybridization. Labeling techniques
Unit 7: Polymerase Chain Reaction: PCR. Fundamentals of the technique. Primers design . Set up of the reaction. Applications. RT PCR and Real time PCR.
Unit 8: Recombinant DNA Technology. General scheme of clonnig experiment. Different types of Vector. Recombinant protein expression. Genomic and C-DNA libraries. Another DNA recombinant techniques

(CRISPR)
Unit 9: Immunological techniques. Preparation of monoclonal and polyclonal antibodies. Antigen-antibody reaction. Immunoelectrophoresis. Immunoprecipitation. ChIP. RIA. ELISA.
Unit 10. Mass spectrometry. Calculation of molecular weight by mass spectrometry. Techniques for biopolymers.
Unit 11: Microscopic. Electron microscope (TEM / SEM). Sample preparation methods.