Teaching Structural Bioinformatics at undergraduate level

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Objectives of Structural Biology
1. Introduction to the basic molecular principles of biophysics
2. Structural principles of biopolymers: proteins and DNA
4. Relationship between structure, function and sequence of proteins.
5. Molecular simulation of proteins and DNA

Competences of Structural Biology
1. Recognizing structural patterns of biomolecules and drugs
2. Relationship between 3D structure and function of biomolecules
3. Handling basic software and datasets of sequences and structures of biomolecules
4. Knowledge on experimental methods to analyze structures and biological systems.
Teaching Structural Bioinformatics at the Undergraduate Level

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Understanding the basic principles of structural biology is becoming a major subject of study in most undergraduate level programs in biology. In the genomic and proteomic age, it is becoming indispensable for biology students to master concepts related to the sequence and structure of proteins in order to develop skills that may be useful in a wide range of applications. Within this context, this article shows a scheme for teaching structural biology based on hands-on computer approaches, including computational genomics, and structural bioinformatics tools. The students learn to use most of the leading computer programs available for the complete path that goes from sequence to structure and eventually function. During the course, they are taught to build models of proteins based on sequence and structure information. The students are also provided with a critical point of view on automatic procedures and learn to discern between likely and unlikely structures of their final models.

Keywords: Structural biology; homology modeling; computer simulations.
BACKGROUND HISTORY

Evaluation
Theory: Multiple Choice + Assay (40%)
Practical (30%)
Presentation (30%)

Competences acquired by presentation
Group management
Technical (IT)
Oral communication
Write and summarize
All members of a team have to present
Already in 2002-2003 many presentations were in English.
BACKGROUND HISTORY

2004-2005 starts the Master of Bioinformatics for Health Sciences
ALL COURSES WERE IN ENGLISH
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Syllabus

The master provides different areas of specialization depending on the election of optional subjects:

- **Genome Bioinformatics**
  Automatic analysis, alignment, comparison and annotation of biological sequences; analysis of genome evolution and variation; molecular biology databases.

- **Structural Bioinformatics**
  An introduction to experimental methods used in determining the structure of biomolecules, protein structure prediction and biomolecular systems simulation.

- **Systems Biology**
  The description of biological networks and protein and metabolic gene network modelling. Emphasis in both topological aspects of networks and their dynamical behavior.

- **Pharmacoinformatics**
  Molecular library management and virtual screening, computer assisted drug design and quantitative modelling of structure-activity relationships (QSAR and 3D-QSAR).

- **Biomedical Computing**
  Clinical and healthcare information systems, biomedical imaging analysis, studying genotype-phenotype relationships and IT support systems for healthcare decision making.
2004-2005 starts the Master of Bioinformatics for Health Sciences
ALL COURSES WERE IN ENGLISH

Structural Bioinformatics was practically the same in the master and undergraduate courses, but the official language was English.

Databases are free accessible in internet
Programs are Open Source
SELECTING A COURSE TO BE IN ENGLISH

1) Material, sources and experience from the master
2) International teachers: Jana Selent (Germany), Gianni de Fabritiis (Italy)
3) Mathematical language, programming languages and IT terms
4) High percentage of the course are practices and seminars with computers
5) Presentations of students are in english, in order to evaluate oral competences

IN SITU

1) Questions by the students are accepted in english, catalan or spanish
2) Individual help in practices can be in english, catalan or spanish
3) Questions of assay are in english and catalan
4) Answers in assay are accepted in english, catalan or spanish
THE RESULTS: 2011-2012 & 2012-2013

Degree of satisfaction of the students with the course of Structural Biology
THE RESULTS: 2011-2012

Selected comments from the students

2011-2012 (first year). **99% negative** comments for having the course in English

*Crec que és una assignatura bastant complicada i el fet de fer-la en anglés augmenta el seu grau de dificultat considerablament.*

I think this is a difficult course and having it in English considerably increases its difficulty

*Per una banda, el fet de l'idioma ha sigut una mica limitant. La nova normativa de tot en anglés (a BE) ha suposat un repte; i mentre en activitats com el treball m'ha semblat una oportunitat, trobo que limitaven molt les classes teoriques ja que no s'entenien bé les explicacions.*

On the one hand, the language has been a little impairment. The new rule of having all the lectures (of SB) in English was a challenge, while for activities such as the presentation this was an opportunity, I think it was a handicap to understand the explanations on the lectures of theory
THE RESULTS: 2012-2013

Selected comments from the students

2012-2013 (second year). Only 40% of negative comments blamed the language

És una assignatura complicada, i el fet de que sigui en anglés ho fa encara més.

This is a complicated course, and being in english makes it worst

Estic d'acord que l'anglés en ciència i en general actualment és imprescindible, però trobo que fer TOTA l'assignatura en anglés no és necessari.

I agree that english in science, and in general nowadays, is essential, but I think that having the whole course in english was not necessary
THE EXAMPLES

Structure to death: CASPASES

IMMUNOGLOBULINS
Few conformations for a lot of diversity

DNA polymerases

THE NUCLEOSOME

Membrane proteins
Retinylidene proteins

Structural Biology of the Proteasome

Ubiquitylation System