



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Protein Biochemistry

2122-1-F0601Q060

Aims

The course aims at introducing concepts related to folding, structure (whether well-defined or disordered), function and evolution of proteins. Besides folding and turnover of proteins *in vivo*, phase separation and protein aggregation, which are at the basis of relevant physiological and pathological phenomena, will also be considered. The course intends not only to convey interest in the mechanisms underlying the functioning and evolution of proteins, but to equip students with useful tools also in the biotechnological field, for the design of synthetic proteins/peptides or the improvement of natural ones. The general objectives of the course are the following:

Knowledge and understanding.

At the end of the course, students will have acquired knowledge on protein folding mechanisms, on the relevance of structural flexibility and functional promiscuity, of conformational and functional transitions, often related to protein-protein interactions, and relevant in both physiological and pathological conditions.

Ability to apply knowledge and understanding.

The examples analyzed during the course reveal main protein functions and the underlying mechanisms, highlighting the role of intrinsic structural properties of proteins and their crosstalk with the environment. Such circumstances are expected to be recognizable in different contexts than those exemplified. Moreover, it is expected this knowledge could be exploited to design, for instance, new synthetic proteins.

Autonomy of judgment.

The student will be stimulated to recognize the relationships between the structure and function of proteins and foresee the effects of some environmental contexts on both.

Communication skills.

At the end of the course, students are expected to acquire the appropriate vocabulary and linguistic skills to

describe biochemical phenomena.

Learning skills

Students will apply their knowledge in the field of Protein Science, to understand functional and structural studies.

Contents

1. Structure of proteins and methods for their study.
2. Protein denaturation/folding and aggregation studies.
3. Protein-protein interactions and phase transition.
4. Turnover and mechanisms of protein degradation.
5. Protein evolution.

Detailed program

1. Structure of proteins and methods for their study.

Structural order and disorder; Structural elements and motifs; Methods for the structural study of proteins.

Circular dichroism spectroscopy; Fluorescence spectroscopy; X-ray crystallography; Electro-cryo microscopy

2. Protein denaturation/folding and aggregation studies.

Theories of protein folding; Protein folding in vivo; Foldases active on neosynthesized proteins; Chaperonins

Amyloid fibrils; Protein aggregation; Prionic proteins

3. Protein-protein interactions and phase transition.

Methods for the study of PPIs (microcalorimetry; surface plasmon resonance); Chemical-physical phenomena underlying molecular condensates. Examples of membrane-free organelles

4. Turnover and mechanisms of protein degradation.

Biochemical mechanisms of protein turnover; Examples of dual target degraders.

5. Protein evolution.

Protein promiscuity and evolvability; Methods of direct protein evolution.

Prerequisites

Prerequisites: Basic knowledge in the fields of Biochemistry and Cellular biology.

Teaching form

Classroom lectures supported by PowerPoint slides, videos, discussions of scientific papers.

Textbook and teaching resource

PPT slides and videos published on the Moodle website (<http://elearning.unimib.it/>).

Articles referred/described in the lessons

Semester

Second semester

Assessment method

Oral exam: an interview of approx. 30 minutes, with questions on the content of lectures and related scientific articles (available on the Moodle site). The understanding of course issues, the ability to recognize the technical-scientific challenges and their possible solutions, as well as the acquisition of linguistic properties and the clarity of the exposition will be evaluated

Office hours

On demand, by mail to stefania.brocca@unimib.it
