BB 650 **Academic Syllabus** **Fall 2017**

Course Name: Protein Structure, Function and Evolution

Faculty: Dr. Elisar Barbar **Contact Info:** 2133 ALS (7-4143; barbare@oregonstate.edu)
Credits: 3 **Hours:** T-Thu 3:30 - 4:55 p.m. (Corvallis, ALS 2018)

Office Hours: By appointment

Course Catalog Description: As proteins are the molecules that enable most of life's tasks, an understanding of proteins and their properties is highly valuable for all areas of biomolecular research. Because the selective pressures of evolution largely occur at the level of protein structure and dynamics, this course focuses on the relationship between the structure/function of proteins and their evolution.

Learning Resources: Readings will be from Assigned Literature. No textbook is required.

Targeted Learning Outcomes:

Students completing this course will

- have a foundational level of understanding of the principles of protein structure-dynamics-function relations

- have a foundational level of understanding of multiple techniques that are collectively used to determine structures of dynamic protein complexes (NMR, cryo-electron microscopy, small angle X-ray scattering)

- understand selective pressure at the level of protein structure and dynamics in the evolution of new functions

- learn that domains are seen as a fundamental unit of proteins in evolution and how they are classified

- understand the concepts of structural/evolutionary vs. functional classifications of protein families

- learn about ancestral sequence reconstruction, and the utility of multiple databases in predicting structure/function (QuickGo, ELM, PROFESS)

- gain an understanding of computational approaches for determining protein structures with minimal experimental data (ROSETTA modeling)

- gain experience reading and critically discussing original literature in this field

Learning Expectations:
This course will incorporate a problem-based learning approach that requires reading primary literature and in-class presentations, and is directed towards students with strong background and interest in Biochemistry and structural biology, as well as those who plan to collaborate with structural biologists on solving problems at the interface of cellular and molecular biology.

Students in this course will …

1. Come prepared for class time having carried out assigned readings;
2. Attend class sessions and actively participate in small group and large group discussions;
3. Participate with teammates to carry out cooperative projects

Evaluation of Student Performance: Fulfillment of the student learning outcomes will be assessed as follows:

30% Presentations/Discussions
35% Quizzes
35% Final Project

GENERAL OSU AND DEPARTMENTAL POLICIES

Statement Regarding Students with Disabilities:
Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at http://ds.oregonstate.edu. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

The Department of Biochemistry/Biophysics follows the university policies on student conduct. These can be found at **Statement of Expectations for Student Conduct**, i.e., cheating policies

Cheating or plagiarism by students is subject to the disciplinary process outlined in the Student Conduct Regulations. Students are expected to be honest and ethical in their academic work. Academic dishonesty is defined as an intentional act of deception in one of the following areas:

* cheating- use or attempted use of unauthorized materials, information or study aids
* fabrication- falsification or invention of any information
* assisting- helping another commit an act of academic dishonesty
* tampering- altering or interfering with evaluation instruments and documents
* plagiarism- representing the words or ideas of another person as one's own

The goal of Oregon State University is to provide students with the knowledge, skill and wisdom they need to contribute to society. Our rules are formulated to guarantee each student's freedom to learn and to protect the fundamental rights of others. People must treat each other with dignity and respect in order for scholarship to thrive. Behaviors that are disruptive to teaching and learning will not be tolerated, and will be referred to the Student Conduct Program for disciplinary action. Behaviors that create a hostile, offensive or intimidating environment based on gender, race, ethnicity, color, religion, age, disability, marital status or sexual orientation will be referred to the Affirmative Action Office.

Student Evaluation of Courses: The online Student Evaluation of Teaching system opens to students the Monday of dead week and closes the Monday following the end of finals. Students will receive notification, instructions and the link through their ONID. They may also log into the system via Online Services. Course evaluation results are extremely important and used to help improve courses and the learning experience of future students. Responses are anonymous (unless a student chooses to "sign" their comments agreeing to relinquish anonymity) and unavailable to instructors until after grades have been posted. The results of scaled questions and signed comments go to both the instructor and their unit head/supervisor. Anonymous (unsigned) comments go to the instructor only.

Planned lecture outline for Protein Structure, Function & Evolution

Brief Course Outline:
I. Principles of Protein Structure and function
II. Principles of Protein Evolution
III. Homology searching and modeling

I. Principles of Protein Structure

A. The building blocks
   1. Chemical structures
   2. Chemical properties
   3. Conformational properties
   4. Functional redundancy

B. Folded conformations of proteins
   1. Overview of protein structure
   2. Secondary Structure
   3. Supersecondary structure
   4. Tertiary structure
   5. Domains
   6. Quaternary structure

C. Structure-function relations

II. Principles of Protein Evolution

A. Overview and mechanisms
   1. What is it
   2. Genetic mechanisms
   3. Divergent, convergent and parallel evolution

B. Clear divergent protein evolution
   1. Definitions
   2. Ten Principles
   3. Differentiation to a similar function
   4. Differentiation to a dissimilar function
   5. Summary of clear divergent evolution
   6. Protein gymnastics

C. Clear convergent protein evolution

III. Homology searching and modeling

A. Purposes
   1. Identify homologs
   2. Align sequences to gain structural/ functional insight

B. Scoring matrices
   1. Simple matrices (ID, GC)
   2. Expected substitution probability matrices
   3. Profile based matrices
   4. Structure-based
   5. Hidden Markov models

C. Pairwise sequence comparisons
   1. Comparison matrices
   2. Optimal alignments
   3. Treatment of gaps
   4. Assessing significance
   5. Manual interventions
   6. Homology modeling
   7. Multiple sequence comparisons

D. Database searches