College of William and Mary
Williamsburg, Virginia 23186

Department of Biology

Protein Structure and Function

BIO 453/553 or CHEM 453

Fall 2021

Instructor: **Dr. Shantá D. Hinton**

Office: Room 2285, ISC III
Telephone: **(757) 221-2587**

Office Hours: Wednesday 2:30-3:50 p.m. or by appointment

E-Mail: sdhinton@wm.edu
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Course Description: In an era when the complete genomic sequences of an ever increasing number of organisms are being deposited in NCBI, scientists have been seeking a more intensive understanding of the other major players in this revolution, proteins. As a result, Proteomics has emerged as a rapidly advancing discipline. The purpose of this course is to provide a thorough knowledge of how protein's structure is integral to its function and interactions. Understanding this dynamic relationship between the structure and function of proteins is critical not only for the advancement of basic research but also for the advancement of healthcare and green technologies. A better understanding of protein structure and function could lead to the development of better medicines, increase food resources, and improve the synthesis of bio-fuels.
This course is an upper level course designed to provide students with comprehensive knowledge of how to use sequence data to understand a protein's physical properties, and predict its function and interactions.

Course Objectives: Course Objectives: The course will emphasize five major aspects of proteins: structure, function, post-modifications, domains, and proteomics. The goal for each aspect is as follows:

Structure: The goal is to emphasize to students the principles of protein structure and folding so that they may infer a protein's structure and function from a genomic sequence. Students will learn how the 3-dimensional structure of a protein is dependent on its 1-dimensional amino acid sequence. In addition, students will use protein bioinformatics to analyze properties of proteins such as its hydrophobicity or hydrophilicity index and whether the protein contains transmembrane spanning domains.

Function: The goal is to emphasize to students that there are many levels to the fundamental axiom that a protein's function is dependent on its 3-dimensional shape. Students will learn how structural features dictate the protein's ability to specifically recognize and interact with other molecules. Also, they will learn how the accessibility of functional groups dictates the ability of proteins to catalyze many chemical processes.

Post-modification: The goal is to analyze various post-translational modifications of proteins such as phosphorylation, ubiquitination, myristoylation, and cleavage. Students will learn how such modifications augment protein function.

Domain: The goal is to introduce students to the various functional peptide motifs (domains) within a protein so that they will begin to understand the full functionality of proteins. Students will learn how proteins interact with each other, and other macromolecules to form complexes.

Proteomics: The goal is to introduce students to the principle of proteomics. Students will learn the concept that protein-protein interaction function as a cellular system. They will learn about the methodologies used to separate and identify proteins and their interactions such as mass spectrometry.

Also, students will develop the skills to create a critical synopsis of primary literature papers on topics related to protein function. After the course, students should be able to observe protein sequences and domain, and make the connection to their functionality. Furthermore, students should be able to understand how mutations that alter the amino acid sequence may change the 3-dimensional shape and function of a protein. Students will also understand the methods used to study protein interactions. Moreover, at the conclusion of the course, students should be able to make predictions about the characteristics of a novel protein.

Required Text: Petsko, Gregory and Dagmar, Ringe. 2004. *Protein Structure and Function*, Sinauer Associates, Incorporated Publishing. ISBN: 0878936637

- **Required Mask:** All individuals are required to properly (covering mouth and nose) wear a mask on the campus of William and Mary, including your classroom. No individual will be allowed to enter the room/class without a mask. If you are sick and have any COVID-10 symptoms (fever; chills; cough; shortness of breath or difficulty breathing; fatigue; muscle or body aches' headache; new loss of taste or smell; sore throat; congestion or runny nose; nausea or vomiting; diarrhea) (**https://www.cdc.gov/coronavirus/2019-ncov/about/index.html**) please follow the guidelines and do not come to class. Contact your professor to determine whether any material needs to be made-up and your peers to obtain notes for the class(es) you missed.

Reading: Students will be assigned reading assignments of current primary literature for which they must write a synopsis.

Evaluation:

Undergraduates

Exams (3)	50%
Synopsis (3)	20%
Final Exam	30%
	100%

Graduate	**500 Level**
Exams (3)	45%
Synopsis (3)	20%
Presentation	10%
Final Exam	25%
	100%

Graduate students are required to perform additional assignments in order to receive graduate credit.

BIOL 553 Requirement: To fulfill this requirement students must give a mini lecture and two figures explanation to accompany each article synopsis. The ten minute (8 minutes lecture and 2 minutes questions) mini lecture must be done the last ten minutes of class the day the synopsis is due. If more than one student, then 7 minute (5 minutes lecture and 2 minutes questions) mini lecture must be done the last 15 minutes of class the day the synopsis is due.

COURSE OUTLINE (Tentative)

Date	Activity
Sep.1 (W)	Introduction: Virtual
Sep. 3 (F)	Ch. 1 –Protein Translation: Virtual
Sep. 6 (M)	Ch. 1 –Protein Translation: Virtual
Sep. 8 (W)	Ch. 1 - Protein Translation/Secondary Structures
Sep. 10 (F)	Ch. 1 – Secondary Structures/Motif
	Add/Drop Ends
Sep. 13 (M)	Ch. 2-Biochemical Functions/Binding
Sep. 15 W)	Ch. 2-Binding
Sep. 17 (F)	Ch. 2-Binding/Scaffold Proteins
Sep. 20 (M)	Ch. 2- Binding/Scaffold Proteins
Sep. 22 (W)	Ch. 2-Enzyme Kinetics
Sep. 24 (F)	Ch. 2-Enymes Kinetics
Sep. 27 (M)	Molecule of the Month
Sep. 29 (W)	Molecule of the Month (Presentation) **Synopsis I**
Oct. 1 (F)	**Exam 1**
Oct. 4 (M)	Ch. 3-Investigating Proteins (Intro)
Oct. 6 (W)	Ch. 3-Controlling Protein Function
Oct. 8 (F).	Ch. 3-Controlling Protein Function
Oct. 11 (M)	Ch. 3- G-proteins and Switches
Oct. 13 (W)	Seminar SUNY Polytechnic Institute (link to TBA)

Oct. 15 (F):	Ch. 3-Post-Translational Modification
Oct. 18 (M)	Fall Break
Oct. 20(W)	Ch. 3-Domains
Oct. 22 (F)	Ch. 3 & 4- Domains/From Sequence to Function
Oct. 25 (M)	Ch. 4- Experimental/Computational Approaches
Oct. 27 (W)	Ch. 4- Experimental/Computational Approaches
Oct. 29 (F)	Ch.4-Modeling
Nov. 1 (M)	Ch. 4- Modeling **(Synopsis II)/ Last day to withdraw from course**
Nov. 3 (W)	**Exam II**
Nov. 5 (F)	Ch. 4- Deducing Function: Protein Superfamilies
Nov. 8 (M)	Ch.5-Strucutre Determination
Nov. 10 (W)	Ch. 5- Investigating 3D Structure of a Protein
Nov. 12 (F)	Proteomic: Introduction
Nov. 15 (M)	Proteomic: Mass Spectrometry
Nov. 2 (T)	**Election Day: Please VOTE**
Nov. 17 (W)	Proteomic: Mass Spectrometry
Nov. 19 (F)	Proteomic Approach
Nov. 22 (M)	Proteomic Approach
Nov. 24 (W)	Thanksgiving Holiday
Nov. 26 (F)	Thanksgiving Holiday
Nov. 29 (M)	Proteomics: Manual De Nova (**Synopsis III)**
Dec. 1 (W)	**Exam III**
Dec. 3 (F)	Proteomics ETD
Dec. 6 (M)	Proteomics ETD/ Exercise/TBA Due
Dec. 8 (W)	Proteomics Exercise
Dec. 10 (F)	Proteomics Exercise Assigned Dec. 6 Due
Dec. 15 (W)	**Final Examination**

COURSE ASSIGNMENTS AND CALENDAR: Materials for the class and class assignments/ announcements will be available on Blackboard.

Please take note of the following dates on which assignments are due. No exceptions will be made.

Wednesday, September 29	**Synopsis I**
Friday, October 1	**Exam I**
Monday, November 1	**Synopsis II**
Wednesday, November 3	**Exam II**
Wednesday, November 29	**Synopsis III**
Wednesday, December 1	**Exam III**
Wednesday, December 15	**Final Exam (9:00 AM - noon); John E. Boswell Hall, 341**

GRADING SYSTEM:

A	94-100	C+	78-79	F	Below 60
A-	90-93	C	74-77		

B+	88-89	C-	70-73
B	84-87	D+	68-69
B-	80-83	D	64-67
B	84-87	D-	60-63

POLICY ON HONOR SYSTEM

Please adhere to all policies stated in the Student Handbook. In particularly, review the policies regarding the Honor System and Infractions (lying, cheating, plagiarism, and stealing).

Virtual Classes

We are not expected to have virtual classes. However, if the institution closes and resume to remote learning this course will become a synchronized virtual course. We will meet at 11:00 AM (EST) through zoom. Please use the following Zoom link https://cwm.zoom.us/j/4807388944. It will be important for us to remain flexible, during this COVID-19 pandemic.

DISCLAIMER

This syllabus is intended to give the student guidance in what may be covered during the semester and will be followed as closely as possible. However, the professor reserves the right to modify, supplement and make changes as course needs arise.

ZOOM LINK INFORMATION FOR SYNCHRONIZED VIRTUAL CLASSES

Join Zoom Meeting
https://cwm.zoom.us/j/4807388944
Meeting ID: 480 738 8944
Join by SIP
4807388944@zoomcrc.com
Join by H.323
162.255.37.11 (US West)
162.255.36.11 (US East)
221.122.88.195 (China)
115.114.131.7 (India Mumbai)
115.114.115.7 (India Hyderabad)
213.19.144.110 (EMEA)
103.122.166.55 (Australia)
209.9.211.110 (Hong Kong)
64.211.144.160 (Brazil)
69.174.57.160 (Canada)
207.226.132.110 (Japan)
Meeting ID: 480 738 8944
Join by Skype for Business
https://cwm.zoom.us/skype/4807388944