# Chemistry 6720
# Prin. Enzymology 1

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**Time and place:** Class will meet in WIDT 330. The **first lecture will be Monday, January 7 from 5:00 – 5:50 PM in WIDT330.** We will choose the permanent class time during the first lecture. Per department policy, class time will be determined based on student and instructor schedules, with special emphasis on accommodating graduate teaching assistant schedules.

**Office Hours:** MW 1:00-2:30 PM or by appt

**Text:** There is no required textbook for this class. However, you should have access to a general biochemistry textbook (Lehninger, Voet and Voet, Garrett and Grisham, etc) for review of fundamental principles. The course material will rely to a large extent on recent papers and review articles which will be available through my resources pages (see below).

**Class resources and management** I will be using Canvas instructure for the management of Chem. 6720. You will use canvas to access your grades, announcements, email, discussion threads, and my resource materials. My resource materials (current exam keys, problem set solutions, material from previous years, lecture overheads, and other material relevant to the course) will be posted on my web site and can be accessed directly at http://biochemistryportal.com or from links in Canvas. Many resource materials will be provided to you as downloadable PDF files, which require AcrobatReader. To log on to canvas, go to the web address: bb.usu.edu. Your **USERNAME** is your BANNER login and your default **PASSWORD** is your BANNER password. I will provide more instructions on using canvas and accessing my class resources in class.

**Computer resources** We will be using SigmaPlot for fitting of kinetic data. A PC with sigmaplot will be made available for students to use.

**Prerequisites:** A full year of undergraduate Organic Chemistry; a comprehensive upper division undergraduate course in Biochemistry (comparable to Biochem 5700 at USU), physical chemistry or physical biochemistry recommended but not mandatory.

**Course Withdrawal:** Withdrawal from the course after Jan.30 will result in a "W" notation being placed on your transcript.

Provisions: The administration of Chem 6720 will adhere strictly to the regulations outlined in the USU academic policies posted here: http://catalog.usu.edu/content.php?catoid=5&navoid=775
Per instructions from the Dean's office, no assignments will be accepted or graded from students not formally enrolled in the course. Students must be registered for the class to attend lectures (no sit ins allowed).

**Course Content:** The focus of this course is enzyme catalysis, mechanism, and kinetics. On the following page is a tentative (subject to some change) outline of the topics to be covered in the class meetings. For those desiring additional exposure to enzymology, a two credit course, chemistry 6730, is offered every other spring semester.

**Problems:** two problem sets, worth 50 points, will be given during the course of the semester.

**Quizzes** A twenty point, closed book quiz, covering concepts from the previous 3 lectures, will be given each Friday at beginning of class. You will have 15 minutes to take the quizzes.

**Exams:** One open book take home exam will be given at the conclusion of the course. The exam format will be a mixture of short answer, short essay, and problem solving.

**Grading:**

| | |
|---|---|
| Two problem sets @ 50 points each | 150 points |
| 5 in class quizzes, 20 points each | 100 points |
| Final exam (take home) | 100 points |
| **Total** | **350 points** |

**Tentative Class Schedule, Chemistry 6720, Spring Semester 2017- see next page**

*In accordance with the Americans with Disabilities Act, reasonable accommodations will be provided for all persons with disabilities in order to ensure equal participation in Chem 570. In cooperation with the Disability Resource Center, reasonable accommodation will be provided for students with disabilities. Please meet with the instructor during the first week of class to make arrangements. Alternative format print materials, large print, audio, diskette or Braille, will be available through the Disability Resource Center.*

| Date | Lecture | Topic | text chapter* | Handout |
|---|---|---|---|---|
| 1/9 | 1 | Course organization and introduction | Creighton 9 | |
| 1/11 | 2 | methods to study enzymes | Walsh 1-2 | Kornberg 10 commandments |
| 1/13 | 3 | enzyme kinetics | | |
| 1/16 | | Holiday: Martin Luther King Jr. Day | | |
| 1/18 | 4 | enzyme kinetics | | Cleland Steady state kinetics |
| 1/20 | 5 | enzyme kinetics | | |
| 1/23 | 6 | enzyme kinetics | | |
| 1/25 | 7 | enzyme kinetics | | |
| 1/27 | 8 | principles of rate acceleration | Creighton 9 | |
| 1/30 | 9 | principles of rate acceleration | Fersht 7 and 9, Walsh 3 | |
| 2/1 | 10 | binding energy: tyrosyl-tRNA synthetase | | Fersht TIBS |
| 2/3 | 11 | binding energy: tyrosyl-tRNA synthetase | | |
| 2/6 | 12 | Methods to study enzymes and intermediates | | |
| 2/8 | 13 | Methods to study enzymes and intermediates | | Mechanism-based inactivators of serine proteases |
| 2/10 | 14 | Methods to study enzymes and intermediates | | |

*reading text chapters is not mandatory

## Chemistry 6720 Learning Objectives

(1) Understand, define, and apply the following principles of enzyme catalysis:

- binding energy
- nucleophilic catalysis
- electrophilic catalysis
- proximity/orientation
- effective molarity
- transition state stabilization
- general acid/base catalysis
- covalent catalysis
- chemical/kinetic competence

(2) Understand, define, and apply the following terms related to enzyme kinetics:

- $V_{max}$, $K_m$, $k_{cat}$
- Determine $V_{max}$, $K_m$ graphically, interconvert $V_{max}$, $k_{cat}$
- Haldane relationship
- sequential, ping-pong reactions
- competitive, noncompetitive, uncompetitive inhibitors
- allosteric effectors
- slow-binding inhibitors, mechanism-based inactivators

(3) Understand the principles of nonlinear regression analysis of kinetic data. Use appropriate software to fit experimental kinetic data to the appropriate Michaelis-Menten models for single and two substrate reactions to determine the kinetic mechanism and derive kinetic constants.

(4) Be able to download ".pdb" files from the Protein DataBank, and render and manipulate the files using the computer software PyMol. Manipulate ".pdb" files to focus on structural details of a portion of an enzyme of interest, e.g. the enzyme active site, and ligand binding therein.

(5) Understand the roles of active-site amino acid residues in stabilizing ES, EI, and transition state complexes, and understand how the contributions can be deduced experimentally.

(6) Outline the mechanism of peptide bond hydrolysis catalyzed by serine proteases. Explain the function of the "catalytic triad" of serine proteases using the current models.

(7) Explain the information the following experiments provided concerning the mechanism of chymotrypsin, and how these techniques can be generally applied for enzymatic analysis:

- (a) burst kinetics
- (b) p-nitrophenyltrimethyl acetate as substrate
- (c) cryoenzymology
- (d) aminoacyl-ester vs. aminoacyl-amide substrates
- (e) substrate partitioning
- (f) affinity label(s)
- (g) group specific agent(s)
- (h) mechanism-based inactivator(s)
- (i) site-directed mutagenesis