Texas A&M University
Departmental Request for a New Course
Undergraduate • Graduate • Professional
• Submit original form and attach a course syllabus.

1. Request submitted by (Department or Program Name): Department of Chemistry

2. Course prefix, number and complete title of course: Chem 640 - Laboratory Methods in Biological Chemistry

3. Catalog course description (not to exceed 50 words):
Chemical biology is an ever-expanding scientific field that involves the application of chemical techniques to the investigation and/or manipulation of biological systems. This laboratory will provide students with a hands-on opportunity to gain an understanding and appreciation for chemical biology techniques.

4. Prerequisite(s): Graduate standing or approval of instructor

5. Is this a variable credit course? Yes ☐ No ☑ If yes, from ______ to ______

6. Is this a repeatable course? Yes ☐ No ☑ If yes, this course may be taken ______ times.
Will this course be repeated within the same semester? Yes ☐ No ☑

7. This course will be:

   a. required for students enrolled in the following degree program(s) (e.g., B.A. in history)

   b. an elective for students enrolled in the following degree program(s) (e.g., M.S., Ph.D. in geography)

M.S., Ph.D. in Chemistry

8. If other departments are teaching or are responsible for related subject matter, the course must be coordinated with these departments. Attach approval letters.

9. Prefix Course # Title (excluding punctuation) CHEM 640 LAB METHODS IN BIOL CHEM

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Approval recommended by:

Chair, College Review Committee

Date 9-19-11

Dean of College

Date OCT 06 2011

Chair, GC or UCC

Date

Associate Director, Curricular Services

Questions regarding this form should be directed to Sandra Williams at 845-8201 or sandra.williams@tamu.edu.
Curricular Services – 3/10

1 of 9 B1
CHEMISTRY 640-Laboratory Methods in Biological Chemistry

Chemical biology is an ever-expanding scientific field that involves the application of chemical techniques to the investigation and/or manipulation of biological systems. This laboratory will give you a hands-on opportunity to gain an understanding and appreciation of the field and are divided into 5 modules. You will be exposed to a variety of modern techniques and instrumentation such as cellular assays (ELISA, cytotoxicity assays), site-directed mutagenesis, DNA techniques (isolation, quantitation, amplification, cloning, electrophoresis, genome mining/screening with degenerate probes), protein expression and purification (kinetic measurements, SDS-PAGE analysis), organic synthesis (including basic characterization methods: ¹H-NMR, ¹³C-NMR, UV, IR, mass-spec), chemoenzymatic synthesis (chemical synthesis using enzymes for catalysis), reporter assays, and activity assays (both in vitro and in vivo). You will also learn to formally communicate these results using clear, concise, and precise writing as all results will be communicated in journal article format.

Prerequisites
Approval from instructor

Required Materials
(1) Handouts will be supplied to supplement these labs
(2) Safety Goggles: These are available at the MSC bookstore and are usually sold the first week of class by The Local American Chemical Society Student Affiliate Section in the chemistry department
(3) Laboratory Notebook: 5x5 Quad Ruled, Roaring Spring #77110 (available in the TAMU Bookstore)
(4) Optional: You might consider obtaining a lab coat. They are required if you plan to wear shorts (a lab coat of sufficient length to cover your knees would be needed).

Instructor Information
Coran M. H. Watanabe, Room 1125, Ph: 979-458-8094
office hours: TBA and by appointment (call or e-mail)
e-mail: watanabe@mail.chem.tamu.edu

Lectures (Once per week)
The lecture component of this course is mandatory. We will discuss fundamentals, techniques, and topically interesting material related to the laboratory you will be performing in the upcoming week.

Preparation and Success in the Laboratory
Considering that only a small fraction of your grade is based on quizzes, it is absolutely necessary to come completely prepared for a laboratory session before coming to the lab. The more prepared you are for this laboratory, the more successful your laboratory experience will likely be. This will not only carry over into your graduate work in your respective research labs, but also when you enter your research careers. That is, you should be very familiar with the protocols and techniques you will be performing or using. A critical part of this preparation is the completion of your prelab report, detailed below. Beyond this, it is imperative that you do any assigned readings. Attending lecture will also greatly benefit your pre-lab preparation. Quizzes will also gauge your level of preparation on these experiments.

Pre-Labs
Pre-lab reports will be written in your laboratory notebooks. The requirements for each prelab will be
specified in the lab handout provided in lecture.

Lab Report Format

All laboratory reports should follow the style of *Organic Letters* (see sample report hand out). The Word template (Mac or PC) for this can be downloaded at the American Chemical Society Paragon Plus website at: [http://pubs.acs.org/paragonplus/submission/orlf7/index.html](http://pubs.acs.org/paragonplus/submission/orlf7/index.html). Once you have it downloaded, you can save the template for all experiments. The laboratory handouts will specify any material to be submitted as supplementary material.

Techniques to Be Covered

- Bacterial cell culture and determination of MIC (minimal inhibitory concentration)
- Gene cloning and verification by sequencing
- Site directed mutagenesis
- Reporter assay
- Protein overexpression in *E. coli* and purification (His-tagged system), verification by SDS page and Western blot and enzymatic assay (measurement of Km and kcat)
- Chemoenzymatic synthesis
- Flash column chromatography
- Synthesis of a simple chemical library and cell-based screening
- Compound characterization (^1H-NMR, ^13C-NMR, IR, UV, mass spec)
- Screening with degenerate probes
- ELISA assay

Module 1  Screening with Green Fluorescent Protein (GFP) and Effects of Site-Directed Mutagenesis  In the first part of this lab you will generate an active site mutant and evaluate the effect on fluorescence of the protein. In the second portion of this lab, you will evaluate the response of a GFP reporter (under the control of a DNA damage protein promoter) to methyl methane sulfonate (MMS, a DNA alkylating agent).

Module 2  Chemoenzymatic Synthesis  In this lab you will overexpress and purify a protein involved in carbohydrate synthesis. You will evaluate the enzyme’s ability to catalyze the formation of a sugar analogue. Kinetic measurements will be made on the reaction and the compound characterized by UV, IR, ^1H-NMR, ^13C-NMR and mass spec.

Module 3  Combinatorial Library Synthesis and Screening  In this lab you will synthesize a chemical library in 96-well format. The library will be examined for their cytotoxic effects against *E. coli*. "Active" compounds will be synthesized in large scale, isolated, purified, and characterized by UV, IR, ^1H-NMR, ^13C-NMR and mass spec.

Module 4  Genome Mining for β-Lactamases and Their Role in Antibiotic Resistance  In the first part of the experiment you will clone and express a gene from *B. subtilis* that appears to be a β-lactamase based upon DNA homology. The ability of this gene to confer resistance to ampicillin will be examined in *E. coli*. In the second part of the lab you will design degenerate probes against β-lactamases and screen them against intestinal microbiota DNA to assay for the presence or absence of these genes.

Module 5  Screening by ELISA  In this lab, you will explore the use of ELISA to detect the levels of biotin within *E. coli* that have been manipulated (e.g. a chemical inhibitor, an *E. coli* auxotroph) as compared to wild-type *E. coli*.

Grading

The grading in this course will be curved. The techniques covered in this course will be integrated into a total of 5 modules or experimental projects that run anywhere from 1-5 weeks in length. Each of
these modules will be worth 100-200 pts. Points will be awarded for the prelab quiz, completing the experiment, obtaining the requested data, interpretation of data, keeping a proper notebook, carrying out correct calculations, and writing up the results. The exact point breakdown for each week’s experiment(s) will be given to you prior to that experiment.

Module 1 Bioluminescence/GFP Lab 200 pts
Module 2 Chemoenzymatic Synthesis Lab 200 pts
Module 3 Combinatorial Libraries 200 pts
Module 4 β-lactamase and Antibiotic Resistance Lab 200 pts
Module 5 Biotin ELISA Lab 100 pts

As a general guide: >80 % is an A; 79-65 % is a B; 64-50 % is a C; 40-49% is a D; <40% is an F

Absences

To prevent a University absence from counting against you or receiving a zero for a quiz you miss, you must see me or e-mail me prior to the laboratory or lecture you will miss or, at the latest, prior to performing the next experiment. You will be required to provide valid documentation regarding a University excused absence. Make-up laboratory experiments can be scheduled with your TA but only after providing documentation to me regarding the excused absence. A makeup quiz will again only be given if you can provide documentation supporting a university excused absence. If you cannot provide such documentation, you will receive a zero for that quiz. If you are unable to take a quiz due to an excused absence, please contact me by phone or e-mail.

Americans with Disabilities Act (ADA) Policy Statement

The Americans with Disabilities Act (ADA) is a federal antidiscrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services in Cain Hall, Room B118, or call 845-1637. For additional information visit http://disability.tamu.edu.

Academic Integrity Statement and Policy

“An Aggie does not lie, cheat or steal, or tolerate those who do.” You should be aware of the TAMU student rules (student-rules.tamu.edu) and the Honor Council Rules and Procedures on the web: http://www.tamu.edu/aggiehonor
Texas A&M University
Departmental Request for a New Course
Undergraduate • Graduate • Professional
• Submit original form and attach a course syllabus.

1. Request submitted by (Department or Program Name): Chemistry

2. Course prefix, number and complete title of course: Chem 644 - Natural Products Biosynthesis

3. Catalog course description (not to exceed 50 words): This course will present a survey of the chemical reactions occurring in living systems, describe the experimental methods used to study these reactions and examine the biosynthesis of the major families of natural products, with an emphasis on the mechanistic chemistry of the biosynthetic pathway.

4. Prerequisite(s): Graduate standing or approval of instructor

5. Is this a variable credit course? ☒ Yes ☐ No If yes, from _____ to _____

6. Is this a repeatable course? ☐ Yes ☒ No If yes, this course may be taken _____ times.

7. This course will be:
   a. required for students enrolled in the following degree programs(s) (e.g., B.A. in history)
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8. If other departments are teaching or are responsible for related subject matter, the course must be coordinated with these departments. Attach approval letters.

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Approval recommended by: [Signature]

Department Head or Program Chair (Type Name & Sign) Date

Chair, College Review Committee Date

Dean of College Date

Chair, GC or ICC Date

Submitted to Coordinating Board by: Associate Director, Curricular Services

Questions regarding this form should be directed to Sandra Williams at 845-8201 or sandra.williams@tamu.edu.
Course title and number
Natural Products Biosynthesis
Term (e.g., Fall 200X)
Fall 2011
Meeting times and location
WF 3:00-4:15; CHEM 2101

Course Description and Prerequisites

This course will apply the principles of organic chemistry to develop a mechanistic understanding of the strategies used to biosynthesize the organic molecules found in living systems. The course will consist of four modules. The first module will present a survey of the chemical reactions found in living systems from a mechanistic perspective. The experimental methods used in modern natural product biosynthetic studies will be covered in the second module. The third module will examine the biosynthesis of the major families of natural products, with an emphasis on the chemical logic of the biosynthetic pathway. A poster session, followed by in-class presentations on student-selected posters, will complete the course.

Natural products biosynthesis is a logical extension of any two-semester organic chemistry course and studying Mother Nature’s synthetic toolkit is one of the easiest ways for organic chemistry students to learn to apply their knowledge of reactions and mechanism to biological systems. Undergraduates who have completed two semesters of organic chemistry are welcome in the class.

Learning Outcomes or Course Objectives

Students will be able to analyze >90% of the reactions found in living systems from a mechanistic perspective.

Students will become familiar with the basic reactivity patterns of the major enzyme cofactors.

Students will learn to analyze enzyme active site structure and to relate structure to reaction mechanism.

Students will become familiar with the major databases and literature resources important in biological chemistry.
Instructor Information

Name: Tadhg Begley
Telephone #: 862-4091
Email address: Begley@chem.tamu.edu
Office hours: By appointment
Office location: 2107 Interdisciplinary Life Sciences Building

Textbook and/or Resource Material
Medicinal Natural Products: A Biosynthetic Approach Paul M. Dewick
Any basic biochemistry text
Organic Chemistry of Biological Pathways John McMurry and Tadhg Begley
Enzyme Mechanisms, Perry A. Frey, Adrian D. Hegeman
Selected papers from the current literature.

Grading Policies
There will be 1 Preliminary Examination, a poster presentation on a topic relevant to the course and a final exam. The distribution of credit will be as follows:

- Preliminary Examination: 15 points
- Homework (6 problem sets): 15 points
- Poster: 25 points.
- Final Examination: 45 points

As a general guide: >80% is an A; 79-65% is a B; 64-50% is a C; 40-49% is a D; <40% is an F

Course Topics, Calendar of Activities, Major Assignment Dates

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| 1    | Introduction to enzyme chemistry, group transfer reactions  
Protein structure analysis |
| 2    | Substitutions  
Carboxylation and decarboxylation |
| 3    | Rearrangements  
Eliminations and Additions |
| 4    | Aldol and Claisen Condensations  
One-carbon transfer reactions |
| 5    | Redox reactions |
| 6    | Redox reactions |
Experimental methods in natural product biosynthesis

Assembly of biosynthetic pathways from DNA sequence

Nucleotide metabolism
Amino acid metabolism

Polyketide biosynthesis

Terpene biosynthesis
Alkaloid biosynthesis

Nonribosomal polypeptide biosynthesis

Vitamin biosynthesis

Student Poster presentations

Other Pertinent Course Information

None

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Academic Integrity

For additional information please visit: http://aggiehonor.tamu.edu

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