

Course Outline: Chem 531 Biosynthesis of Natural Products

Introduces the main building blocks and basic synthetic mechanisms employed in the biosynthesis of natural products. Areas of metabolism fed by the acetate, shikimate, mevalonate and deoxyxylulose phosphate pathways will be studied while investigating modern drug candidates that these pathways have produced. *Prerequisite: CHEM 202L and CHEM 341 or 352.*

Learning Outcomes

- Understand the key pathways for the biosynthesis of fatty acids, polyketides, terpenes, and alkaloids
- Be and be able to apply key biosynthetic reactions to predict how organisms make secondary metabolites (retrobiosynthetic analysis and biosynthesis)
- Understand and apply biomimetic strategies in organic synthesis for the preparation of various natural products.
- Demonstrate the advantages and use of biotransformations in synthesis including hydrolytic reactions, oxidations and reductions and carbon-carbon bond forming reactions and the concept of green chemistry.
- Apply principles learned to the synthesis and biosynthesis of a medicinal natural product and present to peers.

Text: Reader will be based on materials from current journals as well as selected texts, including

- The Biosynthesis of Secondary Metabolites, R. B. Herbert, *Chapman and Hall*, 1990.
- Medicinal Natural Products: a Biosynthetic Approach, P M Derwick, *Wiley, New York*, 1997.
- Biotransformations in Organic Chemistry, K. Faber, *Springer*, 2001.

Attendance: This course is discussion-based and relies heavily on the use of class notes for quizzes rather than texts. For these reasons, attendance is essential to do well in the class.

Examination: An open notes essay- and problem-based final exam will be given.

Quizzes: Eight quizzes are anticipated for the semester. The 15-minutes quizzes will be based on readings and class notes since the last quiz. Goals in this course include the ability to discuss important aspects of study in natural products biosynthesis and to have a good set of notes to take with you.

Grading: The course will be graded based on the following criteria

Presentation & Discussion		200 points
Quizzes	120	(8 quizzes x 15 points each)
Participation	40	
Final Exam	100	
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Total Possible Points	460	

Topics:

Week 1	Primary and secondary metabolites, primary building blocks.
Week 2-3	Fatty acid and polyketide biosynthesis, acetate hypothesis, aliphatic and aromatic compounds.
Week 4-5	Terpene and steroid biosynthesis.
Week 5-6	Alkaloid biosynthesis
Week 7-8	Retrobiosynthesis
Week 8-11	Biotransformation and Synthetic Biology Applications <ul style="list-style-type: none">• Hydrolytic reactions, mechanism, prochiral/meso substrates, racemic substrates and substrate and active site models.• Oxidations and reductions.• Carbon-carbon bond formation, acyloin reactions, biological aldol condensations, cyanohydrin formation.
Week 12	Biomimetic Chemistry
Week 13-15	Applied study of a natural product – Biosynthesis, synthesis, and significance

Presentation

Part 1: Oral. Students will choose from a list of topics to study in more detail and present to the class. Students will choose one paper that would be a good introduction to the topic for classmates. Paper will be submitted to instructor at least 3 class sessions before scheduled oral presentation. The paper will be distributed to the class one week before the discussion. Students will prepare 3-5 thought-provoking questions for the class to incorporate into the presentation.

Part 2: Written. A 5-6 page paper (1.5 – double spaced, 12 pt. font, 3/4” – 1” margins) is due within two weeks of oral presentation. Five points per day will be deducted for late papers. The paper should be written as a review of your topics, complete with abstract.