VANDERBILT UNIVERSITY

Advanced Chemical Biology (CPB8320/BCB4320) 2017

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Office hours: by appointment

Location: Stevenson 1 (Math) 210
Class hours: MWF 2:00 – 3:00

Course Description: It is a wonderful time to be a scientific researcher involved in research and discovery in chemistry and biology. Conceptual advances at the interface of these previously independent sciences, combined with the enabling advances being made in information technology, are changing how we understand the world. For better or worse, we are at the cusp of understanding the chemistry of life, how our genes determine our chemistry and how our chemistry effects who (and what!) we are. This course aims to introduce fundamental concepts of contemporary science at the interface of chemical biology. A series of overviews and in-depth case studies will demonstrate the breadth of chemical biology and the importance of this emerging field in advancing biological sciences.

Theme 1: Chemical Biology of Natural Products Biosynthesis. Focus on biosynthesis of biological mediators, specifically the biosynthesis of secondary metabolites. The field of biosynthetic studies exemplifies many of the thought processes, tools and methods used in the broad field of Chemical Biology as it spans genomics to metabolomics, biochemistry to systems biology. We will develop an understanding of archetypal biosynthetic systems, those responsible for synthesizing polyketides, terpenes, and polypeptides at the level of chemical mechanism of their assembly, the structure and mechanisms of the biosynthetic enzymes

Theme 2: Chemical Biology of Biological Mediators. Within each archetype, we will transition from the biosynthesis of small molecules by multi-enzyme biosynthetic pathways to the interaction of small molecules with biological systems of medical relevance (targets). Most drugs are small molecules and many important biological systems are mediated by their action.

A primary source of pedagogy will be assigning readings and homework. Each area will have an assigned review article and several case study articles. This class entails active participation. Students will be provided with pre-reading prompt questions for the case studies and students will be asked questions about the reading during in-class discussion. In addition, each student will be presenting one or two ~5-10-minute PowerPoint presentations on some of the case studies from assigned readings. Students are expected to comment on background, significance and approach.

Readings. There are no assigned textbooks for this course. Readings from the primary literature comprise a significant portion of this course. Review articles will set the larger stage for selected themes and case studies from the primary literature will illustrate specific examples of solutions to interfacial problems. The literature of chemical biology is currently undergoing a renaissance. In addition to the premier press journals, several new chemical biology focused journals have recently been launched that students may find illuminating:

- Chemistry and Biology (Cell Press)
- Nature Chemical Biology (Nature Press)
- ACS Chemical Biology (ACS)
- ChemBiochem (Wiley)

Approximate Syllabus*

Date		Topic	Assignments	Readings	Instructor
Jan.	9	Organizational Meeting and Course Overview			Bachmann
	11	Introduction Biosynthesis & Methods			Bachman
	13	Method of studying biosynthesis I			Bachmann
	16	**MLK Day, no class**			Bachmann
	18	Method of studying biosynthesis II			Bachmann
UIC	20	**No class**			Bachmann
	23	Method of studying biosynthesis case studies, Duramycin, Lugdunin			Bachmann
	25	Polyketides: biosynthetic mechanisms I / Gene cluster ID			Bachmann
	27	Polyketides: biosynthetic mechanisms I / Gene cluster ID			Bachmann
	30	Polyketides: biosynthetic mechanisms II			Bachmann
Feb	1	Polyketides: biosynthetic mechanisms II			Bachmann
	3	Polyketides: biosynthetic mechanisms II			Bachmann
	6	Polyketides: biosynthetic mechanisms II	Homework 1	77	Bachmann
	8	Polyketides enzymes, structures, and functions			Bachmann
	10	Predictive Biosynthesis of Polyketides			Bachmann
	13	Target identification: Rapamycin			Bachmann
	15	Target identification: Rapamycin			Bachmann
	17	Terpenoids: biosynthetic chemistry			Bachmann
	20	Terpenoids: biosynthetic chemistry	Homework 2	92	Bachmann
	22	Terpenoids: biosynthetic chemistry			Bachmann
	24	Terpenoids: biosynthetic chemistry (menthol)			
	27	Chemical optimization – parallel synthesis			Stauffer
Mar.	1	Chemical optimization – parallel synthesis			Stauffer
	3	**Chemical Biology Methods Clinic I**	Homework 3	100	**Group I,II**
	6	**SPRING BREAK**			N/A
	8	**SPRING BREAK**			N/A
	10	**SPRING BREAK**			N/A
	13	**Chemical Biology Methods Clinic II**			**Group III,IV**
	15	Terpenoids: cyclases structure/function			Bachmann
	17	Terpenoids: Target identification of cyclopamine			Bachmann
	20	Target ID by affinity-based strategies : principals			Bachmann
	22	**Chemical Biology Methods Clinic III**			**Group V, VI**
	24	**Test 1: Polyketides and Terpenes** → 73 (avg)			Bachmann
	27	Target ID by affinity-based strategies			Bachmann
	29	Target ID by affinity-based strategies			Bachmann
	31	Nonribosomal Peptide Synthetases: structure/function			Bachmann
Apr.	3	Nonribosomal Peptide Synthetases: structure/function			Bachmann
	5	Nonribosomal Peptide Synthetases: structure/function			Bachmann
	7	Thalidomide I	Homework 4 X		Bachmann
	10	Thalidomide II			Marnett
	12	ABPP and lipidomics			Marnett
	14	ABPP and lipidomics	Homework 5 X		Marnett
	17	**Workshop – Using CB concepts to solve problems**			Marnett
Apr.	19	**Workshop – Using CB concepts to solve problems**			Bachmann
	21	**Workshop – Using CB concepts to solve problems**			Bachmann
	24	**Hour Exam 2**			Bachmann

*Subject to evolution