

BIOL 4710/5720 – Topics in Prokaryotic Biology: from Molecules to Microbiomes

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This course is an introduction to classical and contemporary research in prokaryotic biology—especially aspects of prokaryotic genetics, cell biology, physiology, and biochemistry—through reading and discussing research articles. The readings will be drawn mostly from the literature on two subjects: quorum sensing and chemotaxis. These topics have been chosen because they have an interesting historical development, they continue to be important active research areas, and they describe aspects of microbiology that I think are likely to capture your imagination.

For each class session, you will be required to read one or two articles in advance. I will call on students randomly to discuss different parts of the article, so it is important that you read the papers carefully. Your grade for the course will be based on class participation and on a final paper.

To learn the material covered in this course, it is essential that you attend all, or almost all, of the class sessions. If missing a class is unavoidable, please let me know in advance. The writing assignment described below is not meant to be a substitute for attending class. If you expect to be missing more than two classes, you should meet with me in advance so we can discuss your situation.

For each class session that you miss, you are required to provide a write-up for the article that we covered. The write-up should include all of the following: 1) a summary of the key questions that the authors are trying to address; 2) for one of the experiments from the paper, an explanation of how the experiment was performed and what was concluded; 3) a discussion of the overall conclusions of the paper, potential flaws in the authors' analysis, and alternative interpretations of the results.

A tentative list of the papers that we will cover is on the following pages.

BIOL 4710/5720 – Spring 2024 Tentative List of Papers

Quorum Sensing

Control of the competent state in pneumococcus - Tomasz - Nature 1965

Cellular Control of the Synthesis and Activity of the Bacterial Luminescent System - Nealson - J. Bacteriol.-1970

Bacterial Bioluminescence - Isolation and Genetic Analysis of Functions from *Vibrio fischeri* - Engebrecht - Cell - 1983

The C-terminal region of the *Vibrio fischeri* LuxR protein contains an inducer-independent lux gene activating domain - PNAS-1991-Choi-11115-9

Autoinducer binding by the quorum-sensing regulator TraR increases affinity for target promoters in vitro and decreases TraR turnover rates in whole cells - PNAS-1999-Zhu-4832-7

Enzymatic Synthesis of a Quorum-Sensing Autoinducer Through Use of Defined Substrates - Margret - Science 1996

A second N-acyl homoserine lactone signal produced by *Pseudomonas aeruginosa* - Pearson - PNAS - 1995

Active Efflux and Diffusion Are Involved in Transport of *Pseudomonas aeruginosa* Cell-to-Cell Signals - J. Bacteriol.-1999-Pearson-1203-10

Multiple signalling systems controlling expression of luminescence in *Vibrio harveyi* - sequence and function of genes encoding a second sensory pathway - Bassler_et_al-1994-Molecular_Microbiology

Quorum sensing in *Escherichia coli* and *Salmonella typhimurium* - PNAS-1998-Surette-7046-50

Structural identification of a bacterial quorum-sensing signal containing boron - chen - Nature 2002

Quorum Sensing-Dependent Biofilms Enhance Colonization in *Vibrio cholerae* - Zhu - Dev Cell 2003

The Small RNA Chaperone Hfq and Multiple Small RNAs Control Quorum Sensing in *Vibrio harveyi* and *Vibrio cholerae* - Lenz - Cell 2004

Cooperation and conflict in quorum-sensing bacterial populations - Diggle - Nature 2007

Members of the human gut microbiota involved in recovery from *Vibrio cholerae* infection -Hsiao - Nature 2014

Chemotaxis

Chemotaxis in Bacteria - Adler - Science 1966

Escherichia coli mutants defective in chemotaxis toward specific chemicals - Hazelbauer - Biochemistry 1969
Chemotaxis in Escherichia coli analyzed by three-dimensional tracking - Berg - Nature 1972
Flagellar rotation and the mechanism of bacterial motility - Silverman - Nature 1974
Change in direction of flagellar rotation is the basis of the chemotactic response in Escherichia coli - Larsen - Nature 1974
Failure of sensory adaptation in bacterial mutants that are defective in a protein methylation reaction - Goy - Cell 1978
Histidine phosphorylation and phosphoryl group transfer in bacterial chemotaxis - Hess - Nature - 1988
Magnetosomes are cell membrane invaginations organized by the actin-like protein MamK - Komeili - 2006
Chemotaxis shapes the microscale organization of the ocean's microbiome - Raina - Nature - 2022

Chemotaxis and autoinducer-2 signalling mediate colonization and contribute to co-existence of <i>Escherichia coli</i> strains in the murine gut - Laganenka - Nature Microbiology - 2023

Two-Component Signaling

Isolation and Characterization of Mutations Altering Expression of the Major Outer Membrane Porin Proteins Using the Local Anaesthetic Procaine - j mol biol 1983 166 273
Phosphorylation and dephosphorylation of a bacterial transcriptional activator by a transmembrane receptor - Igo - Genes Dev.-1989-Igo-1725-34
EnvZ Controls the Concentration of Phosphorylated OmpR to Mediate Osmoregulation of the Porin Genes - Russo - j mol biol 1991 222 567
Rewiring the Specificity of Two-Component Signal Transduction Systems - Skerker - Cell 2008
Fucose sensing regulates bacterial intestinal colonization - Pacheco - Nature 2012