

BCMB INDEPENDENT RESEARCH PROJECTS (BCMB 4960L/H, BCMB 4970L/H, BCMB 4980L/H)

Course Description for SPRING and/or SUMMER, 2019

All students who major in Biochemistry & Molecular Biology are required to take **two semesters** of independent research (BCMB 4960L/H and BCMB 4970L/H, each 4 hr credit). For additional semesters of research, BCMB 4970L/H can be repeated and/or students can take up to two semesters of **BCMB 4980L/H**. Honors students may elect to complete **BCMB 4990H** as an Honors Thesis (4 hr). BCMB 4960L/H requires no previous lab experience.

Objective: The objective of these courses is to train students in the basic techniques used in biochemistry and molecular biology, and the application of the scientific method. Students typically become part of a dynamic research environment and gain experience in both the experimental approach and the culture of a research laboratory. Students in these courses have been co-authors of research papers published in the primary scientific literature.

How to find a Laboratory: These courses are unusual in that the onus is on the student to find a Faculty member that will accept the student into their laboratory. A list of BCMB faculty mentors and their research interests is given below. All are familiar with the requirements of these courses and have mentored students in the past. Prospective students should arrange for an appointment with prospective Faculty mentors to discuss research areas. Students choose laboratories based on personal research interests, their knowledge of the professor, recommendations from other students, etc. Although it is possible for students to take BCMB 4960 and BCMB 4970 courses in different laboratories, they are usually carried out in the same laboratory.

Laboratories outside of BCMB: Students can take the BCMB 4960 and 4970 courses with faculty members not affiliated with the Department and a list of non-BCMB mentors is given below. It is also possible to carry out research with faculty not on that list as long as the research is biochemically-related and it is pre-approved the prior semester by the BCMB undergraduate committee. To obtain approval, please submit to Dr. Adams (adamsm@uga.edu) a one-page abstract of the proposed research together the name and email address of the proposed mentor.

When to find a Laboratory: BCMB 4960 and BCMB 4970 courses must be arranged during the semester **prior** to when the student will begin the course. It is never too early to talk to prospective Faculty mentors about their research and about the possibility of taking this course with them. It is highly recommended that arrangements are made before the mid-point of the prior semester.

Registration: Permission of the Department is required to register for these courses. A **REGISTRATION FORM** must also be completed by the student and signed by the Faculty mentor. The form can be obtained from the Departmental web site (<http://www.bmb.uga.edu/independent-research>), from the Biochemistry Office (Life Sci., B122) or from the Biochemistry Advisor. Once the form is signed by the Faculty mentor, you must take the signed form to Ms. Angie Stockton in the Biochemistry Office (Life Sci., B122) and you will be cleared to register.

Time Requirement: BCMB 4960L and BCMB 4970L are taken for 4 hr credit each. Students should expect to be in the laboratory for a minimum of 12 hr/ week (for 15 weeks) in the Spring/Fall or 24 hr/week (for 7.5 weeks) in the Summer. The exact schedule is to be determined by the Faculty mentor and the student.

Examinations and Grades: The final grade is determined by the Faculty mentor. This is based on:
a) Performance in the laboratory (75%). This does not mean the number or accuracy of the results! It reflects the aptitude, effort, reliability, dependability, perseverance and meticulousness of the student in the laboratory setting.
b) Written Presentation of Research (25%). Each student must write a **Research Report**, which describes what has been accomplished in the laboratory. The report should resemble a brief scientific paper and be of at least 8 pages in length (double spaced, 1" margins). The report should be sub-divided into a) Summary, b) Introduction, c) Experimental Methods, d) Results, e) Discussion and f) References. The rubric for writing the Research Report is on the following page.

The Research Report should be sent by email as a single word.doc or pdf file attachment to Dr. Adams (adamsm@uga.edu) by 5 pm on the last day of classes.

Note that Research Reports not received by 5 pm on Tuesday April 30th (Spring) or Wednesday, July 31st (Summer) will result in a C grade (no exceptions)

(09/06/18)

Rubric for BCMB 4960/4970/4980 Research Reports

This rubric will be used by your faculty mentor to evaluate your research report. This rubric is holistic, meaning that all of the criteria will be considered together to generate a final grade. We encourage you to refer to it as you do your research this semester, especially while you are writing and revising your paper.

Criteria	Definition
Introduction	
Context	Demonstrates a clear understanding of the big picture; Why is this question important/interesting in the field of biochemistry and molecular biology?
Accuracy	Content knowledge is accurate, relevant and provides appropriate background including defining critical terms.
Hypotheses / Research Directions	
Testable	For hypothesis-driven research, hypotheses are clearly stated, testable and consider plausible alternative explanations.
Scientific Merit	The hypotheses or research directions are novel, insightful, and have the potential to contribute useful knowledge to the field.
Methods	
Controls and replication	Appropriate controls (including appropriate replication) are present and explained.
Study design	The study design is likely to produce salient and fruitful results (actually tests the hypotheses posed and/or directly addresses the research direction).
Results	
Data selection	Data chosen are comprehensive, accurate and relevant.
Data presentation	Data are summarized in a logical format. Table or graph types are appropriate. Data are properly labelled including units. Graph axes are appropriately labelled and scaled and captions are informative and complete.
Statistical analysis	Any statistical analysis is appropriate for hypotheses tested and appears correctly performed and interpreted with relevant values reported and explained.
Discussion	
Conclusions based on data	Conclusion is clearly and logically drawn from data provided. A logical chain of reasoning from hypothesis to data to conclusions is clearly and persuasively explained. Conflicting data, if present, are adequately addressed.
Alternative explanations	Alternative explanations (hypotheses) are considered and clearly eliminated by data in a persuasive discussion.
Limitations of design	Limitations of the data and/or study design and corresponding implications for data interpretation are discussed.
Significance of research	Paper gives a clear indication of the significance and direction of the research in the future.
Primary literature	Writer provides a relevant and reasonably complete discussion of how this research project relates to others' work in the field (scientific context provided) using primary literature.
Writing quality	Grammar, word usage, and organization facilitate the reader's understanding of the paper.

Adapted from the Rubric for Science Writing, Timmerman, Strickland, Johnson, & Payne. (2011) Development of a 'Universal' Rubric for Assessing Undergraduates' Scientific Reasoning Skills Using Scientific Writing. *Assessment & Evaluation in Higher Education* 36, 509–47. <https://doi.org/10.1080/02602930903540991>.

BMB FACULTY MENTORS FOR INDEPENDENT RESEARCH PROJECTS (BCMB 4960L/H)

Potential Projects for SPRING or SUMMER, 2019

Dr. Michael W.W. Adams (Life Sciences, Rm. B218. Tel: 706 542-2060. adamsm@uga.edu). 1. Physiology, metabolism and enzymology of microorganisms growing near 100°C from marine volcanic vents including biochemical, genetic- and genomics-based approaches. 2. Metabolic engineering for plant biomass conversion and biofuel production at extreme temperatures.

Dr. Tessa Andrews (Life Sciences, Rm C208A, Tel: 706-542-3340, tandrews@uga.edu) 1. Teacher expertise for active-learning instruction in large undergraduate courses; 2. Sources of support and barriers to investing in improving teaching among college science faculty; 3. How beliefs, attitudes, and identity shape college teachers. Research methods include interviews, surveys, video analysis and classroom observation.

Dr. Fikri Y. Avci (Complex Carbohydrate Research Center, Riverbend Road, Room 3064. Tel: 706 542-3831. avci@uga.edu). 1. Identification of molecular interactions involved in uptake and presentation of carbohydrate antigens by antigen presenting cells (APCs). 2. Isolation and characterization of T cells and their epitopes generated from model carbohydrate antigens. 3. Understanding the basis for cellular and humoral immune responses induced by carbohydrate presentation and recognition that enable eradication of disease-causing agents.

Dr. Maor Bar-Peled (Complex Carbohydrate Research Center, 315 Riverbend Road; Tel: 706 542-4496. peled@ccrc.uga.edu). 1). Study of recombinant genes (and encoding enzymes) involved in synthesis of cell surface glycans in pathogenic microbes; 2) genetic approach to study the formation of biofilm: colonization of bacteria to surfaces; 3) determine by GC-MS and NMR polysaccharide structures that 'glue' cells to surface.

Dr. Carl Bergmann (Complex Carbohydrate Research Center, 315 Riverbend Road Tel 706-542-4428 cberg@ccrc.uga.edu) Proteomic and glycomic changes in Medaka fish as a result of chronic low dose exposure to Ionizing radiation.

Dr. David L. Blum (Life Sciences, Rm A414A. Tel: 706 542-1035. blum@uga.edu). 1. Improving expression of recombinant proteins in microbial and mammalian cell culture. 2. Discovery monoclonal antibodies against novel targets

Dr. Stephen Dalton (Coverdell Building. Tel: 706 583-0480. sdalton@uga.edu). The biology of embryonic stem cells and their differentiation into cell types that have applications for curing diseases such as diabetes.

Dr. Erin Dolan (Life Sciences, B210B. Tel: 706-713-2324. eldolan@uga.edu) 1. Key features and outcomes of scalable ways of involving undergraduates in research. 2. Structures and functions of undergraduate research mentoring and how they relate to student outcomes. 3. Applying theories and methods from industrial, organizational, and social psychology to improve undergraduate teaching and learning. Research methods include surveys, classroom observations, interviews, focus groups, and qualitative content analysis as well as statistical analyses such as linear regression and multi-level modeling.

Dr. Diana M. Downs (361A Biological Sciences, 706-542-9573. dmdowns@uga.edu). 1. Biochemical and genetic analysis of metabolic integration in bacteria. 2. Enzyme purification and analysis.

Dr. David J. Garfinkel (Life Sciences, Rm. A130. Tel: 706 542-9403. djgarf@uga.edu). 1. Understanding the mechanism of Ty1 retrotransposon copy number control in *Saccharomyces cerevisiae* and closely related species. 2. Understanding the variation and evolution of Ty1 copy number control. 3. Generating and characterizing Ty1 elimination strains using Cas9 editing.

Dr. Michael G. Hahn (Complex Carbohydrate Research Center, 315 Riverbend Road; Tel: 706 542-4457. hahn@ccrc.uga.edu). 1. Characterization of monoclonal antibodies against plant cell wall polysaccharides. 2. Characterization of proteins encoded by a gene family involved in the biosynthesis of pectic polysaccharides in plant walls. 3. Studies of plant signal transduction pathways.

Dr. Robert S. Haltiwanger (Complex Carbohydrate Research Center, 315 Riverbend Road, Tel: 706 542-4151, rhalti@uga.edu). 1. Regulation of the Notch signaling pathway by glycosylation. 2. Effects of glycosylation on protein folding. 3. Involvement of glycosylation in development and disease.

Dr. Takahiro Ito (Coverdell Building. Tel 706 542-0197. ito@bmb.uga.edu). Mechanism and regulation of self-renewal cell division in tissue stem cells and cancer development.

Dr. Eileen J. Kennedy (Pharmacy South, Rm 342. Tel: 706 542-6497. ekennedy@rx.uga.edu). Chemical biology projects focusing on kinase signal transduction and regulation in breast, prostate, and lung cancer.

Dr. William N. Lanzilotta (Life Sciences, A130. Tel: 706 542-1573. wlanzilo@bmb.uga.edu). 1. Structure/function investigation into the mechanism of heme uptake and transport by enteric pathogens. 2. The role of iron-sulfur clusters in radical chemistry: biochemical and structural analysis of the 1,3-propanediol pathway from *Clostridium acetobutylicum*.

Dr. Paula Lemons (Life Sciences, Rm. C116. Tel: 706 542-9616. plemons@uga.edu). (1) Undergraduate problem solving about biochemistry, particularly in the area of molecular structure and function and metabolic pathway dynamics and regulation; (2) College science faculty teaching attitudes and practices and how to support faculty through professional development. Data collection methods include tests, interviews, classroom observations, focus groups. Data analysis methods include qualitative content analysis and statistics.

Dr. Amy E. Medlock (Coverdell Building. Tel: 706 542-7843. medlock@uga.edu) . 1. Heme synthesis and intracellular trafficking. 2. Organismal heme homeostasis.

Dr. Debra Mohnen (Complex Carbohydrate Research Center, 315 Riverbend Road. Tel: 706 542-4458. dmohnen@ccrc.uga.edu). 1. Characterization of glycosyltransferases involved in pectin biosynthesis, a plant cell wall polysaccharide required for plant growth with beneficial effects on human health and importance in the food, biofuel, agricultural and materials industries. 2. Structure/function relationships and mechanisms of biosynthesis of cell wall matrix polysaccharides and novel cell wall proteoglycans/polymers with emphasis on the *GAUT1*-related gene family. 3. Modification of plants to improve plant growth and cell wall polymer synthesis, to enhance biomass for biofuel, biopolymer and materials production, and to provide a knowledgebase for sustainable development.

Dr. Kelley Moremen (Complex Carbohydrate Research Center, 315 Riverbend Rd., Rm 3055 Tel: 706 542-1705. moremen@uga.edu). 1. Expression and characterization of mammalian enzymes and lectins involved in glycoprotein biosynthesis and degradation. 2. Structure-function studies on glycoprotein processing enzymes. 3. Transcript analysis and gene regulation of glycan-related genes.

Dr. Artur Muszynski (Complex Carbohydrate Research Center, 315 Riverbend Rd, Rm 2029; Tel: 706 542-4479. muszynski@ccrc.uga.edu). Structure of lipopolysaccharides, glycolipids and cell surface polysaccharides of human pathogenic and plant symbiotic bacteria and their biological role in host interaction. a) introduction to cultivation of bacteria and basic microbial techniques in glycobiology; b) techniques for characterization of microbial polysaccharides and glycolipids including extraction of biologically significant microbial cell polysaccharides and lipids, methods of purification, size exclusion, liquid and gas chromatography, glycosyl and fatty acid composition, gel electrophoresis, mass spectroscopy and spectrometry, colorimetry.

Dr. Ron Orlando (Complex Carbohydrate Research Center, 315 Riverbend Road. Tel: 706 542-4429. orlando@ccrc.uga.edu). 1. Proteomics. 2. Mass Spectrometry. 3. Identifying post-translational modifications on proteins

Dr. Robert Phillips (Chemistry, Room 313. Tel: 706 542-1996. rsphillips@chem.uga.edu). 1. Isolation of wild-type and mutant enzymes and comparison of kinetic properties, and site-directed mutagenesis to prepare new mutant enzymes.

Dr. Michael Pierce (Complex Carbohydrate Research Center, 315 Riverbend Road, Rm 3056. Tel: 706 542-1702. hawkeye@uga.edu). 1. Identification of glycan-specific cancer markers. 2. Investigation of members of a new family of animal lectins that have physiological functions in humans. 3. Effects of glycosylation on tumor cell adhesion, invasion, and tumorigenicity.

Dr. James Prestegard (Complex Carbohydrate Research Center, 315 Riverbend Rd., Rm 1077 Tel: 706 542-6281. jpresteg@ccrc.uga.edu). 1. Expression and structural characterization of proteins using nuclear magnetic resonance (NMR). 2. Structural characterization of carbohydrates using NMR. 3. Enzyme kinetics using NMR. 4. Preparation of isotopically labeled substrates and ligands for biochemical studies.

Dr. Robert Sabatini (Life Sciences, Rm A128B. Tel: 706 542-9806. rsabatini@bmb.uga.edu). 1. Characterization of enzymes involved in the glucosylation of telomeric DNA in kinetoplastids. 2. Investigate the biological role of DNA glucosylation in telomeric gene expression/recombination in African trypanosomes.

Dr. Walter K. Schmidt (Life Sciences, Rm. A416. Tel : 706-583-8241. wkschmidt@uga.edu). Characterization of enzymes required for protein prenylation, a post-translational modification that impacts the function and localization of many proteins, including the Ras GTPases involved in cellular transformation/cancer.

Dr. Michael Terns (Life Sciences, Rm. A326. Tel: 706 542-1896. mterns@uga.edu). CRISPR-based prokaryotic immune systems, host-viral interactions and development of biotechnological tools.

Dr. Michael Tiemeyer (Complex Carbohydrate Research Center, 315 Riverbend Road, 706 542-2740, mtiemeyer@ccrc.uga.edu) 1. Structure and function of carbohydrates that direct cell-cell interactions during nervous system development in *Drosophila*. 2. Genetic control of tissue-specific glycan expression, 3. Comparative glycomics and proteomics of model organisms.

Dr. Bi-Cheng (B.C.) Wang (Life Sciences, Rm. B204A. Tel: 706-542-1747. wang@bcl1.bmb.uga.edu). 1. New approach for the characterization of metal oxidation state in macromolecules by a novel extended wavelength 4D crystallography. 2. Se-DNA as a

tool for phasing DNA/RNA and their protein complexes. 3. Sulfur-SAD approach in direct determination of protein structures. 4. Structure-function revisits of selected metalloproteins.

Dr. Chris West (Life Sciences, Rm. A310. Tel: 706 542-8486/4259. westcm@uga.edu). 1. Cellular mechanisms of O₂ sensing in protists including the social amoeba Dictyostelium and the agent for human toxoplasmosis Toxoplasma gondii. 2. Structural biology of E3(SCF)ubiquitin ligase complexes. 3. Glycogene editing in eukaryotic pathogens Trypanosoma cruzi and Toxoplasma gondii. 4. Structure/function studies on non-heme dioxygenases and glycosyltransferases.

Dr. William B. Whitman (Biological Science Bldg., Rm. 541. Tel: 706 542-4219. whitman@uga.edu). 1. Isolation and characterization of soil bacteria. 2. Genetics and physiology of methanogenic archaea.

Dr. Zachary Wood (Life Sciences, RM A428, Tel: 706 583-0304, zac@bmb.uga.edu). 1. Structural and biochemical studies of enzymes involved in nucleotide sugar metabolism. 2. Allosteric control of enzyme activity.

Dr. Robert J. Woods (Complex Carbohydrate Research Center, 220 Riverbend Road, 706 542-4454. rwoods@ccrc.uga.edu). Molecular simulations of proteins and carbohydrate-protein complexes of immunological relevance.

Dr. Ying Xu (Life Sciences, Rm A110, Tel: 706 542-9779, xyn@bmb.uga.edu). 1. Computational structural biology. 2. Computational inference and reconstruction of biological pathways and networks. 3. Biological data mining.

Dr. Hang Yin (Complex Carbohydrate Research Center, 220 Riverbend Road, Rm. 2058, Tel: 706 583-0655. hyin@uga.edu). 1. Muscle stem cell biology, the self-renewal, differentiation and lineage determination of skeletal muscle stem cells and applications in curing muscle atrophy and sarcopenia. 2. Biology of brown adipose tissue, determination of adipose stem/progenitor cells, regulation of adipose functions and applications in preventing disease. 3. Metabolic controls of stem cell and cancer cell behaviors.

Dr. William S. York (Complex Carbohydrate Research Center, 220 Riverbend Road, 706 542-4628. will@ccrc.uga.edu). 1. Bioinformatics of cell surface glycans in developing animal cells and roles of cell wall polysaccharides in plant development.

Dr. Shaying Zhao (Life Sciences, Rm. B316. Tel: 706 542-9147. szhao@bmb.uga.edu). 1. Microsatellite instability detection in cancer samples. 2. Gene expression alternation in cancer development and progression. 3. Gene expression alternation due to genomic rearrangements during evolution.

(09/06/18)

**NON-BMB FACULTY MENTORS FOR INDEPENDENT RESEARCH PROJECTS
(BCMB 4960L/H)**

SPRING or SUMMER, 2019

The following faculty members are outside of the Department of Biochemistry & Molecular Biology but have served as mentors for BCMB 4960L/H courses in the past. Please see their respective laboratory or Departmental web sites for further information on their research. For these faculty members, pre-approval of proposed research projects is NOT required.

Faculty Member	Email	Department/College
Franklin West	westf@uga.edu	Animal & Dairy Science
Honxiang Liu	lhx@uga.edu	Animal & Dairy Science
John Peroni	jperoni@uga.edu	Animal & Dairy Science
Lohitash Karumbaiah	lohitash@uga.edu	Animal & Dairy Science
Edward Kipreos	ekipreos@uga.edu	Cellular Biology
Kojo Mensa-Wilmot	mensawil@uga.edu	Cellular Biology
Ping Shen	pshen@uga.edu	Cellular Biology
Vasant Muralidharan	vasant@uga.edu	Cellular Biology
Douglas Jackson	dmjackson@uga.edu	Chemistry
Ramaraja Ramasamy	rama@uga.edu	Chemistry
Richard Morrison	rwm@uga.edu	Chemistry
Vladimir Popik	vpopik@uga.edu	Chemistry
Eric Freeman	ecfreema@uga.edu	Engineering
Hitesh Handa	hhanda@uga.edu	Engineering
Kerry Oliver	kmoliver@uga.edu	Entomology
Charles Easley	cae25@uga.edu	Environmental Health Science
Chung-Jui Tsai	cjtsai@uga.edu	Genetics
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Sidney Kushner	skushner@uga.edu	Genetics
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Ralph Tripp	ratripp@uga.edu	Infectious Disease
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Mike Adang	adang@uga.edu	Microbiology
Vincent Starai	vjstarai@uga.edu	Microbiology
Brian Cummings	bsc@rx.uga.edu	Pharmaceutical & Biomedical Sciences
Cory Momany	comomany@uga.edu	Pharmaceutical & Biomedical Sciences
Eileen Kennedy	ekennedy@uga.edu	Pharmaceutical & Biomedical Sciences
George Zheng	yzheng@uga.edu	Pharmaceutical & Biomedical Sciences
Houjian Cai	caihj@uga.edu	Pharmaceutical & Biomedical Sciences

Faculty Member	Email	Department/College
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Shelley Hooks	shooks@rx.uga.edu	Pharmaceutical & Biomedical Sciences
Jae-Kyung Lee	jamlee@uga.edu	Physiology & Pharmacology
Rabindranath De La Fuente	rfuente@uga.edu	Physiology & Pharmacology
Alexander Bucksch	bucksch@uga.edu	Plant Biology
Elizabeth Howerth	howerth@uga.edu	Veterinary Medicine
Jesse Shank	jschank@uga.edu	Veterinary Medicine
Kyrstoff Czaja	czajak@uga.edu	Veterinary Medicine
Naola Ferguson-Noel	naolaf@uga.edu	Veterinary Medicine
Balázs Rada	radab@uga.edu	Veterinary Medicine
Jaroslava Halper	jhalper@uga.edu	Veterinary Medicine
Sheba MohanKumar	shebamk@uga.edu	Veterinary Medicine

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