

HCS/HN/FST/BMI 7600: Metabolomics, Principles and Practice
Spring 2019, 3 credits

Meeting dates and location: Monday/Wednesday, 12:30-1:35pm (lecture), Wednesday 1:45-3:45pm (lab). Both lecture and lab are held in Kottman Hall 451 (Columbus) and Williams 123 (Wooster).

Course format: in person lecture and laboratory. For students stationed at OARDC: lectures and laboratories will be videolinked to Wooster, though we recommend for 2-3 labs that Wooster students travel to the Columbus campus for hands-on, wet lab experiences. The dates of these labs will be determined prior to the start of the course.

Instructors:

Jessica Cooperstone, Ph.D., Horticulture and Crop Science, 348 Howlett Hall, cooperstone.1@osu.edu
Rachel Kopec, Ph.D., Human Nutrition, 262G Campbell Hall, kopec.4@osu.edu
Emmanuel Hatzakis, Ph.D., Food Science & Technology, 233 Parker, chatzakis.1@osu.edu
Matthias Klein, Ph.D., Food Science & Technology, 313 Parker, klein.663@osu.edu
Devin Peterson, Ph.D., Food Science & Technology, 317 Parker, peterston.892@osu.edu
Ewy Mathé, Ph.D., Biomedical Informatics, 340D Lincoln Tower, mathe.5@osu.edu

Office hours: by appointment

Pre-requisites: Approval of instructor. Because of the interdisciplinary nature of this course, we understand students will have different backgrounds and we encourage you to discuss with the instructors your suitability for this course. However students will gain the most from the course if they understand the basics of univariate and multivariate statistical techniques, as well as the basics of spectroscopy. The instructors can suggest remedial reading material for those for whom this will be helpful.

Textbooks/readings: no textbook required, readings as assigned

Course description: This course aims to introduce students to the principles and practice of metabolomics. Metabolomics is the study of the totality of small molecules existing within a system. We will focus here on the application of metabolomics to plant, food, nutrition and health-related research, although concepts are applicable to other disciplines. Each part of the metabolomics workflow will be covered, with hands-on experience in sample preparation, data collection, data processing and analysis, modeling, contextualization and validation. The course will also contain a journal-club component, where students chose work from the primary literature and briefly explain it to the class during week 2, and then present a deeper, critical review at week 15, incorporating what they've learned throughout the course.

Goals: Students will learn the foundations of metabolomics and each part of the workflow from experimental design to data acquisition to data analysis. After completing the course, students will comprehend the strengths and pitfalls of the technology, understand the nomenclature and various experimental approaches, and have hands-on experience in analysis. In addition, they should be able to design multidisciplinary metabolomics studies and critically evaluate publications in the field. Overall, the course will prepare those who intend to directly apply these techniques to plant, food and nutrition-based research, and will give them confidence to interact with other scientists conducting metabolomics experiments.

Course objectives:

Students will have the ability to:

1. Recall and describe the fundamental principles of metabolomics, as applicable to any discipline.
2. Discuss each part of the metabolomics workflow including sample preparation, data acquisition, data processing, data analysis, data interpretation/contextualization.
3. Complete each part of the metabolomics workflow, including preparing samples, acquiring data, processing data, analyzing data, data interpretation/contextualization.
4. Read, interpret, review and present primary literature on metabolomics.
5. Design a metabolomics experiment that is relevant and appropriate to their own research field/area of study.

Students will meet these course objectives through lecture, hands-on experience (laboratory), take-home assessments, presentation activities and designing their own metabolomics experiment.

Course schedule: assignments are due at the beginning of class at the last meeting time of the week.

Week	Week of	Topics, Assignments, Deadlines, Events	Instructor responsible
1	1/7/2019	<u>Introduction: What is metabolomics? What kinds of questions can it help answer? Expectations of metabolomics vs. reality.</u> Overview of the metabolomics workflow. Overview of mass spectrometry and NMR. Due: Students submit their choice of paper for initial metabolomics paper presentation for instructor approval.	Cooperstone
2	1/14/2019	<u>Online materials and resources for metabolomics research</u> <u>Students give initial metabolomics paper presentations</u> Due: Students give 3-5 min presentation on a metabolomics paper of their choice. Presentation includes background/rationale, metabolomics methodology used, major finding	Cooperstone, Mathé
3	1/21/2019	<u>Study design and sample collection</u>	Cooperstone
4	1/28/2019	<u>LC-MS sample preparation, data acquisition, pre-processing, compound identification</u> Due: assessment on introduction/online materials/study design & sample collection.	Kopec
5	2/4/2019	<u>LC-MS sample preparation, data acquisition, pre-processing, compound identification</u>	Kopec
6	2/11/2019	<u>GC-MS sample preparation, data acquisition, pre-processing, compound identification</u> Due: assessment on LC-MS sample preparation, data acquisition pre-processing, compound identification.	Peterson
7	2/18/2019	<u>GC-MS sample preparation, data acquisition, pre-processing, compound identification</u>	Peterson
8	2/25/2019	<u>NMR sample preparation, data acquisition, pre-processing, compound identification</u>	Hatzakis

		Due: assessment on GC-MS sample preparation, data acquisition pre-processing, compound identification.	
9	3/4/2019	<u>NMR sample preparation, data acquisition, pre-processing, compound identification</u>	Hatzakis
10	3/11/2019	Spring break (no classes)	
11	3/18/2019	<u>Data analysis</u> Due: assessment on NMR sample preparation, data acquisition pre-processing, compound identification.	Mathé, Klein
12	3/25/2019	<u>Data analysis</u>	Mathé, Klein
13	4/1/2019	<u>Data interpretation/contextualization</u> Due: assessment on data analysis	Mathé, Klein
14	4/8/2019	<u>Targeted analysis, quantification and validation</u> <u>Other field-specific considerations for metabolomics:</u> field considerations, animal considerations, clinical considerations	Cooperstone, Kopec, Jain (guest)
15	4/15/2019	<u>Student final metabolomics paper presentations</u> Due: Student final metabolomics paper presentations (15 min) Due: assessment on data interpretation/contextualization, other field-specific considerations for metabolomics.	All

Evaluations:

- Take-home assignments (6) after each module: 45%
- Cumulative final (during finals week): 25%
- Initial metabolomic paper presentation (3-5 min): 5%
- Final metabolomics paper presentation (15 min): 15%
- Design your own metabolomics experiment (1 single spaced page): 10%

Grading Scale: The standard grading scale is below. Grades can be adjusted upward but will not be adjusted downward (e.g., an 88 can become an A- but an 81 will not become a C+).

<u>Percentage</u>	<u>Grade</u>	<u>Percentage</u>	<u>Grade</u>
93-100	A	73-76.9	C
90-92.9	A-	70-72.9	C-
87-89.9	B+	67-69.9	D+
83-86.9	B	60-66.9	D
80-82.9	B-	<60	E
77-79.9	C+		

Metabolomics paper presentations:

One objective of this course is to give students experience in reading primary literature in the metabolomics field. During week 1, students will choose a piece of primary literature that utilizes metabolomics and present it briefly to the course during week 2. After the course, students will present the same paper in a longer format during week 15, critically evaluating the work and potentially identifying alternative approaches, using knowledge gained in the previous 14 weeks.

Course policies:

Attendance policy: We expect you to attend class as it will be critical to your learning this material, though we will not take attendance. Any class material you miss will be your responsibility to learn. If

there are extenuating circumstances that cause you to miss class, please alert the appropriate faculty member for further discussion.

University policies:

Academic Misconduct: It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct at <http://studentconduct.osu.edu/>.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact us.

Disability Services: The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.