BIOCHEM/NUTR SCI 510 – *Nutritional Biochemistry and Metabolism*
University of Wisconsin-Madison

Fall Semester 2023
Lectures in nutrition for students with a substantial background in biochemistry. Emphasis on biochemical and physiological fundamentals of nutrition. Discussion of protein, fat, carbohydrate, energy, minerals and vitamins and their roles and interrelationships in nutrition and metabolism.

Instructors: Professor Joseph Pierre (course director), Professor Brian Parks
Credits: 3
Instructional Mode: In-Person
Day: MWF **Time:** 8:50 AM – 9:40 AM
Course Attribute: Biological Sciences; LAS Advanced Credit; graduate attribute
Prerequisites: BIOCHEM 301, 501, 507, BMOLCHEM 503, or graduate/professional standing

Location: Microbial Sciences 1520

Website (Learn@UW): https://canvas.wisc.edu

COURSE LEARNING OUTCOMES:
After completing this course you will:

Learning Outcome	**Level**
1. Understand nutrient metabolism in normal and disease states	Undergraduate and Graduate
2. Integrate the regulation of metabolism of nutrients under normal and disease state conditions	Undergraduate and Graduate
3. Understand the biochemical and molecular functions of nutrients we consume	Undergraduate and Graduate
4. Apply how nutrients affect pathogenesis and health.	Undergraduate and Graduate
5. Think critically about nutrient claims and fads using your knowledge of nutritional biochemistry.	Undergraduate and Graduate
6. Integrate current research in the area of metabolism and micronutrient function into existing knowledge and formulate new hypotheses to guide future research.	Graduate Only

ACEND REQUIREMENT for DIDACTIC PROGRAM IN DIETETICS: This course provides for learning activities to satisfy core knowledge requirement KRDN 3.5: Describe basic concepts of nutritional genomics and how they relate to medical nutrition therapy, health and disease. The specific learning activity is completion of a Nutritional Genomics Assignment illustrating how personalized modifications in dietary carbohydrate intake may improve glycemic response for patients.

REQUIRED TEXT:

Advanced Nutrition & Human Metabolism, 6th ed. Gropper, Smith and Groff. Thomson/Wadsworth (2012).

THE 5TH AND 7TH EDITIONS ARE ALSO ACCEPTABLE BUT NOTE THAT THE ASSIGNED PAGE NUMBERS DIFFER. We will provide page numbers for 5th AND 7th edition readings separately. Many students find it useful to have available a biochemistry text such as *Biochemistry* by Nelson, Cox and Lehninger.

Lecture PowerPoint files will be available on the course website prior to lectures.

MP3 audio recordings of the lectures will be posted on the website after the lectures.

GRADING POLICY:

Point Distribution for Undergraduate Students

Distribution		Grade	
100 pts	Exam 1	A	≥ 90%
100 pts	Exam 2	AB	88-89%
100 pts	Exam 3	B	80-87%
100 pts	Exam 4 (optional)	BC	78-79%
125 pts	Final Exam	C	70-77%
60 pts	Quizzes (3)	D	61-69%
20 pts	Take Home Assignment	F	< 61%

Grade percentages are based on a total of 505 or 605 points depending on if optional Exam 4 is included (see below). Mid-term exams are worth 100 points each and will be held on the dates listed below. In case of scheduling conflicts, alternative exam days will be provided given prior notification and permission from Prof. Parks or Pierre; we reserve the right to request written documentation of the scheduling conflict. Exam regrades are permissible within 2 weeks of an exam/quiz but the entire exam/quiz will be regraded (exception: math errors made by the instructors will be corrected without regrading). The final exam will be worth 125 points and will be cumulative.

Exam 4 is optional. We provide it as a way to improve your grade should you do poorly on any of the other mid-term exams. If you decide to take it, the result will be counted toward your final grade whether you do well or not. The material from Exam 4 will be on the final.

Exam	Covers (approx.)	Given
1	Intro – Lipid 5	Wednesday, Oct 4
2	Protein 1 – Metabolism 6	Wednesday, Oct 25
3	Energy Metab. 1 – B12	Wednesday, Nov 15
4	Vitamin K – Vitamin A	Wednesday, Dec 6
Final	Cumulative	Thursday, Dec 21

QUIZZES: Three announced quizzes (20 pts each) will be given and they will cover glycolysis, the TCA cycle, and redox concepts. There are no make-up quizzes without prior arrangement with the faculty.

TAKE HOME ASSIGNEMENT ON NUTRITIONAL GENOMICS (20 pts): One assignment will be given based on the following paper: *Personalized Nutrition by Prediction of Glycemic Responses, Zeevie D. et. al. Cell. 2015 Nov 19.* The assignment will consist of 10 short answer questions about the article. The assignment must be turned in on Canvas on November 4th.

ASSUMED KNOWLEDGE: An introductory biochemistry course is a REQUIRED prerequisite for enrollment in NS/Biochem 510 and the instructors expect you to already have a working knowledge of biochemical pathways and structures. You'll need to review/remember the following: glycolysis, the TCA cycle, the electron transport system, and the urea cycle. The emphasis of the course is on INTEGRATION of knowledge you have acquired in this and previous courses.

ATTENDANCE: We do not take attendance. However, you are expected to prepare for, attend, and participate fully in all lectures and you are responsible for obtaining material from any missed lectures. It is our experience that regular attendance is a good predictor of success in this course due to the volume and complexity of the material that we cover.

CREDIT HOUR POLICY: The credit standard for this course is met by an expectation of a total of 135 hours of student engagement with the course learning activities (at least 45 hours per credit), which include reading, viewing lectures, practice quizzes and problem sets, and other student work as described in the syllabus.

GRADUATE ATTRIBUTE: Graduate students enrolled in this course will be assigned two research papers during the course of the semester that are related to the lecture material and will be discussed in separate sessions (to be scheduled) with the instructors. Each assignment will be worth 40 points each totaling an additional 80 points to be factored into the final grade. Thus, grad students will be graded on the percentage of 585 or 685 total points depending on optional Exam 4 participation. Grading of these assignments will be based on assessment from assigned scientific research papers.

GRADING POLICY FOR <u>GRADUATE</u> STUDENTS

Point Distribution		Grade	
Distribution			
100 pts	Exam 1	A	≥ 90%
100 pts	Exam 2	AB	88-89%
100 pts	Exam 3	B	80-87%
100 pts	Exam 4 (optional)	BC	78-79%
125 pts	Final Exam	C	70-77%
60 pts	Quizzes (3)	D	61-69%
20 pts	Take Home Assignment	F	< 61%
40 pts	Research paper 1		
40 pts	Research paper 2		

INSTRUCTOR AVAILABILITY:
The instructors are committed to respond quickly to all questions within 24 hours and are available via email. In person office hours will be provided weekly (schedule to be announced).

CONTACT INFORMATION:

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Dr. Brian Parks (262-3445)
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RULES, RIGHTS & RESPONSIBILITIES

- See: https://guide.wisc.edu/undergraduate/#rulesrightsandresponsibilitiestext

ACADEMIC CALENDAR & RELIGIOUS OBSERVANCES

- See: https://secfac.wisc.edu/academic-calendar/#religious-observances

HATE AND BIAS REPORTING – FILE A BIAS INCIDENT REPORT
Hate and Bias is not acceptable at UW-Madison. We stand with all students who have experienced these, including students who have dealt with hate and bias due to the COVID-19 pandemic. COVID-19 is not specific to an ethnicity or race—disease does not discriminate. If you experience harassment or discrimination, you are encouraged to file a bias incident report.

STATEMENT AGAINST RACISM AND HATE
The College of Agricultural and Life Sciences (CALS) at the University of Wisconsin–Madison is committed to providing inclusive, equitable and accessible opportunities and environments to students, stakeholders, partners, staff and faculty from all backgrounds. We aim to build a college free from exclusion, discrimination, hate and racism in our academics, research, outreach, administration and the life of the college.

Racism, hate, colonialism and discrimination show themselves in many forms, sometimes with malicious intent and often as unconscious bias. We acknowledge that their wide-ranging effects can come from actions or inactions of individuals, as well as from the policies and practices of institutions. In any form, these are harmful to individuals, our college, the university and society. Our goal is to establish systems and structures in CALS that protect against discrimination and build a welcoming community where everyone feels they belong.

As a college, we recognize our history of underrepresentation of Black, Indigenous and other people of color in teaching, research and outreach in the agricultural and life sciences. Our classrooms, laboratories and research stations occupy the ancestral lands of the Native Nations of Wisconsin. Moreover, lands of Native peoples were violently

taken by the U.S. government, and their redistribution created an early investment that funded land-grant universities, including ours. We commit to exploring our history and evaluating our current systems to identify and address any areas of inequity in the college.

We also expect members of our college community to commit to fighting racism and hate individually. We call on the college's faculty, staff, and students to engage in self-reflection and examine their own biases and prejudices, and to educate themselves about systems that have created inequalities and use their voices and actions to create change.

Members of underrepresented groups have shouldered the weight of anti-racist and anti-hate endeavors for years. It should not and cannot be the responsibility of those most affected to solve these issues; it is not the job of individuals from underrepresented groups to teach others. We must all be active participants in expecting and enabling meaningful change and creating an anti-racist culture.

As a college, we must individually and communally identify and confront bias, prejudice, racism, colonialism and hate and their impacts on our students, staff and faculty. As UW–Madison strives to advance its mission by "[embodying], through its policies and programs, respect for, and commitment to, the ideals of a pluralistic, multiracial, open and democratic society," the college celebrates the diverse life experiences of all our community members.

Lecture schedule

Week	Date	Topic	Assigned Reading (5th ed)
1	9/6	Digestion I: The gastrointestinal tract (Parks)	pp. 33-62
	9/8	Digestion II: Nutrient absorption and diseases of digestion (Parks)	pp. 33-62
	9/11	CHO 1: Intro to Metabolism; CHO structures; CHO digestion; Absorption; (Parks)	pp. 249-253, 63-78
2	9/13	CHO 2: Glycolysis; TCA Cycle; [**Online quiz on glycolysis**] (Parks)	pp. 70-86
	9/15	CHO 3: Gluconeogenesis; Other key pathways; Regulation of metabolism; (Parks)	pp. 86-100
	9/18	CHO 4: Regulation of CHO metabolism; [**Online quiz on TCA cycle**] (Parks)	pp. 100-106
3	9/20	Lipid 1: Lipid structures; Fatty acid synthesis; (Parks)	pp. 137-48,173-75
	9/22	Lipid 2: Fatty Acid oxidation; Other key pathways; (Parks)	pp. 164-173
	9/25	Lipid 3: Lipid structures; Digestion and Lipid Absorption (Parks)	pp. 137-150
4	9/27	Lipid 4: Lipoprotein metabolism (Parks)	pp. 151-163
	9/29	Lipid 5: Lipid metabolism & Heart Disease (Parks)	pp. 164-179
	10/2	Protein 1: Amino acids; Digestion; Transport; General reactions of amino acids (Parks)	pp. 179-194
5	**10/4**	**EXAM 1 (through Lipid 5; 11 lectures)**	**--**
	10/6	Protein 2: AA uptake; AA catabolism; Plasma AA; Urea cycle and Regulation (Parks)	pp. 183-92,209-24
	10/9	Metabolism 1: Overview/review of metabolism (Parks)	pp. 249-255
6	10/11	Metabolism 2: Fed-Fast Cycle/Starvation (Parks)	pp. 255-261
	10/13	Metabolism 3: Integration of Metabolism/Endocrinology (Parks)	pp. 261-266
	10/16	Metabolism 4: Cellular regulators of metabolism (Parks)	--
7	10/18	Metabolism 5: Loss of Metabolic Integration/Diabetes (Parks)	pp. 265, 274
	10/20	Metabolism 6: Obesity & Nutritional Genomics (Parks)	--
		Take home assignment on Nutritional Genomics (Due 11/4)	
	10/23	Vitamins and energy metabolism 1: Acyl/acetyl transfers (pantothenate) (Pierre)	pp. 307-10, 334-8
8	**10/25**	**EXAM 2 (Protein 1 through Metabolism 6; 8 lectures)**	**--**
	10/27	Vitamins and energy metabolism 2: Redox cofactors (niacin, riboflavin) (Pierre)	pp. 325-34
	10/30	Vitamins and energy metabolism 3: Niacin and alcohol metabolism (Pierre)	pp. 175-79
9	11/1	Vitamins and energy metabolism 4: Decarboxylations (thiamin) (Pierre)	pp. 319-25
	11/3	Vitamins and energy metabolism 5: Carboxylations (biotin) (Pierre)	pp. 338-43
		Take home Assignment Due	
	11/6	Vitamins and energy metabolism 6: Decarboxy-, trans- & deaminations (pyridoxine) (Pierre)	pp. 360-65
10	11/8	Vitamins and blood function 1: 1-carbon transfer reactions (folate) (Pierre)	pp. 344-53
	11/10	Vitamins and blood function 2: 1-carbon transfer reactions (B12) (Pierre)	pp. 354-60
	11/13	Vitamins and blood function 3: blood clotting (Vitamin K) (Pierre)	pp. 409-14
11	**11/15**	**EXAM 3 (Energy metabolism 1 through B12; 8 lectures)**	**--**
	11/17	Antioxidant nutrients 1: Overview (Pierre)	pp. 416-23
	11/20	Antioxidant nutrients 2: Vitamin E and carotenoids [**in class quiz on redox concepts**] (Pierre)	pp. 400-07
12	11/22	Antioxidant nutrients 3: Vitamin C and Se (Pierre)	pp. 310-18,519-26
	11/24	Thanksgiving Break	
	11/27	Metal nutrients 1: Fe Part I (Pierre)	pp. 481-99
	11/29	Metal nutrients 2: Fe Part II (Pierre)	pp. 481-99
13	12/1	Metal nutrients 3: Cu (Pierre)	pp. 510-19
	12/4	Nutrients and hormones 1: Vitamin A (Pierre)	pp. 371-89
	12/6	**EXAM 4 (Vitamin K through Vitamin A; 8 lectures)**	
14	12/8	Nutrients and hormones 2: Calcium and Vitamin D (Pierre)	pp. 425-37
	12/11	Nutrients and hormones 3: Calcium and Vitamin D (Pierre)	pp. 391-400,450-3
15	12/13	Overview of micronutrients (Pierre)	--
	12/21	**Final exam 7:45AM – 9:45AM (cumulative)**	**--**