

Phar 6734: Cellular Metabolism & Nutrition
Fall 2020, 2.8 Credits
Course Syllabus and Lecture Schedule

Class Schedule

August 24–November 12: M 11:15–12:05; T 11:15–12:05; Th 3:35–4:25; F 10:10–11:00
November 13–December 11: M 11:15–12:05; T 11:15–12:05; F 10:10–11:00

Course Website: On [Canvas](#)

Prerequisites: Phar 6702: Integrated Biochemical Sciences

Course Overview: This course takes the basic molecules of life and tracks them all the way from their cellular metabolism through growth, energy production, metabolite formation to nutrition and their roles as OTC products. The intermediary metabolism part of the course focuses on biochemical pathways that are important in the normal functioning of the cell and that are affected in such disease states as diabetes, metabolic syndrome, atherosclerosis, obesity, and cancer. Emphasis is placed on the control mechanisms that regulate these pathways and on the interrelationships between pathways. These principles provide a foundation for understanding various disease states and the effects of numerous therapeutic agents and dietary constituents on metabolic pathways. The nutrition part of the course focuses on the basic nutrients, their use by the body, any toxicity and their roles as OTC products. Areas of emphasis include the effects of under- and over-nutrition and the drugs used to treat them, food additives and contaminants, how the nutrient processing pathways of the body interact with drugs, and the use of nutrients in therapy.

This course will be temporally integrated with Phar 6732: Medicinal Chemistry and Pharmacology of Cardiovascular Agents and Phar 6736: Cardiovascular Pharmacotherapy. Specifically, the sections dealing with lipid and fatty acid metabolism will provide foundational content for the hypolipidemic drugs in Medicinal Chemistry and Pharmacology of Cardiovascular Agents, which in turn provides supporting content for the treatment of hyperlipidemias section in Cardiovascular Pharmacotherapy. Aspects of carbohydrate, lipid, amino acid, and nucleotide metabolism and nutrition will provide fundamental and foundational content for subsequent courses in the curriculum, including Integrated Endocrinology, Diabetes and Metabolic Syndrome, Kidney, Fluid and Electrolytes, and Oncology.

Course Format: Cellular Metabolism and Nutrition is primarily a lecture-based course with the course being divided into five units. In an effort to minimize the spread of Covid-19, the course will be offered as a *Remote-Instruction* class. (Students and instructors must be online at the same time, at scheduled days and times. 100% of instruction is online with no in-person meetings. Exams are also all online). Readings from the course e-textbooks will be assigned. A variety of assessments and learning activities will be employed. These include unit exams, individual problem sets, group in-class exercises, literature evaluation, an OTC active learning project, and Participoll.

Course Goals and Learning Objectives

Course Goal 1: Describe how the metabolic pathways for biosynthesis and catabolism of molecular building blocks of the cell are interconnected and how they are disrupted in disease.

Objective 1: Describe the biochemical pathways by which each of the four building blocks of the cell (carbohydrates, lipids, amino acids, and nucleotides) are made and broken down.

Objective 2: Identify important points where the flow of substrates through each pathway intersect and describe how they are regulated.

Objective 3: Explain the consequences of misregulation or disruption of these pathways on human health.

Objective 4: Explain the molecular basis for the normalization of aberrant metabolic processes through therapeutic intervention

Course Goal 2: Identify the components of a healthy diet and the role key nutrients, vitamins and minerals play in the human health.

Objective 1: Describe the normal physiological demands for common nutrients and provide examples of the consequences of nutrient deficiencies and the relationship of nutrition and supplementation to drug metabolism and disposition.

Objective 2: Identify the impact of nutrient deficiencies locally and globally.

Objective 3: Develop a care plan for iron, B12, and/or folate deficiency anemia.

Objective 4: Compare and contrast nutrient uptake and drug bioavailability.

Objective 5: Distinguish the commonalities between pharmacy and nutrition. Interpret the U.S. RDA values for individual major vitamins and minerals.

Course Goal 3: Identify the vitamins, minerals and nutritional supplements that are available to the public OTC, and recognize their nature, composition, uses and toxic effects.

Objective 1: Identify the vitamins, minerals and nutritional supplements that are available to the public OTC, and describe their nature, composition, uses and toxic effects.

Objective 2: Formulate answers to patient questions about dietary sources of the various vitamins and trace elements.

Objective 3: Formulate answers to patient questions about the major functions of individual vitamins and minerals in humans.

Objective 4: Formulate answers to patient questions about disease states or drugs that may cause vitamin or mineral deficiency.

Objective 5: Apply literature research skills to advise patients on safe and effective self-care uses of OTC vitamins, minerals, nutraceuticals, dietary supplements, food additives, excipients and other components of drug formulations and their potential drug interactions.

Course Instructional Team

Course Directors:	Barry Finzel (TC) 2-160 Weaver-Densford Hall 612-626-5979 finze007@umn.edu	Jon Rumbley (Duluth) 127 Life Science Building 218-726-6047 jrumbley@d.umn.edu
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Other Instructors:

Carrie Haskell-Luevano (TC) 8-102 Weaver-Densford Hall 612-626-9262 chaskell@umn.edu	W. T. Shier (TC) 8-168 Weaver-Densford Hall 612-624-9465 shier001@umn.edu	Wendy L. St. Peter (TC) 7-125B Weaver-Densford Hall 612-625-5848 stpet002@umn.edu
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Teaching Assistants:

Damilola Ademola-Green (TC) ademo009@umn.edu	Mackenzie Wyllie (TC) wyllie008@umn.edu	Angel Yang (TC) yang7624@umn.edu
Benjamin Hanson (Duluth) hans4984@d.umn.edu		

Course faculty have an open-door policy for students to meet and discuss the course material. Students should feel free to e-mail them to schedule an appointment, to initiate a Zoom conversation, or to simply ask a question.

Course Materials

- Handouts and lecture slides, available through the course Canvas site.
- eTextbook: *Biochemistry*, 8th edition, J. M. Berg, J. L. Tymoczko, G. J. Gatto, Jr., and L. Stryer, 2015.

Computer and Technology Requirements

- Canvas: This course will use Canvas to distribute learning materials and assignments. See [Canvas Setup Requirements](#).
- E-Mail: Course instructors may communicate through email about course administrative issues. We suggest that you check your email daily.
- Student-response systems: Drs Finzel and St. Peter will use Participoll during their lectures. You will need a device (e.g. smart phone, ipad, computer) to answer polling questions.

Attendance Policy: Students are expected to attend every class. Students are required to participate in the in-class group exercises unless they have notified the instructor beforehand of their inability to attend class because of illness or another emergency.

Assessments and Grading: In terms of calculating the final grade, each unit will be weighted as outlined below. The primary assessment component of each unit will be the unit exam. In addition, for some units as outlined in the table below other forms of graded assessments will be employed. The unit exams will primarily consist of short answer-type questions, but some multiple-choice, true/false, matching, or essay questions may appear on an exam. The individual problems sets are aimed at reinforcing the key concepts being presented in the course and evaluating the student's progress in understanding this material. The problem set questions will consist of short answer-type questions that are similar in format to the questions students will encounter on the unit exams. The in-class group exercises will consist of questions or scenarios that will require the students to integrate and apply the material they have covered in the course. The literature evaluation problem will focus on drug activities or disease states in current literature related to in-class learning. A grade will be assigned for the report on the results of an active learning assignment on an OTC nutritional supplement or nutraceutical product in a retail setting.

Course Score: The course score will be determined by applying the following percentage (weight) to each assessed activity.^a

Unit	Assessment Activity	Percentage of Final Grade	Due Date
1	Problem set 1	2%	Sept. 4th
	Exam 1	18%	Sept. 11th
2	Literature evaluation problem set	2%	Sept. 22th
	Group exercise	2%	Sept. 26th
	Exam 2	16%	Sept. 26th
3	Problem set 2	2%	Oct. 5th
	Problem set 3	2%	Oct. 22th
	Exam 3	16%	Oct. 23rd
4	Exam 4	9%	Nov. 15th
	Scavenger hunt report	2%	Dec. 13th
	Weekend quizzes	5%, 1% each	10/31, 11/6, 11/21, 11/28, 12/12
	Discussion group reports	15%, 2%/week except 1% first week	10/25 (1%), 11/1, 11/8, 11/15, 11/22, 11/29, 12/6, 12/13 (2% each)
5	Exam 5	9%	Dec 18th

^aIf you complete a course/instructor evaluation, 1 point will be added to your course score.

Course Grade: A letter grade will be assigned using the final course score according to the following grading scale:

A: 93–100; A–: 90–92; B+: 87–89; B: 83–86; B–: 80–82; C+: 77–79; C: 73–76; C–: 70–72;
D: 60–69; F: 0–59

Our practice regarding the rounding-off of the final course score, which is calculated to one decimal point, to determine the course grade can be illustrated as follows. In considering final course scores that fall between 92 and 93, the cutoffs for A– and A, respectively, a score between 92.5 and 92.9 for example will be rounded up to a 93 and will be an A, while a final course score between 92.1 and 92.4 will be rounded down to a 92 and will be an A–. Analogous rounding-off will be done for each grade cut-off.

Also, although the above grading scale is used in this course, the course faculty reserve the right to adjust this scale at the end of the semester if for some unexpected reason the performance of the class as a whole on one or more exams during the semester falls outside what is typically expected for the exams in this course. This type of adjustment is expected to be a rare occurrence.

Statement on Penalties for Late Work: Assignments turned in after the due date will not be graded unless the instructor has been notified beforehand of an illness or other emergency and an arrangement has been made for turning the assignment in late.

Exam Guidelines:

- Exams and quizzes will be taken online via Canvas or Exemplify. The honor code is in effect for all examinations, and students are expected to complete them alone and without access to materials not explicitly allowed within the exam instructions.
- Students who detect errors in examination questions are asked to contact the instructor or a monitor immediately. During examinations, students should present questions only to the instructor, unless directed otherwise. In the interest of being fair to all students, additional information or explanation of questions will not be given to individuals during examinations.
- Make-up exams will not be offered except under the following circumstances: illness, verified by a note from a licensed professional; a family emergency, verified by a note from the professional person in attendance; or a University-sponsored event, verified by a note from the leader of the sponsoring organization. If a student is unable to attend the scheduled exam, the relevant instructor *must be notified by either email or phone at least 24 hours in advance of the exam time*, unless there are extenuating circumstances. If an acceptable circumstance or adequate documentation is not provided, a grade of zero will be assigned for the exam. Unless there are extenuating circumstances, the make-up exam date is generally not more than one week after the original exam date.

Problem Set Guidelines:

- Problem sets will be posted on the course Canvas site under the unit to which they pertain. These problem sets are to be completed on an individual basis. The honor code is in effect for these assignments.
- The use of previous years' answer keys or graded problem sets from past students in answering these questions is **not allowed** and is considered a violation of the honor code.
- The problem set may be either written or typed, and uploaded to Canvas for grading. A photograph of a sketch or hand-written page may be acceptable, provided it is legible.

Group In-class Exercise Guidelines:

- A group exercise will be completed in class on the date designated in the lecture schedule. Your group assignment can be found in the In-class Exercise Student Groups document on the course Canvas site. The group exercise will be posted on the course Canvas site the day before the

scheduled group session. Dr. Rumbley must be notified beforehand if an illness or other emergency prevents you from participating in a group problem assignment.

- The group exercise will require the use of current literature in order to formulate a reasonable answer, thus, students are allowed to utilize web resources in addition to their lecture notes and textbook. You are only to work with your assigned group in formulating your answers. The group exercises are to be submitted electronically at the end of the class session. Specific instructions will be provided at that time.

Literature Evaluation Problem Set: The literature project will be an exposure to current literature related to lecture material. The article will contain current research, either novel drug development/targeting or molecular aspects of disease, directly related to the pathways and/or proteins/enzymes being discussed in class. To encourage engagement with the article, essay questions will be posed whose answers are assembled from the article and in-class material. The questions are to be completed on an individual basis and will be reviewed following submission.

Weekend Quiz Guidelines: Students will have a defined period of time (based on the number of questions being asked) in a 24-hr window to complete an exam with typically NAPLEX-type multiple choice questions, without being able to navigate back to revise earlier answers. Students scoring 60% or more will be given a full 1.0% (passing) grade, while any student scoring less than 60% will be given 0%.

Discussion Group Guidelines: Small group discussions will be conducted for grade throughout the Nutrition units. During class, groups of 5-6 students (with composition changing regularly) will be assigned to numbered Zoom breakout rooms for a short period (~5 minutes) to organize a discussion of a question posed during that lecture. In many cases the question will be about an OTC product. Group members will decide how to conduct the discussion and prepare a written response to the Canvas Group discussion assignment before it is due (Sunday at midnight). Answers will be graded by a TA based on rubrics that will be published on Canvas after the grades have been posted. Each student in a Discussion Group will receive the same grade (0 to 2.0%, in 0.1% increments).

Scavenger Hunt Active Learning Exercise: Each student in the course will be assigned one OTC nutritional supplement nutraceutical or herbal remedy and given a series of questions about their product. The student should find the product in a community pharmacy and document the find by taking a selfie including them self, the assigned product, and other products shelved nearby. The student will submit online the selfie, the pharmacy name and address, and the answers to the series of questions given.

Exam and Assessment Re-grading Guidelines: If a student wishes to have an examination or problem set re-graded, the student must arrange for it within one week after the graded exam or problem set has been returned. The student must explain in writing the grading error and justify why their answer is consistent with that provided in the key or otherwise correct. Such explanations should be concise and to the point. Re-grading requests are to be made to the instructor giving the exam or problem set. Remember that when you request a re-grade of a question the whole question will be re-graded, which means you can either lose points or gain points.

Minimum Passing Level: Per University and College Policy, students who receive a grade below D in this course must successfully repeat the course before advancing to courses which require this course as a prerequisite.

Course Lecture Schedule

Lec	Date	Day	Time	Room (TC/Dul)	Topic	Readings ^a	Instructor
1	8/24	M	11:15	Zoom	Course Introduction Basic Concepts of Cellular Metabolism	<i>Biochem</i> Chapt 15	Rumbley Finzel
2	8/25	T	11:15	Zoom	Basic Concepts of Cellular Metabolism	"	Finzel
3	8/27	Th	3:35	Zoom	Glucose Transporters & Glycolysis Prerecorded lecture	<i>Biochem</i> Chapt 16	Haskell- Luevano
4	8/28	F	10:10	Zoom	Glycolysis	"	Haskell- Luevano
5	8/31	M	11:15	Zoom	Gluconeogenesis	"	Haskell- Luevano
6	9/1	T	11:15	Zoom	Glycogen Synthesis	<i>Biochem</i> Chapt 21	Haskell- Luevano
7	9/3	Th	3:35	Zoom	Glycogen Breakdown	"	Haskell- Luevano
8	9/4	F	10:10	Zoom	Pentose Phosphate Pathway Problem Set 1 Due	<i>Biochem</i> Chapt 20 p. 601-611	Haskell- Luevano
	9/7	M			No Class – Labor Day		
9	9/8	T	11:15	Zoom	Glucose 6-phosphate dehydrogenase deficiency/Review		Haskell- Luevano
10	9/10	Th	3:35	Zoom	Review for Exam Problem set 1 review		Finzel Haskell- Luevano
11	9/11	F	10:10	Zoom	Citric Acid Cycle	<i>Biochem</i> Chapt 17	Rumbley
	9/11	F	05:00	Canvas	Exam 1 (Lectures 1-10) Due		Finzel Haskell- Luevano
12	9/14	M	11:15	Zoom	Oxidative Phosphorylation	<i>Biochem</i> Chapt 18	Rumbley
13	9/15	T	11:15	Zoom	Oxidative Phosphorylation & Oxidative Stress	<i>Biochem</i> Chapt 18	Rumbley
14	9/17	Th	3:35	Zoom	Apoptosis & Cell Death Review	"	Rumbley
15	9/18	F	10:10	Zoom	Lipid Digestion and Absorption	<i>Biochem</i> Chapt 22	Rumbley
16	9/21	M	11:15	Zoom	Fatty Acid Biosynthesis and Degradation	"	Rumbley
17	9/22	T	11:15	Zoom	Lipolysis, Ketone Bodies, & Triacylglycerol Cycle Literature Evaluation Problem Set Current Literature Discussion	<i>Biochem</i> Chapt 26	Rumbley
18	9/24	Th	3:35	Zoom	Cholesterol Biosynthesis & Regulation	"	Rumbley
19	9/25	F	10:10	Zoom	Group Exercise		Rumbley
	9/26	Sa	05:00	Canvas	Exam 2 (Lectures 11-19) Due		Rumbley
20	9/28	M	11:15	Zoom	Amino acid catabolism Proteolytic & Ubiquitin/Proteasome Protein Degradation, Transamination Mechanisms	<i>Biochem</i> Chapt 23	Finzel
21	9/29	T	11:15	Zoom	Glucose-Alanine Cycle, Urea Cycle, Phenylketonuria	<i>Biochem</i> Chapt 23	Finzel
22	10/1	Th	3:35	Zoom	Amino acid Biosynthesis Essential Amino Acids, Nitrogen Cycle	<i>Biochem</i> Chapt 23	Finzel
23	10/2	F	10:10	Zoom	Activated Methyl Carriers, Aromatic Amino Acid Biosynthesis, Ornithine Decarboxylase	<i>Biochem</i> Chapt 24	Finzel
24	10/5	M	11:15	Zoom	Metabolic Profiles of Major Organs	<i>Biochem</i>	Haskell-

					Problem Set 2 Due	Chapt 27	Luevano
25	10/6	T	11:15	Zoom	Effects of Disease on Metabolic Processes	<i>Biochem</i> Chapt 27	Haskell-Luevano
25	10/8	Th	3:35	Zoom	Nucleic Acid Salvage Pathways, Diseases of Defective Purine Metabolism	<i>Biochem</i> Chapt 25	Finzel
26	10/9	F	10:10	Zoom	Pyrimidine Biosynthesis Allostery of Aspartate Transcarbamoylase	<i>Biochem</i> Chapt 10.1 p. 290-296	Finzel
	10/12	M	11:15	Zoom	No Class - PD3 IPPEs		
	10/13	T	11:15		No Class - PD3 IPPEs		
	10/15	Th			No Class – Fall Break		
	10/16	F			No Class – Fall Break		
27	10/19	M	11:15	Zoom	De Novo Purine Nucleotide Biosynthesis	<i>Biochem</i> Chapt 25	Finzel
28	10/20	T	11:15	Zoom	Nucleotides & Cancer Chemotherapies	<i>Biochem</i> Chapt 25	Finzel
29	10/22	Th	3:35	Zoom	Problem Set 3 Due Problem set discussion Exam Review.		Finzel Haskell-Luevano
	10/23	F	05:00	Canvas	Exam 3 (Lectures 20–29)		Finzel Haskell-Luevano
30	10/23	F	10:10	Zoom	Nutrition & Society, ADME for Food, Food Fraud, Nutrigenomics		Shier
31	10/26	M	11:15	Zoom	Toxins in Food, Pesticide Residues, Alcohol		Shier
32	10/27	T	11:15	Zoom	Drug-Nutrient Interactions, Energy Dynamics		Shier
33	10/29	Th	3:35	Zoom	Food and Disease: Obesity		Shier
34	10/30	F	10:10	Zoom	Food-induced Disease: Drugs for Weight, Bariatric Surgery, Food Allergy		Shier
35	11/2	M	11:15	Zoom	Food and Disease: Cardiovascular Disease, Cancer, Chemoprevention		Shier
36	11/3	T	11:15	Zoom	Food and Disease Issues: Carbohydrate-induced Diseases, Eating Disorders, Diets, Fad Diets, Food Additives, Oral Nutrition Products		Shier
37	11/5	Th	3:35	Zoom	Macronutrients		Shier
	11/6	F			PedRx - No Class		
38	11/9	M	11:15	Zoom	Minerals		Shier
39	11/10	T	11:15	Zoom	Minerals		Shier
40	11/12	Th	3:35	Zoom	Trace Elements		Shier
41	11/13	F	10:10	Zoom	Exam review		Shier
	11/14	Sa	5:00	Canvas	Exam 4 (Lectures 30–39)		
42	11/16	M	11:15	Zoom	Trace Elements		Shier
43	11/17	T	11:15	Zoom	Fat Soluble Vitamins		Shier
44	11/20	F	10:10	Zoom	Fat Soluble Vitamins		Shier
45	11/23	M	11:15	Zoom	Water Soluble Vitamins		Shier
46	11/24	T	11:15	Zoom	Water Soluble Vitamins		Shier
	11/27	F			Thanksgiving Holiday – No Class		
47	11/30	M	11:15	Zoom	Water Soluble Vitamins		Shier
48	12/1	T	11:15	Zoom	Clinical Tie-in: Iron, Folate and Vitamin B12 Deficiency Anemias		St. Peter (recorded)

49	12/4	F	10:10	Zoom	Clinical Tie-in: Iron, Folate and Vitamin B12 Deficiency Anemias		St. Peter (recorded)
50	12/7	M	11:15	Zoom	Foods as Therapeutic Agents		Shier
51	12/8	T	11:15	Zoom	Nutraceuticals and Herbal Remedies		Shier
52	12/11	F	11:15	Zoom	Nutraceuticals and Herbal Remedies Scavenger Hunt Report Due		Shier
	12/18	F	8:00	Canvas	Exam 5 (Lectures 40–52) (Max 2 hr)		Shier St. Peter

^a *Biochem* refers to the e textbook: Biochemistry, 8th edition, J. M. Berg, J. L. Tymoczko, and L. Stryer, 2015. Reading before class is highly recommended

For information about UMN and CoP policies-wide policies [e.g., Attendance; Academic Freedom; Copyright; Course Evaluations; Disability Accommodations; FERPA, etc.], see the **Centralized Syllabus: [University of Minnesota and College of Pharmacy Policy Reference](#)**