NUTR 370
Nutritional Biochemistry and Physiology: Macronutrients
Fall 2018

Time: Tuesdays, Thursdays and Fridays (10:00 AM-12:00 noon)

Room: J155

Course Director: Stefania Lamon-Fava, MD PhD, Cardiovascular Nutrition Laboratory, HNRCA 520
e-mail: stefania.lamon-fava@tufts.edu; tel: 617-556-3105. Office hours by appointment.

Instructors

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<thead>
<tr>
<th>Instructors</th>
<th>Room</th>
<th>Telephone</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
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<td>Lynne Ausman, DSc</td>
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</tbody>
</table>

Teaching Assistant: Jisun So, Doctoral Student, Cardiovascular Nutrition Laboratory, HNRCA 526
Email: Jisun.So@tufts.edu

Tufts Graduate Credit: 4.5 credits

Prerequisites: Graduate Biochemistry (BCHM 223)

Course Description: NUTR 370 is an advanced course in the nutrition sciences. Students are expected to be familiar with the material covered in introductory nutrition as well as the biochemistry and physiology courses offered at Tufts. These courses will serve as the foundation for the material we will explore in this course. NUTR 370 will cover topics related to: energy metabolism, carbohydrates and fiber, lipids and lipoproteins, and amino acids and proteins. These topics will be covered in 3 sections, each of approximately 4 weeks duration. Class format will include lectures, student presentations, and class discussion/student participation/team-based learning. There will also be an online learning component, which will allow students to view pre-recorded lectures online with possible follow-up in-class discussions of the covered material. These online segments will allow students some greater flexibility in managing the course materials along with greater pre-class preparation for class discussion.

Course material will all be available on Canvas: https://canvas.tufts.edu

Course objectives:
1) To expand the knowledge of how carbohydrates, lipids, and proteins are digested, absorbed, transported in the blood, and metabolized in the whole organism using principles of physiology, biochemistry, cell biology, and molecular biology.
2) To explain how metabolic pathways are regulated during different dietary and environment conditions.

3) To integrate information of macronutrients in health and disease, with particular emphasis on the most prevalent nutrition-related diseases: cardiovascular disease, obesity, diabetes, cancer, and sarcopenia.

4) To provide the forum for discussing experimental approaches to studying macronutrient metabolism and function.

**Grading:**

<table>
<thead>
<tr>
<th>% of Final Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>60%</td>
<td>Exams (one for each section) 3 x 20%</td>
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<tr>
<td>10%</td>
<td>Student presentation (All sections)</td>
</tr>
<tr>
<td>10%</td>
<td>Abstract (Protein section)</td>
</tr>
<tr>
<td>10%</td>
<td>Team-based learning</td>
</tr>
<tr>
<td>10%</td>
<td>Class participation</td>
</tr>
</tbody>
</table>

For assignments that are turned in late, a one letter grade deduction will be applied for every day that the assignment is late. Students are expected to take exams on the specified dates and times unless otherwise arranged ahead of time with the course instructor. Last-minute absences from exams due to illness will require a note from the doctor in order to re-take the exam at a later date.

**Course text and material:** There is no required textbook but selected chapters from *Modern Nutrition in Health and Disease* (Editors: A. Catharine Ross, Benjamin Caballero, Robert J. Cousins, Katherine L. Tucker, and Thomas R. Ziegler; 11th Edition, Lippincott Williams and Wilkins, Baltimore, MD, 2012) will be assigned throughout the semester. This book is available online through the Hirsch Health Sciences Library under "e-books".

**Academic Conduct:** Each student is responsible for upholding the highest standards of academic integrity, as specified in the Friedman School’s Policies and Procedures manual (http://nutrition.tufts.edu/documents-and-forms/policies-and-procedures-students) and Tufts University policies (http://students.tufts.edu/student-affairs/student-life-policies/academic-integrity-policy). It is the responsibility of each student to understand and comply with these standards, as violations will be sanctioned by penalties ranging from failure on an assignment and the course to dismissal from the school.

**Description of assignments, participation, exams and other required activities:**

**Readings:**Readings will be assigned for all class meetings. The list of readings will be provided at the beginning of each section. Read assigned material prior to the class. Selected papers will also be discussed in class. Preparation will maximize your benefit from each lecture and enable you to contribute to class discussions.

**Exams:** There will a two-hour exam at the end of each section. The format of the exam will be open questions and answers.

**Student Presentations:** Students will be provided a research question and will develop a small, 2 pages written proposal based on the assigned question that they will also present in class. All students should be prepared to contribute their opinion during the discussion. Each presentation will be approximately 15-20 minutes, including the student presentation and general discussion. Further details of the assignment will be given in class. Presentation grade will be based on presentation content and clarity, study design and innovation.

**Abstract (Protein Section):** During the Protein section, all students will be given protein turnover data (excel format). Students will be asked to analyze and then prepare a written abstract similar to that for a conference or journal publication. The abstract should follow standard journal guidelines and include: background/purpose, methods, results and conclusion and be limited to 300 words. Abstracts will be graded on clarity, study design, interpretation of the results, and final conclusions. Further details of the assignment will be given in class.
**Team-based learning:** Students will work together in class for this activity. Reading will be assigned and must be completed in advance. Students will be divided into small groups and questions for discussion will be assigned. The class will then gather for discussion of the assigned questions with each small group reporting. Specific instructions will be provided in class. *Attendance is required to receive credit.*

**Student participation:** Participation to class activities and discussions will be expected during all class periods. For this reason your prior preparation is essential. If a situation arises that prevents you from preparing adequately prior to the class, please inform the instructor prior to the class. Likewise, if you will have to miss a class, common courtesy asks that you tell the instructor in advance.

**Grading of student presentation, participation and team-based learning** will be as follows:

- 90-100/100 Very good
- 80-90/100 Good
- 50-70/100 Mediocre
- <50/100 Poor
- 0/100 No evident participation
## Course Schedule

<table>
<thead>
<tr>
<th>Course</th>
<th>Instructor</th>
<th>Lecture Topic</th>
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<tbody>
<tr>
<td>NUTR 370 - Biochemistry and Physiology: Macronutrients</td>
<td>Dr. Stefania Lamon-Fava</td>
<td>Introduction/(Online: Carbohydrates: basic concepts &amp; other)</td>
</tr>
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### Energy and Carbohydrate Section

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Lecture Time</th>
<th>Room</th>
<th>Instructor</th>
<th>Lecture Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept 4</td>
<td>Tue</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Lamon-Fava/Online</td>
<td>Energy and Carbohydrate Section/Introduction/(Online: Carbohydrates: basic concepts &amp; other)</td>
</tr>
<tr>
<td>6</td>
<td>Thur</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Rios</td>
<td>Central control of energy</td>
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<tr>
<td>7</td>
<td>Fri</td>
<td>10:00-12:00</td>
<td>Pothos</td>
<td>Non homeostatic control of energy</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Tue</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Das</td>
<td>Energy expenditure</td>
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<tr>
<td>13</td>
<td>Thur</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Das</td>
<td>Under- and Over-nutrition</td>
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<tr>
<td>14</td>
<td>Fri</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Online</td>
<td>(Online: Fiber)</td>
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<tr>
<td>18</td>
<td>Thur</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Roberts</td>
<td>Factors affecting energy metabolism</td>
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<tr>
<td>20</td>
<td>Thur</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Team-based learning activity</td>
<td>To be determined</td>
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<tr>
<td>21</td>
<td>Fri</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Kaushik</td>
<td>Insulin resistance</td>
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<tr>
<td>25</td>
<td>Tue</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Saltzman/Kane</td>
<td>Gut hormones/Microbiota</td>
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<tr>
<td>27</td>
<td>Thur</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Obin/Students' presentation</td>
<td>Diabetes</td>
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<tr>
<td>28</td>
<td>Fri</td>
<td>10:00-12:00</td>
<td>J155</td>
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### Lipid Section

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Lecture Time</th>
<th>Room</th>
<th>Instructor</th>
<th>Lecture Topic</th>
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<tr>
<td>5</td>
<td>Fri</td>
<td>10:00-12:00</td>
<td>Online</td>
<td></td>
<td>Substitute Monday’s class schedule (Online: Basic concept)</td>
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<tr>
<td>9</td>
<td>Tue</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Lamon-Fava</td>
<td>Endogenous pathway/LDL metabolism</td>
</tr>
<tr>
<td>11</td>
<td>Thur</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Lamon-Fava/Kaushik</td>
<td>Exogenous pathway of lipid metabolism</td>
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<tr>
<td>12</td>
<td>Fri</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Lamon-Fava</td>
<td>Reverse cholesterol transport pathway</td>
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<tr>
<td>16</td>
<td>Tue</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Lamon-Fava</td>
<td>Lipids and gene regulation</td>
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<tr>
<td>18</td>
<td>Thur</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Team-based learning activity</td>
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<td>22</td>
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<td>J155</td>
<td>Ordovas</td>
<td>Gene diet interactions</td>
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### Protein Section

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<tr>
<th>Date</th>
<th>Day</th>
<th>Lecture Time</th>
<th>Room</th>
<th>Instructor</th>
<th>Lecture Topic</th>
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<tbody>
<tr>
<td>9</td>
<td>Fri</td>
<td>10:00-12:00</td>
<td>Online</td>
<td></td>
<td>(Online: Protein: Basic Concepts)</td>
</tr>
<tr>
<td>13</td>
<td>Tue</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Fielding</td>
<td>Sarcopenia and other health outcomes</td>
</tr>
<tr>
<td>15</td>
<td>Thur</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Margolis abstract instructions</td>
<td>Calorie restriction and protein metabolism</td>
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<tr>
<td>16</td>
<td>Fri</td>
<td>10:00-12:00</td>
<td>Online</td>
<td></td>
<td>(Online: Protein requirements and quality; Protein energy malnutrition)</td>
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<td>20</td>
<td>Tue</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Rivas</td>
<td>Muscle mass and function: effect of aging</td>
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<tr>
<td>22</td>
<td>Thur</td>
<td>10:00-12:00</td>
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<tr>
<td>23</td>
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<td>10:00-12:00</td>
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<tr>
<td>27</td>
<td>Tue</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Maher</td>
<td>Neurotransmitters: phenylalanine and tryptophan</td>
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<tr>
<td>29</td>
<td>Thur</td>
<td>10:00-12:00</td>
<td>J155</td>
<td>Maher</td>
<td>NO production</td>
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<tr>
<td>30</td>
<td>Fri</td>
<td>10:00-12:00</td>
<td>Team-based learning/Student presentations</td>
<td></td>
<td>To be determined</td>
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</table>

### Exam Dates

- **First Midterm Exam:** Energy and Carbohydrates
- **Second Midterm Exam:** Lipids
- **Third Midterm Exam:** Proteins
Course Schedule and Class Objectives

Required readings and supplemental readings will be posted on Canvas approximately one week prior to each class.

ENERGY AND CARBOHYDRATES SECTION

Class 1: September 4
Topic: Course description
Instructor: Stefania Lamon-Fava, MD PhD

Topic: Online Module - Carbohydrate Classification, Digestion, Transport, and Controversies
Instructor: Edward Saltzman, MD

Learning Objectives
Upon completion of this class, students will:

• know the structure and classification of carbohydrates
• have learned the food sources of different types of carbohydrates
• have learned the digestion and absorption of carbohydrates
• know the different transporters involved in carbohydrate absorption and cellular uptake
• have learned how to assess glucose homeostasis
• have learned about fructose metabolism and health effects
• understand the concept of glycemic index and glycemic load

Class 2: September 6
Topic: Central Control of Energy
Instructor: Maribel Rios, PhD

Learning Objectives
Upon completion of this class, students will:

• learn the central nervous system (CNS) regions involved in the regulation of food intake
• learn the neurotransmitters and cells involved in appetite regulation
• know the anorexigenic and orexigenic input signals in the brain

Class 3: September 7
Topic: Non-Homeostatic Control of Energy Intake
Instructor: Emmanuel Pothos, PhD

Learning Objectives
Upon completion of this class, students will:

• know the difference between homeostatic and non-homeostatic CNS signals
• know the neurotransmitters involved in non-homeostatic control of energy
• understand the biological and psychological implications of non-homeostatic control of energy intake

Class 4: September 11
Topic: Energy Expenditure
Instructor: Sai Krupa Das, PhD

Learning Objectives:
Upon completion of this class, students will:

• know the different components of total energy expenditure
• know the different laboratory methods to assess energy expenditure

Class 5: September 13
Topic: Under- and Over-Nutrition
Instructor: Sai Krupa Das, PhD

Learning Objectives
Upon completion of this class, students will:
Fall 2018

- know how to define under-nutrition and over-nutrition
- understand the changes in the different components of energy expenditure during under-nutrition and over-nutrition
- understand adaptation to under- and over-feeding
- know carbohydrate, lipid, and protein metabolism in under-nutrition

Class 6: September 14
Topic: Online Module - Fiber
Instructor: Edward Saltzman, MD
Learning Objectives
Upon completion of this class, students will:
- know the definition and classification of different types of fiber
- know the food sources of fiber
- understand the physiological effects of fiber on energy regulation, cardiovascular disease, insulin resistance, and colon cancer

Class 7: September 18
Topic: Factors Affecting Energy Metabolism
Instructor: Susan Roberts, PhD
Learning Objectives
Upon completion of this class, students will:
- understand the effects of age on energy metabolism
- understand the effects of gender on energy metabolism
- know the hormones that influence energy expenditure and why
- know how diet influences energy metabolism

Class 8: September 20
Topic: To be determined
Instructor: Stefania Lamon-Fava, MD PhD
Learning Objectives:
- Team-based learning

Class 9: September 21
Topic: Insulin Resistance
Instructor: Virendar Kaushik, PhD
Learning Objectives:
Upon completion of this class, students will:
- understand the definition of insulin resistance (IR) and type 2 diabetes mellitus
- understand the integrated action of insulin
- know the sensing of energy demands by the cell via AMP-activated protein kinase (AMPK) and Silence Information Regulator 2.1 (SIRT1)
- know how to clinically assess IR and diabetes

Class 10A: September 25
Topic: Gut Hormones
Instructor: Edward Saltzman, MD
Learning Objectives
Upon completion of this class, students will:
- understand what is sensed by the gut and how it is sensed
- understand how information is conveyed to the brain
- be able to describe how different types of bariatric surgery could influence these sensing mechanisms

Class 10B: September 25
**Topic: Microbiota**  
**Instructor:** Anne Kane, MD  
**Learning Objectives:**  
Upon completion of this class, students will:  
- learn how the field of microbiota has developed  
- know what is currently known about composition and function of microbiota  
- learn about the role of microbiota in metabolism

**Class 11: September 27**  
**Topic:** Diabetes  
**Instructor:** Martin Obin, PhD  
**Learning Objectives**  
Upon completion of this class, students will:  
- understand that the Metabolic Syndrome as a critical stage in development of T2DM  
- understand the role of adipocytes in glucose and fatty acid homeostasis  
- know the function of adipose tissue as an endocrine organ- adipokines, lipokines  
- know the effect of dysregulated adipokines and adipose tissue inflammation on insulin resistance  
- have learned about therapeutic effects of TZDs, incretins, and bariatric surgery

**LIPIDS SECTION**

**Class 1: October 5**  
**Topic:** Online Module - Basic Concepts  
**Learning Objectives**  
Upon completion of this class, students will:  
- know the biochemistry of the different classes of lipids  
- have learned the lipid and apolipoprotein composition of different lipoproteins

**Class 2: October 11**  
**Topic:** Exogenous Pathway of Lipid Metabolism  
**Instructor:** Stefania Lamon-Fava, MD PhD  
**Learning Objectives**  
Upon completion of this class, students will:  
- know how dietary fat digestion and absorption occurs and how lipids are delivered to target tissues  
- have learned the role of the gut in lipid homeostasis

**Class 3A: October 16**  
**Topic:** Endogenous Pathway of Lipid Metabolism  
**Instructor:** Stefania Lamon-Fava, MD PhD  
**Learning Objectives**  
Upon completion of this class, students will:  
- know the metabolism of VLDL, IDL, and LDL  
- understand the biological functions of LDL and other atherogenic lipoproteins  
- have learned about Lipoprotein(a) and its association with cardiovascular disease  
- be able to describe the pathogenesis of cardiovascular disease and the role of dietary fat on lipoprotein metabolism and on the pathogenesis of cardiovascular disease

**Class 3B October 16**  
**Topic:** Regulation of LDL Metabolism  
**Instructor:** Virendar Kaushik, PhD  
**Learning Objectives**  
Upon completion of this class, students will:  
- understand the membrane cycling of the LDL receptor
- understand the different pathways of LDL regulation (SREBP, PCSK9, IDOL, etc.)

**Class 4: October 18**  
**Topic:** HDL and Reverse Cholesterol Transport Pathway  
**Instructor:** Stefania Lamon-Fava, MD PhD  
**Learning Objectives**  
Upon completion of this class, students will:  
- understand the role of HDL in reverse cholesterol transport  
- know other anti-atherosclerotic functions of HDL  
- be able to describe genetic and secondary causes of low HDL-C and high HDL-C levels  
- understand the role of life-style factors on HDL-C levels

**Class 5: October 19**  
**Topic:** Online Module – Diabetic Dyslipidemia  
**Instructor:** Henry Ginsburg, MD  
**Learning Objectives**  
Upon completion of this class, students will:  
- understand the interrelation between insulin resistance and cardiovascular disease  
- understand the plasma lipid alterations associated with insulin resistance  
- know the mechanism of the insulin resistance-related dyslipidemia

**Class 6: October 23**  
**Topic:** Lipids and Regulation of Gene Expression  
**Instructor:** Stefania Lamon-Fava, MD PhD  
**Learning Objectives**  
Upon completion of this class, students will:  
- understand the role of lipid molecules as transcriptional regulators of gene expression  
- understand the role of lipid molecules as regulators of gene expression in signal transduction  
- understand how these roles affects lipid utilization and storage, and cell function  
- be able to describe the molecular mechanisms of regulation of plasma lipids by dietary lipids and carbohydrates

**Class 7: October 25**  
**Topic:** To be determined  
**Instructor:** Stefania Lamon-Fava, MD PhD  
**Learning Objectives:**  
- Team-based learning

**Class 8: October 30**  
**Topic:** Gene-Diet Interactions  
**Instructor:** Jose Ordovas, PhD  
**Learning Objectives**  
Upon completion of this class, students will:  
- understand the concept of personalized nutrition  
- understand the interaction between genetics and nutrition and its role in lipid metabolism, obesity, and inflammation  
- learn about the function of microRNA in gene expression

**Class 9: November 1**  
**Topic:** Adipocyte Lipid Metabolism  
**Instructor:** TBD  
**Learning Objectives**  
Upon completion of this class, students will:  
- understand the regulation of adipose cell metabolism in obesity
• know how triglyceride metabolism (synthesis and hydrolysis) is regulated during feeding and fasting
• know the role of adipose tissue as an endocrine organ
• know the modulation of insulin resistance by the adipose tissue

Class 10: November 6  
Topic: Essential FA, Eicosanoids, and Immune Function  
Instructor: Dayong Wu, MD PhD  
Learning Objectives  
Upon completion of this class, students will:  
• have reviewed the essential fatty acids structure and PUFA biosynthesis  
• know the pathways of eicosanoid biosynthesis  
• understand the function of prostaglandins, thromboxanes, and leukotrienes  
• understand the role of eicosanoids and other PUFA-derived mediators in inflammation and in the resolution of inflammation  
• know the different molecular aspects of the anti-inflammatory effects of aspirin

PROTEIN SECTION

Class 1: November 9  
Topic: Online Module - Protein: Basic Concepts, Digestion, Absorption, etc.  
Instructor: Lynne Ausman, DSc  
Learning Objectives  
Upon completion of this class, students will:  
• able to describe the type of roles that proteins play in the body  
• understand protein structure and organization  
• understand amino acid classification systems  
• be able to describe the nitrogen cycle and its importance to replenishment of nitrogen into foodstuffs.  
• be able to describe protein digestion and absorption, and resultant transport of amino acids and peptides across the epithelial membrane.  
• know the fate of absorbed amino acids, as well as their synthesis and degradation.

Class 2: November 13  
Topic: Sarcopenia and Other Health Outcomes  
Instructor: Roger Fielding, PhD  
Learning Objectives  
Upon completion of this class, students will:  
• have learned the definition of sarcopenia  
• know the role of protein intake and protein metabolism on sarcopenia  
• know the effect of exercise on muscle mass in the elderly

Class 3: November 15  
Topic: Calorie Restriction, Protein Metabolism and BCAA  
Instructor: Lee Margolis, PhD  
Learning Objectives  
Upon completion of this class, students will:  
• learn the effect of caloric restriction on protein metabolism  
• learn the metabolism of branched chain amino acids  
• learn the biological functions of glutamine and alanine
Class 4: November 16  
**Topic:** Online Module - Protein Requirements and Quality/Protein Energy Malnutrition  
**Instructor:** Lynne Ausman, DSc  
**Learning Objectives**  
Upon completion of this class, students will:  
- be able to describe the protein contents in the major food groups  
- know the principles of the DRI and how they were established for protein  
- be able to describe in detail the methods used to determine human protein requirements.  
- be able to compare the several methods by which protein quality is measured

Class 5: November 20  
**Topic:** Muscle Mass and Function: Effects of Aging  
**Instructor:** Donato Rivas, PhD  
**Learning Objectives**  
Upon completion of this class, students will:  
- understand the concept of muscle plasticity  
- learn anabolic resistance in muscle cells  
- learn the major metabolic and molecular determinants of anabolic resistance  
- know the role of exercise on insulin sensitivity in muscle cells and its mechanism of action

Class 6: November 27  
**Topic:** Neurotransmitters: Phenylalanine and Tryptophan  
**Instructor:** Timothy Maher, PhD  
**Learning Objectives**  
Upon completion of this class, students will:  
- have learned the metabolism of AA serving as precursors of neurotransmitters (choline, tryptophan, tyrosine, histidine, threonine)  
- know how AA are transported into the brain and their role in cognition and other effects

Class 7: November 29  
**Topic:** NO production  
**Instructor:** Timothy Maher, PhD  
**Learning Objectives**  
Upon completion of this class, students will:  
- know the metabolism of arginine and the effects of its metabolite ADMA  
- know the synthesis of NO from arginine and the effects of NO on the vascular system

Class 8: November 30  
**Topic:** To be determined  
**Instructor:** Stefania Lamon-Fava, MD PhD  
**Learning Objectives**  
- Team-based learning

Class 9: December 4  
**Topic:** Sulfur AA Metabolism, Lysine and Threonine  
**Instructor:** Lynne Ausman, DSc  
**Learning Objectives**  
Upon completion of this class, students will:  
- be able to discuss the concept of amino acid pattern and complementation vis-à-vis the importance of methionine and cysteine sufficiency  
- be able to describe the transmethylation, transsulfuration, and transamination pathways of sulfur amino acid metabolism and how they are regulated  
- understand the chemical role that sulfur plays as a component of sulfur amino acids and their metabolites
- know taurine production and its importance in nutrition
- understand the important role of the liver in metabolizing/catabolizing the amino acid influx from the portal vein
- know the structures of lysine and why its structure predicts some of the roles that it plays
- be able to explain the important catabolic steps for lysine

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### Class 10: December 6
**Topic:** Protein Modification and Degradation  
**Instructor:** Elizabeth Whitcomb, PhD  
**Learning Objectives**
Upon completion of this class, students will:
- know the different systems that break down proteins inside cells.
- know why and what kind of proteins need to be degraded
- have learned methods to monitor intracellular protein degradation

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### Class 11: December 7
**Topic:** Macronutrients: Metabolism, Storage and Regulation of Fuel Utilization  
**Instructor:** Stefania Lamon-Fava, MD PhD  
**Learning Objectives**
Upon completion of this class, students will:
- learn about macronutrients interconversion and storage
- understand tissue-specific differences in fuel utilization
- know the body’s regulation of fuel utilization during fasting and starvation
- know the regulation of fuel utilization in the feeding state by different organs and tissues
- understand the regulation of fuel utilization by muscle tissue during exercise
- understand gender differences in fuel utilization