NUTR 246-- Scientific Basis of Nutrition: Macronutrients
Spring 2019

Class Meetings: Mondays, 3:15-6:15pm

Location: Sackler 507* (check dates)

Instructor(s): Erin Hennessy
erin.hennessy@tufts.edu
75 Kneeland Street, Room 823
617-636-3636

Teaching Asst.: Rebecca Cohen
Rebecca.cohen@tufts.edu

Office hours: By appointment

Graduate Credits: 3 Semester Hour Units (SHUs)

Prerequisites: Undergraduate-level biology and chemistry, or by instructor

Course Description:
NUTR 246 is one course of a pair of courses (with NUTR 245) designed to provide students with an in-depth understanding of nutrition and its scientific underpinnings. NUTR 246 focuses on macronutrients and energy, and will cover topics related to energy metabolism, carbohydrates and fiber, lipids and lipoproteins, and amino acids and proteins while NUTR 245 focuses on micronutrients including fat- and water-soluble vitamins and minerals. The course has been designed to review and build upon students’ existing knowledge of biology and chemistry, and will provide instruction in biochemical and physiologic principles necessary to understand the aspects of macronutrients described above. The focus of the course will be on the scientific basis for and real-world application of macronutrients and energy.

The course is divided into 4 sections in 3-week cycles: energy/energy metabolism, carbohydrates and fiber, lipids and lipoproteins, amino acids and proteins. Each section will address five major questions: what, where, why, when, and how. For example,
- What is a carbohydrate? What is its function?
- Where do I obtain carbohydrates (food sources)?
- Why does my body need carbohydrates?
- When do my needs change (across the lifecourse)?
- How does my body digest/absorb/metabolize carbohydrates?

Course Objectives:
- Describe each macronutrient including the recommend dietary intake, major functions and biochemical role, and food sources
- Summarize how macronutrients are digested, absorbed, transported in the blood, and metabolized using principles in physiology, biochemistry, cell biology and molecular biology.
- Explain the health effects associated with each macronutrient

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/student/documents) 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.

**Classroom Conduct:** The goal is for everyone to attend each class and arrive on time. If for any reason you must miss class, arrive late, or leave early, please let the Instructor or TA know as soon as possible (via email is fine!). This is a 3-hour course so we will have a ~10-minute break during each class. Food and beverages are allowed. Laptops are allowed during lectures but will not be allowed during Debate presentations.

**TEXTS/READINGS**
The Byrd-Bredbenner et al text (on reserve at the Health Sciences library) provides an easy-to-read overview of the nutrition concepts presented in class while the Ross et al and Gropper et al provide additional detail. Chapters from required texts and other readings will be assigned throughout the course.

**Required:**
1. Wardlaw’s Perspectives in Nutrition, 2016 (Editors: Byrd-Bredbenner, Moe, Berning and Kelley)
2. Modern Nutrition in Health and Disease, 2014 (Editors: Catherine Ross, Benjamin Caballero, Robert Cousins, Katherine Tucker and Thomas Ziegler; 12th Edition). *This is a free e-book from the Health Sciences library*

**Recommended, not required:**

**MATERIALS**
Course materials will be available on CANVAS: [http://Canvas.tufts.edu](http://Canvas.tufts.edu).

For the Diet Analysis Projects, we will utilize the National Cancer Institute’s Automated Self-Administered Recall System (ASA24). The program is available online at no cost to students. See: [https://epi.grants.cancer.gov/asa24/](https://epi.grants.cancer.gov/asa24/) Students may wish to familiarize themselves with the basics of nutritional assessment methods. See: [https://dietassessmentprimer.cancer.gov/](https://dietassessmentprimer.cancer.gov/)

**DESCRIPTION OF COURSE ELEMENTS**

**Lectures:** Lectures will be provided in the classroom and to the extent possible will be recorded. Links to online lecture slides and recordings will be posted on Canvas.

**Readings:** Required and recommended readings will be listed and/or posted on Canvas. Required readings that accompany a lecture or activity should be completed in advance of class so that content can be discussed during the class. Recommended readings have been chosen to improve understanding of course material or to allow students to go ‘deeper’ into a topic. These readings are optional and content from the recommended reading list will not be assessed in course assignments but can be utilized in those assignments.

**Individual Assignments:**
- Diet Analysis Project: Additional details on this assignment and grading rubric are available on Canvas. For this assignment, students will be asked to:
  - Interview an adult (e.g. a friend, partner, family member, etc) using the multiple-pass, 24-hour dietary recall method. Two recalls must be completed representing 1 weekday and 1 weekend day.
Interviews can be conducted in person and/or by phone/video. It is ideal that you interview another person as this a unique learning experience; however, if you cannot find another person to interview then you may complete self-assessments. You will record the interview using paper/pen.

- Enter the data (after data collection). You will use the ASA24 web platform to enter data after the recall however you should familiarize yourself with the procedures and level of detail required by the program.
- Provide a written assessment of your participant’s diet based on the information obtained during the recall. The focus of this report will be on energy and energy-yielding nutrients not micronutrients.

- Take Home Exams: Students will complete 2 take-home quizzes at the midpoint and end of the semester. Exams will be based on the materials presented in lectures and the required readings. The exam will require you to write comprehensive answers demonstrating knowledge of and ability to apply the materials presented in the course. Your written responses must be in your own words. Please review the Tufts policies on plagiarism prior to completing each exam (links to these policies are provided under the Academic Conduct section above). We will use automated software via canvas to screen exam responses for plagiarism.

- Diet Review Paper: Each student will have the opportunity to apply the knowledge gained over the entire course in a written paper. Students may choose their topic based upon discussion and approval with the Instructor and/or TA. Papers will focus on “Diets”. For example, the Mediterranean Diet, Paleo Diet, Vegan-diet, Vegetarian-diet, Western Diet, Weight Watchers Diet, etc. While the student may select any diet of their choosing, the only requirement is that the evidence base related to the diet be sufficient (yield at least 3 peer-reviewed articles in which the diet is tested/critiqued/observed). Students are expected to critique the healthfulness of their chosen diet by applying the concepts learned in class – focusing on energy and energy-yielding nutrients. It is STRONGLY recommended that students work on this assignment throughout the semester and there are due dates throughout the semester to ensure that this is executed. Grading rubric and instructions are available on Canvas.

Group Assignment:

- Debate-style presentations: To help students synthesize and extend their knowledge of course materials, as well as become familiar with the nutrition science literature and communication of that literature in the mass media, students will be required to do an in-class, debate-style presentation summarizing their viewpoint (for or against) a current controversy in nutrition science. You will have the opportunity to rank order your topic choice; teams will be assigned by the Instructor/TA and posted on Canvas. The debate will start with a 20-minute presentation by each team (team 1: ‘pro’ talk for 10 minutes; team 2: ‘con’ talk for 10 minutes), followed by 15-20-minutes of debate. The Instructor or TA will act as Moderator. The Grading Rubric will be available on Canvas.

Instructions for Submission of Assignments and Exams: Assignments should be submitted via Canvas. If Canvas is not operational, the assignment should be emailed to the course Instructor and TA prior to the assignment deadline. Students who are unable to complete an assignment or exam on time and need to request an extension, please notify the Instructor by email prior to the deadline. You will need to provide a brief explanation for why the extension is needed. Assignments received after the deadlines without approved extensions are subject to an automatic 10% reduction in credit per day.
Assessment and Grading: The contribution of course activities to the course grade is found in the table below:

<table>
<thead>
<tr>
<th>Activity (number during the course, % contribution per each)</th>
<th>Contribution to final grade (%)</th>
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<tbody>
<tr>
<td>Exams (2, 20% each)</td>
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<tr>
<td>Diet Review Project (1, 25%)</td>
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<td>Debate-style presentation (1, 15%)</td>
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<td>Diet Analysis Project (1, 10%)</td>
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<td>Class attendance and engagement in class discussions/debates</td>
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Accommodation of Disabilities:
Tufts University is committed to providing equal access and support to all students through the provision of reasonable accommodations so that each student may access their curricula and achieve their personal and academic potential. If you have a disability that requires reasonable accommodations please contact the Friedman School Assistant Dean of Student Affairs at 617-636-6719 to make arrangements for determination of appropriate accommodations. Please be aware that accommodations cannot be enacted retroactively, making timeliness a critical aspect for their provision.

*Tufts University values the diversity of our students, staff, and faculty; recognizing the important contribution each student makes to our unique community. Furthermore, inclusion and diversity are highly valued at the Friedman School and are promoted values within our community. My goal for this course is to create a safe learning environment whereby our collective expertise is respected and everyone can feel open to expressing their ideas, opinions and questions. Please know that I have an open door policy; please do not hesitate to reach out to myself or the TA at any time if your needs are not being met.*
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<td>1</td>
<td>Jan 23* (Wed)</td>
<td>Dental School, Rm 1414**</td>
<td>Foundations, Concept Review and Course Introduction</td>
<td>Hennessy</td>
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<td>Conducting a literature review</td>
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<td>Energy Foundation: Basics of Energy Metabolism and Factors Influencing Energy Metabolism</td>
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<td>3</td>
<td>Feb 4</td>
<td>Sackler 507</td>
<td>Energy Expenditure; Under- and Over-nutrition</td>
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<td>Feb 11</td>
<td>Dental School, Rm 1414**</td>
<td>Neurobiology of Food Reward and Addiction</td>
<td>Pothos</td>
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<td>Feb 25</td>
<td>Sackler 507</td>
<td>Introduction to the Microbiota</td>
<td>Rowan</td>
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<td>Dental School, Rm 1414**</td>
<td>Glycemic Index</td>
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<td>Mar 18</td>
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<td>Diet Review Paper: Rough Draft</td>
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<td>9</td>
<td>Mar 25</td>
<td>Sackler 507</td>
<td>Health Effects of Fat Intake: The Good, The Bad, and The Ugly</td>
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<td>Apr 8</td>
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<td>Protein and Amino Acids Foundations: Structure, Function, Digestion, Absorption</td>
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<td>Diet Analysis Project</td>
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<td>Apr 22</td>
<td>Sackler 507</td>
<td>Protein Requirements, Protein-related Health Conditions and Outcomes</td>
<td>Hennessy &amp; Cohen</td>
<td>Debate (Group F)</td>
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<td>13</td>
<td>Apr 29</td>
<td>Sackler 507</td>
<td>Alcohol &amp; Semester Wrap-Up</td>
<td>Hennessy</td>
<td>Debate (Group G)</td>
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<td>May 6</td>
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<td>Take Home Exam 2 – Lipids, Proteins</td>
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<td>Diet Review Paper: Final</td>
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*Note: Substitute Monday’s schedule on Thursday*
COURSE TOPICS, LEARNING OBJECTIVES AND ASSIGNMENTS

INTRODUCTION

Week 1: Foundations, Concept Review and Course Introduction

Learning objectives:
- Describe the characteristics of a healthy diet
- Summarize and know the principles of the Dietary Reference Intakes (DRIs) for Macronutrients, how they are determined
- Discuss the macronutrient information provided on the Nutrition Facts Panel
- Explain the purpose of the Dietary Guidelines for Americans
- Describe the physiological processes of digestion and absorption
- Identify the enzymes and hormones that act in digestion

Required reading:
- Wardlaw, Chapter 2 – Tools of a Healthy Diet
- Wardlaw, Chapter 4 – Digestion and Absorption
- 2015-2020 Dietary Guidelines for Americans – Executive Summary
- US Evidence-based Dietary Guidelines: The History and the Process
- The new Nutrition Facts Label

Recommended reading:
- Gropper, Chapter 2 – The Digestive System

ENERGY SECTION

Week 2: Energy Foundation: Basics of Energy Metabolism and Factors Influencing Energy Metabolism

Learning objectives:
- Define energy
- Understand the effect of age and gender on energy metabolism
- Describe the basics of energy metabolism and how diet influences energy metabolism
- Identify hormones that influence energy expenditure

Required reading:
- Wardlaw, Chapter 9
- Ross, Chapter 5, Energy Needs: Assessments and Requirements

Recommended reading:
- Khan Academy, Basics of Metabolism
- Additional videos on Canvas
- Gropper, Chapter 1 – The Cell, Biological Energy section (pp17-24)
- Gropper, Chapter 7 – Integration and Regulation of Metabolism
Week 3: Energy Expenditure; Under- and Over-nutrition

Learning objectives:
• Define key concepts such as under-nutrition, over-nutrition, energy balance; discuss changes in energy balance affect body weight
• Discuss the different components of total energy expenditure; describe the major components of ‘energy in’ and ‘energy out’
• Understand issues and controversies related to under-nutrition, over-nutrition, energy balance such as obesity and caloric restriction

Required reading:
• Wardlaw, Chapter 10 – Energy Balance and Weight Management (except Eating Disorders)
• Ross, Energy Needs: Assessment and Requirements

Recommended reading:
• Gropper, Chapter 8 – Energy Expenditure

Week 4: Neurobiology of Food Reward and Addiction

Learning objectives:
• Describe how the Central Nervous System influences the regulation of food intake
• Understand the difference between homeostatic and non-homeostatic control of energy
• Identify the neurotransmitters involved in appetite regulation and in non-homeostatic control of energy
• Describe the communication between the gut and the brain in control of appetite

Required reading:
• Wardlaw, Chapter 9 – Energy Metabolism

CARBOHYDRATE SECTION

Week 5: Carbohydrate Foundations: Structure, Function, Digestion, Absorption and Metabolism

Learning objectives:
• Describe the structure, classification, function, digestion, absorption of carbohydrates
• Summarize carbohydrate metabolism
• Recognize the different transporters involved in carbohydrate absorption and cellular uptake
• Identify food sources of different types of carbohydrates
Required reading:
- Wardlaw, Chapter 5 – Carbohydrates
- Ross – Carbohydrates

Recommended reading:
- Gropper, Chapter 3 - Carbohydrates

Week 6: Introduction to the Microbiota; Fiber

Learning objectives:
- Summarize what is known about the composition and function of microbiota and its role in metabolism
- Describe the definition and classification of different types of fiber
- Identify food sources of fiber
- Summarize the physiological effects of fiber on energy regulation, CVD, insulin resistance and colon cancer

Required reading:
- Wardlaw, Chapter 5
- Ross – Fiber
- Komaroff AL. 2016. The Microbiome and Risk for Obesity and Diabetes. JAMA.

Recommended reading:
- Gropper, Chapter 6 – Fiber

Week 7: Carbohydrate Needs and Disorders

Learning objectives:
- Understand the concept of glycemic index and glycemic load
- Summarize recommended intakes of carbohydrates
- Describe life stages or situations in which needs change

Required reading:
- Wardlaw, Chapter 5

LIPIDS SECTION

Week 8: Lipid Foundations: Structure, Function, Digestion, Absorption
Learning objectives:
- Describe the structure of saturated, monounsaturated, polyunsaturated fatty acids and identify the fatty acids that are considered essential
- Identify the lipid and apolipoprotein composition of different lipoproteins
- Describe how dietary fat digestion and absorption occurs and how lipids are delivered to target tissues
- Describe the structure of triglycerides and phospholipids and explain their biological significance
- Explain the digestion and absorption of dietary fat, including bile

Required reading:
- Wardlaw, Chapter 6 – Lipids
- Ross – Lipids, Sterols, and Their Metabolites

Recommended reading:
- Gropper, Chapter 5 – Lipids

**Week 9: Health Effects of Fat Intake: The Good, The Bad, and The Ugly**

Learning objectives:
- Identify the essential fatty acid structure, pathways of eicosanoid biosynthesis, and role in inflammation
- Describe the role of long chain PUFAs in brain development and cognition
- Summarize the relationship between fat and cardiovascular disease
- Identify food sources and recommend intakes of all lipid classes, including trans fatty acids

Required reading:
- Wardlaw, Chapter 6 – Lipids
- Ross – Lipids, Sterols, and Their Metabolites
- Sacks et al. 2017, Dietary Fats and Cardiovascular Disease: A Presidential Advisory from the American Heart Association.

**Week 10: Lipid Metabolism**

Learning objectives:
- Identify exogenous, endogenous pathways of lipid metabolism
- Describe the regulation of LDL metabolism
- Summarize the role of cholesterol in human nutrition
- Describe how triglyceride metabolism is regulated during feeding and fasting

Required reading:
- Wardlaw, Chapter 6 – Lipids
- Ross – Lipids, Sterols, and Their Metabolites
PROTEINS/AMINO ACIDS (...and alcohol) SECTION

Week 11: Protein and Amino Acids Foundations: Structure, Function, Digestion, Absorption, etc.

Learning objectives:
- Describe the chemical structure of amino acids and understand protein structure and organization
- Describe the function of protein in the body
- Identify the AA that are essential in the diet
- Summarize protein digestion and absorption, and transport of AA
- Learn how the metabolism of AA serving as precursors of neurotransmitters; how AA are transported into the brain and their role in cognition

Required reading:
- Wardlaw, Chapter 7 – Proteins
- Ross, Chapter 1 – Proteins and Amino Acids

Recommended reading:
- Gropper, Chapter 6 - Protein

Week 12: Protein Requirements and Protein-related Health Conditions and Outcomes

Learning objectives:
- Describe the protein contents in the major food groups
- Explain the different between high-quality and lower-quality proteins and the concept of limiting amino acid
- Broadly discuss protein requirements across life stages
- Identify and compare methods used to determine human protein requirements
- Describe the types of Protein-Energy Malnutrition (PEM)
- Identify the different types of common food protein allergies (e.g. Wheat/Celiac Disease), their symptoms and treatment options

Required reading:
- Wardlaw, Chapter 7 – Proteins
- Ross – Proteins and Amino Acids

Week 13: Alcohol

Learning objectives:
- Define moderate alcohol consumption and ‘one drink’ when referring to an alcoholic beverage
- Describe the process of alcohol absorption and metabolism
- Identify the health implications of alcohol consumption

Required reading:
• Wardlaw, Chapter 8 – Alcohol
• Ross – Nutrition in Liver Disorders and the Role of Alcohol

Recommended reading:
• Risk thresholds for alcohol consumption, The Lancet, 2018