

## Term Information

Effective Term Spring 2023  
[Previous Value](#) Autumn 2018

## Course Change Information

### What change is being proposed? (If more than one, what changes are being proposed?)

This course is being restructured. Changes to the subject area, course title, course description, credit hours, course goals, and content topics are being proposed.

### What is the rationale for the proposed change(s)?

This course is being restructured to be part of the Sustainability Theme as an Interdisciplinary Team Taught Course. As a result, changes to the subject area, course title, credit hours, course topics, and learning outcomes are being proposed.

### What are the programmatic implications of the proposed change(s)?

(e.g. program requirements to be added or removed, changes to be made in available resources, effect on other programs that use the course)?

The change to credit hours may affect the FABE program.

Is approval of the request contingent upon the approval of other course or curricular program request? Yes

Please identify the pending request and explain its relationship to the proposed changes(s) for this course (e.g. cross listed courses, new or revised program)

The course is cross-listed with FST; they are processing their course change request. The course is also a required course for the new FST program curriculum, which will be submitted in November.

Is this a request to withdraw the course? No

## General Information

Course Bulletin Listing/Subject Area <a href="#">Previous Value</a>	Food, Agricul & Bio Engineer <a href="#">Agricultural Systems Mgmt</a>
Fiscal Unit/Academic Org	Food, Agric & Biological Eng - D1123
College/Academic Group	Food, Agric & Environ Science
Level/Career	Undergraduate
Course Number/Catalog	3400
Course Title <a href="#">Previous Value</a>	Sustainability of the Food Supply Chain <a href="#">Food Supply-Chain Equipment Operations</a>
Transcript Abbreviation <a href="#">Previous Value</a>	Sustain Food Supp <a href="#">Food Chain Eq Op</a>
Course Description  <a href="#">Previous Value</a>	Sustainability of the food supply chain depends on the efficiency of transforming raw food materials into consumer food products. This course introduces key operations in each sector of the supply chain along with sustainability parameters, focusing on energy, water, and waste. Students will recognize the challenges of maintaining a sustainable food supply while minimizing environmental impact.  <i>The focus of this course is description of equipment used throughout the food supply chain from harvest/assembly to preparation for consumption. After completing this course, students will recognize how equipment systems are assembled within a facility and the role of sensing and control systems in operation of facilities for handling, manufacturing, storage, distribution and preparation of foods.</i>
Semester Credit Hours/Units <a href="#">Previous Value</a>	Fixed: 3 <a href="#">Fixed: 2</a>

## Offering Information

Length Of Course	14 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Laboratory, Lecture
<a href="#">Previous Value</a>	<a href="#">Lecture, Recitation</a>
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
<a href="#">Previous Value</a>	<a href="#">Sometimes</a>
Campus of Offering	Columbus, Lima, Mansfield, Marion, Newark, Wooster
<a href="#">Previous Value</a>	<a href="#">Columbus</a>

## Prerequisites and Exclusions

Prerequisites/Corequisites	
Exclusions	Not open to students with credit for FDSCTE 3400
<a href="#">Previous Value</a>	
Electronically Enforced	Yes
<a href="#">Previous Value</a>	<b>No</b>

## Cross-Listings

Cross-Listings	FDSCTE 3400
<a href="#">Previous Value</a>	<a href="#">Cross-listed in FdScTe.</a>

## Subject/CIP Code

Subject/CIP Code	14.0301
<a href="#">Previous Value</a>	<a href="#">01.1001</a>
Subsidy Level	Baccalaureate Course
Intended Rank	Sophomore, Junior, Senior

## Requirement/Elective Designation

Sustainability

The course is an elective (for this or other units) or is a service course for other units

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[The course is an elective \(for this or other units\) or is a service course for other units](#)

## Course Details

**Course goals or learning objectives/outcomes**

- Recognize critical operations within the food supply system for handling, preservation, storage, transportation, and preparation of safe and high-quality foods.
- Understand and interpret the quantitative measures of sustainability as defined in Life-Cycle-Assessment (LCA) and applied to the food supply system.
- Gain experience with the interpretation of sustainability parameters for food products, as influenced by specific operations or sector of the food supply system.
- Recognize the importance of energy efficiency, water reclamation, and food waste management to sustainability of a safe and high-quality food supply.

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- *Gain recognition of major equipment systems required for safe and sanitary handling, preservation, storage and transport of foods between harvest or assembly and final preparation for consumption.*
- *Understand the operating mechanisms of primary equipment systems used in the transformation of raw food materials into safe and high-quality food products.*
- *Develop an understanding of the equipment systems needed and the configuration of equipment components needed to manufacture consumer food products.*
- *Appreciate the importance of sensors, instrumentation and control systems required for efficient operation of facilities for transport, storage, manufacture and distribute high-quality and safe food products.*
- *Understand the importance of sanitary design of all food contact surfaces in equipment used throughout the food supply chain.*

**Content Topic List**

- Introduction to the food supply system.
- The role of preservation in a sustainable food supply system.
- An introduction to sustainability parameters; use of Life-Cycle Assessment (LCA) to quantify impacts of industrial operations on natural resource and the environment.
- The role of sanitation in the food supply system; the importance of sanitary design of food contact surfaces. The role of regulatory agencies in ensuring a safe food supply.
- Handling and storage operations for raw food materials and ingredients; the use of water for washing of fruits and vegetables prior to fresh produce marketing.
- The role of refrigeration in the food supply system; maintaining food quality and extending the shelf-life of food products.
- The role of heat exchangers in ensuring maximum thermal energy efficiency, including description of typical heat exchangers (conduction, convection, radiation, microwave) used throughout the food supply system.
- The use of thermal energy for preservation and preparation of food; extending shelf-life of a product by elevating the temperature to inactivate spoilage microorganisms and pathogens.
- The frozen food supply system; the operations required to remove thermal energy from food during the manufacturing of frozen foods, the energy requirements for transportation and low-temperature storage of a frozen food, including storage in the home
- The concentration and drying of food products and ingredients; the removal of water to reduce volume for storage and distribution of the product or ingredient.
- The manufacturing of liquid food ingredients; an introduction to the operations used for mechanical separation and the membrane technologies for refined separation for liquid food ingredients.
- The operations involving the extraction of food ingredients from solid raw materials; the grinding of grain for flour manufacturing; the extraction of oil from oil seeds.
- The packaging and containers used for food products and ingredients throughout the food supply system; packaging/container materials for liquid and solid foods.
- Cleaning and sanitation throughout the food supply system; an introduction to the materials and operations required to ensure a safe food supply.
- Cleaning and sanitation equipment; presentation of key components of cleaning systems for food contact surfaces; introduction to control systems for ensuring that in-place cleaning is accomplished in an efficient and effective manner.

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- *Intro to the food supply chain; understanding the scope of the supply chain and the important role of equipment in meeting the demands of converting raw food materials into safe, high quality consumer products in an effective and efficient manner.*
- *Basic principles of equipment design to ensure that food contact surfaces meet industry standard; both voluntary (3A, etc.) and from regulatory agencies. Understanding that sanitary design applies to facilities as well as equipment.*
- *Materials handling equipment for raw food materials; washing fruits and vegetables in the field, bulk transportation of liquids (including pumps for liquid transport), slaughter house equipment for meat products, drying, storage and grain handling.*
- *Heat exchanges; a descriptive review of heat exchangers used throughout the food supply chain; from refrigeration condensers to plate heat exchangers for liquids to heating/cooling of solid foods (convection, microwave, infrared) to cooking in oil.*
- *Refrigeration; an introduction to the primary components of refrigeration systems, with emphasis on recognizing system components in large scale systems for refrigerated warehouses as well as appliances in the kitchen or food service establishments.*
- *Equipment for food preservation and preparation, including blanching solid materials, pasteurization of liquid foods, UHT for aseptic products and retorts for canned foods; including an intro to equipment for non-thermal preservation methods.*
- *Food freezing and frozen food storage; a review of food freezing equipment, from continuous freezing systems to IQF using cryogenic refrigerants to cold air blast tunnels to plate freezers and other methods used to accelerate freezing of foods.*
- *Concentration of liquid foods; a description of thermal evaporation systems, from single- effect evaporators to multiple-effect systems for efficient removal of water and concentration of product solids; an intro to non-thermal concentration methods.*
- *Separation and mixing systems; a description of various types of equipment used to separate liquid foods into components, from milk separators to membrane systems for separation; equipment for mixing, blending and agitation of liquids.*
- *Food dehydration; a review of the range of drying systems used for food products, from basic cabinet dryers to spray dryers for liquid foods. Equipment used for manufacturing of bakery products will be presented and described.*
- *Extraction equipment; an array of different types of equipment used for extraction of components from food materials will be described; including grinding steps for flour products and extraction of oil from oil seeds.*
- *Extrusion equipment; description of various types of extrusion equipment, from single-screw to double-screw; and with an emphasis on understanding the role of the equipment on characteristics of products produced.*
- *Packaging equipment; a review of the range of filling equipment used for liquid foods and for placement of solid food in containers; specific attention to the unique requirements for aseptic filling and similar systems.*
- *Storage and distribution; a review of materials handling equipment for shelf-stable foods during transportation and distribution, including unique types of transportation vehicles and materials handling in warehouses.*
- *Cleaning and sanitation equipment; presentation of key components of cleaning systems for food contact surfaces; introduction to control systems for ensuring that in-place cleaning is accomplished in an efficient and effective manner.*

**Sought Concurrence**

Yes

Previous Value

No

## Attachments

- ASC\_Ohio\_State\_Course\_Review\_Concurrence\_Form - FDSCTE 3400 signed.pdf: ASC Concurrence  
*(Concurrence. Owner: Heldman, Dennis Ray)*
- FW\_Concurrence Request for FDSCTE 3400.pdf: Concurrence  
*(Concurrence. Owner: Heldman, Dennis Ray)*
- FW\_Concurrence Request for FDSCTE 3400\_2.pdf: Concurrence  
*(Concurrence. Owner: Heldman, Dennis Ray)*
- SENR\_Ohio\_State\_Course\_Review\_Concurrence\_Form\_SENR.pdf: SENR Concurrence  
*(Concurrence. Owner: Heldman, Dennis Ray)*
- RE\_Concurrence Requested for Course Change - FDSCTE 3400, Sustainability of the Food Supply Chain.pdf: FCB Concurrence  
*(Concurrence. Owner: Heldman, Dennis Ray)*
- 3400 submission-sustainability\_1-17-22.pdf: Sustainability Theme  
*(Other Supporting Documentation. Owner: Heldman, Dennis Ray)*
- FDSCTE-FABE 3400 Responses to ASC Panel Recommendations\_9-7.docx: Cover Letter  
*(Other Supporting Documentation. Owner: Heldman, Dennis Ray)*
- FDSCTE3400SustainabilitySyllFinal\_9-7-2022.docx: Syllabus  
*(Syllabus. Owner: Heldman, Dennis Ray)*

## Comments

- Revised as per Panel feedback email sent 9/12/2022 *(by Heldman, Dennis Ray on 09/12/2022 11:41 AM)*
- Minor fix to syllabus

Revise as per COAA via email message 21 February 2022

Revise as per email message 22 November 2021 *(by Osborne, Jeanne Marie on 09/09/2022 05:24 PM)*

- Please see Panel feedback e-mail sent 09/02/22. *(by Cody, Emily Kathryn on 09/02/2022 04:33 AM)*
- Please see Panel feedback email sent 05/17/2022. *(by Hilty, Michael on 05/17/2022 04:39 PM)*
- Note: This course is an elective or service course for all units except FST.

Jeanne: Please advise if this course with FABE number needs an ad-hoc approver from CoE. *(by Chen, Qian on 11/19/2021 05:47 PM)*

**COURSE CHANGE REQUEST**  
3400 - Status: PENDING

Last Updated: Osborne, Jeanne Marie  
09/13/2022

**Workflow Information**

Status	User(s)	Date/Time	Step
Submitted	Heldman, Dennis Ray	11/17/2021 11:38 AM	Submitted for Approval
Approved	Chen, Qian	11/19/2021 05:47 PM	Unit Approval
Revision Requested	Osborne, Jeanne Marie	11/22/2021 09:34 AM	College Approval
Submitted	Heldman, Dennis Ray	01/12/2022 01:15 PM	Submitted for Approval
Approved	Chen, Qian	01/13/2022 01:03 AM	Unit Approval
Revision Requested	Quinzon-Bonello, Rosario	01/18/2022 09:55 AM	Ad-Hoc Approval
Submitted	Heldman, Dennis Ray	01/19/2022 10:54 AM	Submitted for Approval
Approved	Chen, Qian	01/20/2022 04:13 AM	Unit Approval
Approved	Quinzon-Bonello, Rosario	02/24/2022 08:36 AM	Ad-Hoc Approval
Revision Requested	Osborne, Jeanne Marie	02/24/2022 12:04 PM	College Approval
Submitted	Heldman, Dennis Ray	02/25/2022 08:21 AM	Submitted for Approval
Approved	Chen, Qian	02/25/2022 11:47 AM	Unit Approval
Approved	Quinzon-Bonello, Rosario	02/25/2022 12:35 PM	Ad-Hoc Approval
Approved	Osborne, Jeanne Marie	02/28/2022 12:03 PM	College Approval
Revision Requested	Hilty, Michael	05/17/2022 04:39 PM	ASCCAO Approval
Submitted	Heldman, Dennis Ray	05/20/2022 04:57 PM	Submitted for Approval
Approved	Chen, Qian	05/21/2022 12:24 PM	Unit Approval
Approved	Quinzon-Bonello, Rosario	05/23/2022 10:27 AM	Ad-Hoc Approval
Approved	Osborne, Jeanne Marie	05/23/2022 11:38 AM	College Approval
Revision Requested	Cody, Emily Kathryn	09/02/2022 04:33 AM	ASCCAO Approval
Submitted	Heldman, Dennis Ray	09/09/2022 04:53 PM	Submitted for Approval
Revision Requested	Osborne, Jeanne Marie	09/09/2022 05:24 PM	Unit Approval
Submitted	Heldman, Dennis Ray	09/12/2022 11:42 AM	Submitted for Approval
Approved	Chen, Qian	09/12/2022 12:30 PM	Unit Approval
Approved	Quinzon-Bonello, Rosario	09/12/2022 03:09 PM	Ad-Hoc Approval
Approved	Osborne, Jeanne Marie	09/13/2022 09:38 AM	College Approval
Pending Approval	Cody, Emily Kathryn Jenkins, Mary Ellen Bigler Hanlin, Deborah Kay Hilty, Michael Vankeerbergen, Bernadette Chantal Steele, Rachel Lea	09/13/2022 09:38 AM	ASCCAO Approval

September 7, 2022

Dear ASC Curriculum Committee,

We thank the Themes Panel of the ASC Curriculum Committee for reviewing FDSCTE/FABE 3400 – Sustainability of the Food Supply System. The panel listed one item that they would like us to address. Below we list the actions (**shown in green font**) that we took to address this concern.

Based on the panel's recommendations, we revised the syllabus for FDSCTE/FABE 3400. We believe that we have adequately addressed all the committee's feedback with this syllabus update. If the committee has additional concerns or questions, please let us know so we can keep working on these items until the committee is fully satisfied.

Sincerely,

Department of Food Science and Technology

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Good morning,

On Thursday, August 11, the Themes Panel of the ASC Curriculum Committee reviewed a new High-Impact Practice: Interdisciplinary Team-Teaching request for Food Science and Technology & FABE 3400. Please see below for the Panel's feedback.

Food Science and Technology & FABE 3400 was not voted on for High-Impact Practice: Interdisciplinary Team-Teaching as the Panel would like the following feedback items addressed:

- The reviewing faculty would like to extend their appreciation and thanks for the submitted revision of Food Science and Technology & FABE 3400. They approve of this course for the GE Theme: Sustainability but do not approve of the revision for the High-Impact Practice: Interdisciplinary Team-Teaching. As an option, the reviewing faculty offer the opportunity to submit the course as a three-credit hour GE Theme: Sustainability course, scaled to meet the standards for a three-credit hour course, which will be reviewed by the Panel Chair. Please see below for additional feedback regarding the High-Impact Practice: Interdisciplinary Team-Teaching portion of the revision, should you wish to submit a revision for that.
  - **We chose to revise the syllabus and resubmit this course as a 3-credit hour Sustainability course. We accordingly revised the syllabus, including removing one 120-minute lab session each week to scale the credit hours appropriately. We removed the Faculty Team and Expertise section since the course will no longer be considered for HIP: Interdisciplinary Team-Teaching.**
- The reviewing faculty are unable to see how the instructors co-teaching the course will engage in Interdisciplinary Team-Teaching as defined by the High-Impact Practice forms created by the Office of Academic Affairs (see here: <https://oaa.osu.edu/sites/default/files/uploads/general-education-review/new-ge/interdisciplinary-team-courses-description-expectations.pdf>). While they acknowledge that the course is being co-taught, in order to count within the



Interdisciplinary Team-Teaching category, a course must establish that an interdisciplinary co-teaching style will be developed and introduced, as defined by the Office of Academic Affairs. For example:

- “In multidisciplinary courses, faculty present their individual perspectives one after another, leaving differences in underlying assumptions unexamined and integration up to the students. In interdisciplinary courses, whether taught by teams or individuals, faculty interact in designing a course, bringing to light and examining underlying assumptions and modifying their perspectives in the process. They also make a concerted effort to work with students in crafting an integrated synthesis of the separate parts that provides a larger, more holistic understanding of the question, problem or issue at hand. Smith’s iron law bears repeating: ‘Students shall not be expected to integrate anything the faculty can’t or won’t’ (quoted in Gaff, 1980, pp. 54-55). (Klein & Newall, 12).”
- “A team-taught course requires that two or more faculty from different disciplines, programs or departments develop and offer a course together. Team-taught courses must be taught collaboratively by faculty who integrate distinctly separate disciplines, model interdisciplinary academic exchange, and demonstrate the interdisciplinary nature of the course. This includes explicitly synthesizing across and between the disciplines that each instructor brings to the team-taught, interdisciplinary course.”
- “Teaching partners are expected to collaborate on defining the objectives for the course, putting together the course materials, conducting the formal instruction of students, and evaluating student performance. Note that courses in which one faculty member of record convenes the course and invites one or more guest speakers to take part in the class are not considered team-taught courses.”
- We chose to revise the syllabus and resubmit this course as a 3-credit hour Sustainability course.
- The reviewing faculty request a cover letter that details all changes made in response to this feedback.
  - Cover letter provided herein.

# Sustainability of the Food Supply Chain: Syllabus

FDSCTE/FABE 3400 Spring 2023

## Course Information

- **Course times and location:** Two 55-min lectures; one 2-hr laboratory session
- **Credit hours:** 3
- **Mode of delivery:** In person

## Instructors

Department of Food Science & Technology:

Dennis R. Heldman  
Email: [heldman.20@osu.edu](mailto:heldman.20@osu.edu)  
Phone: 614-292-5899  
229 Parker Food Science and Technology Building  
Office hours: TBD

Valente Alvarez  
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Rafael Jimenez-Flores  
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Department of Food, Agricultural and Biological Engineering:

Ajay Shah  
Email: [shah.971@osu.edu](mailto:shah.971@osu.edu)  
Phone: 330-263-3858  
110 FABE  
Office hours: TBD

- **Preferred contact method:** First contact with any instructor should be at Ohio State email address. Student will receive a response within **24 hours**.



## Teaching Assistant

- TBD

## Course Prerequisites

None

## Course Description

Sustainability of the food supply chain depends on the efficiency of transforming raw food materials into consumer food products. This course introduces key operations in each sector of the supply chain along with sustainability parameters, focusing on energy, water, and waste. Students will recognize the challenges of maintaining a sustainable food supply while minimizing environmental impact.

## Learning Outcomes

On completion of this course, students will:

- Recognize critical operations within the food supply chain for handling, preservation, storage, transportation, and preparation of safe and high-quality foods.
- Understand and interpret the quantitative measures of sustainability as defined in Life-Cycle-Assessment (LCA) and applied to the food supply chain.
- Gain experience with the interpretation of sustainability parameters for food products, as influenced by specific operations or sector of the food supply chain.
- Recognize the importance of energy efficiency, water reclamation, and food waste management to sustainability of a safe and high-quality food chain.

## General Education Expected Learning Outcomes

As part of the Sustainability theme of the General Education curriculum, this course is designed to prepare students to:

**Goal 1: Successful students will analyze sustainability at a more advanced and in-depth level than in the Foundations component.**

ELO 1.1 Engage in critical and logical thinking about the topic or idea of sustainability.

ELO 1.2 Engage in an advanced, in-depth, scholarly exploration of the topic or idea of sustainability.

**Goal 2: Successful students will integrate approaches to sustainability by making connections to out-of-classroom experiences with academic knowledge or across disciplines and/or to work they have done in previous classes and that they anticipate doing in future.**



2.1 Identify, describe, and synthesize approaches or experiences as they apply to sustainability.

2.2 Demonstrate a developing sense of self as a learner through reflection, self-assessment and creative work, building on prior experiences to respond to new and challenging contexts.

**Goal 3: Successful students will analyze and explain how social and natural systems function, interact and evolve over time; how human well-being depends on these interactions; how actions have impacts on subsequent generations and societies globally; and how human values, behaviors and institutions impact multifaceted potential solutions across time.**

3.1 Describe elements of the fundamental dependence of humans on Earth and environmental systems, and on the resilience of these systems.

3.2 Describe, analyze and critique the roles and impacts of human activity and technology on both human society and the natural world, in the past, present and future.

3.3 Devise informed and meaningful responses to problems and arguments in the area of sustainability based on the interpretation of appropriate evidence and an explicit statement of values.

This course fulfills the General Education learning objectives for the Sustainability Theme by:

- Engaging in critical and logical thinking about the topic of sustainability through a series of lectures, discussions, assignments, and reports with a focus on sustainability and the food supply. The first two assignments and reports will require the students to study and understand the food supply chain, and the role of food production, preservation, packaging, storage, distribution, retail marketing, and final preparation in delivery of safe and high-quality food products to consumers.
- Engaging in an advanced, in-depth, and scholarly exploration through a semester-long study of the specific operations, processes, and equipment required to manufacture and deliver a specific food product selected by the student.
- Identifying, describing, and synthesizing approaches or experiences as the student develops sustainability metrics to the food product selected. A series of exercises will be completed leading to quantification of the total sustainability metric for the product, as well as the contribution of each operation and process.
- Demonstrating a developing sense of self as a learner through reflection, self-assessment, and creative work, building on prior experiences to respond to new and challenging contexts. Throughout the semester project, students will be provided with opportunities to interact with other students to share observations about the operations and processes for their specific food product and learn about the differences in operations and processes for other products. These exchanges will include comparisons of the sustainability metrics and the contribution of specific operations and processes to the total sustainability metric for each food product. These interactions will allow students to build on their knowledge throughout the semester.
- Describing elements of the fundamental dependence of humans on Earth and environmental systems, and on the resilience of these systems through early lectures



and discussions emphasizing the demand for food by an increasing world population and the decreasing supply of natural resources needed to sustain the supply of food, along with the impacts of sustaining the food supply on quality of the environment.

- Describing, analyzing, and critiquing the roles and impacts of human activity and technology on both human society and the natural world through an evaluation of the delicate balance between an adequate food supply for a growing population and the natural resources required to meet these demands in the future.
- Devising informed and meaningful responses to problems and arguments in sustainability based on the interpretation of appropriate evidence and an explicit statement of values. Knowledge gained will provide students with the understanding required to evaluate the sustainability metrics displayed on packages of food products. The experiences from the course will allow the student to make informed decisions about the selection of food products based on sustainability, as well as the other factors associated with the quality and safety of a food product.



# How This Course Works

**Mode of delivery:** This course is in person. Two lecture sessions per week will be delivered in person. One 120-min laboratory session will be scheduled each week.

**Credit hours and work expectations:** This is a 3-credit-hour course. According to [Ohio State bylaws on instruction](https://www.osu.edu/credit-hours) (go.osu.edu/credit hours), students should expect around 4 hours per week of time spent on direct instruction in lecture and laboratory sessions, in addition to 4 hours of homework to receive a grade of C average.

**Attendance and participation requirements:** The following are the expectations for students enrolled in this course:

- **Attend lectures and study materials presented**  
Students are expected to attend the lectures and study information presented during these two lectures each week.
- **Participate in the 120-min laboratory session each week.**  
Participation in the laboratory session will be critical to understanding concepts to be presented and discussed. Information presented during lectures and discussed during laboratory session will provide background for a report due on Monday of the following week.
- **If you are unable to attend** a lecture or laboratory session, please contact Dr. Heldman by email as soon as possible.



# Course Materials, Fees, and Technologies

## Required Materials and/or Technologies

All readings will be provided through Carmen. These reading materials will be utilized as background literature in the Weekly Reports. See the Course Schedule for additional details.

- Bevilacqua, M., M. Braglia, G. Carmignani and F.A. Zammori. 2007. Life cycle Assessment for pasta production in Italy. *J.Food Quality* 30(6), 932-952.
- Canning, P., Ainsley, C., Huang, S., Polenske, K.R., Walters, A., 2010. Energy use in the U.S. Food System. USDA-ERS Report #94. Washington, DC.
- Cacurachi, S., Scherer, L., Guinee, J., Tukker, A., 2019. Life cycle assessment of food systems. *One Earth*. 1(3), 292-297.
- Fellows, P.J. 2016. *Food Processing Technology; Principles and Practice*. Fourth Edition. Woodhead Publishing. ISBN: 9780081019078. 1152 pp.
- Gleick, Peter H., Palaniappan, M., 2010. Peak water limits to freshwater withdrawal and use. *Proceedings National Academy Science*. 107(25), 11155-11162.
- Heller, M.C., Koeleian, G.A., 2000. Life Cycle-Based Sustainability Indicators for Assessment of the U.S. Food System. The Center for Sustainable Systems, Report no. CSS00-04. University of Michigan.
- Heller, M.C., Koeleian, G.A., 2003. Assessing the sustainability of the U.S. food system: a life cycle perspective. *Agric. Syst.* 76, 1007-1041.
- Leib E.B., Gunders, D., 2013. The Dating Game: How Confusing Food Date Labels Lead to Food Waste in America. National Resources Defense Council. Washington, DC
- Lundie, S. Peters, G.M., 2005. Life cycle assessment of food waste management options. *J. of Cleaner Production*. 13(3), 275-286.
- McCarthy, D., Matopoulos, A., Davis, P., 2015. Life cycle assessment in the food supply chain: A case study. *Int Journal of Logistics: research and applications*. 18(2), 140-154.
- Mogensen, L., Hermansen, J., Halberg, N., Dalgaard, R., Vis, J., Smith, B. 2012. Life cycle assessment across the food supply chain. Chapter 5 (pp 115-144) in *Sustainability in the Food Industry* (Cheryl Baldwin, Editor). Wiley-Blackwell. ISBN:9780813808468.
- Morawicki, R.O. 2012. *Handbook of Sustainability in the Food Sciences*. John Wiley & Sons. Hoboken, NJ.



- National Research Council, 2015. *A Framework for Assessing Effects of the Food System*. Washington, DC: The National Academies Press.
- Ridoutt, B.G., Huang, J., 2012. Environmental relevance--the key to understanding water footprints. *Proc Natl Acad Sci U S A* 109, E1424.
- Ridoutt, B.G., Pfister, S., 2010. A revised approach to water foot-printing to make transparent the impacts of consumption and production on global freshwater scarcity. *Global Environ. Change*. 20(1), 113-120. (doi:10.1016/j.gloenvcha.2009.08.003)
- Tassou, Savvas A., 2014. Energy demand and reduction opportunities in the UK food chain. *Proceeding of the Institute of Civil Engineers – Energy*. 167(3), 162-170.
- Uhlin, Hans-Erik., 1997. Why Energy Productivity is Increasing: An I-O Analysis of Swedish Agriculture. *Agricultural Systems*. 56(4), 443-465.

## Required Equipment

- **Computer:** current Mac (MacOS) or PC (Windows 10) with high-speed internet connection.
- **Webcam:** built-in or external webcam, fully installed and tested
- **Microphone:** built-in laptop or tablet mic or external microphone
- **Other:** a mobile device (smartphone or tablet) to use for BuckeyePass authentication

If the student does not have access to the technologies, options for [technology and internet access](https://go.osu.edu/student-tech-access) (go.osu.edu/student-tech-access) should be considered.

## Required Software

**Microsoft Office 365:** All Ohio State students are now eligible for free Microsoft Office 365. Visit the [installing Office 365](https://go.osu.edu/office365help) (go.osu.edu/office365help) help article for full instructions.

## CarmenCanvas Access

Each student will need to use [BuckeyePass](https://buckeyepass.osu.edu) (buckeyepass.osu.edu) multi-factor authentication to access this course in Carmen. To ensure connection to Carmen, the following is recommended:

- Register multiple devices in case something happens to your primary device. Visit the [BuckeyePass - Adding a Device](https://go.osu.edu/add-device) (go.osu.edu/add-device) help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes, good for 365 days, that can each be used once.





- [Install the Duo Mobile application](https://go.osu.edu/install-duo) (go.osu.edu/install-duo) on all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If these options do not work, contact the IT Service Desk at [614-688-4357 \(HELP\)](tel:614-688-4357) and IT support staff will provide a solution.

## Technology Skills Needed for This Course

- Basic computer and web-browsing skills
- [Navigating CarmenCanvas](https://go.osu.edu/canvasstudent) (go.osu.edu/canvasstudent)
- [CarmenZoom virtual meetings](https://go.osu.edu/zoom-meetings) (go.osu.edu/zoom-meetings)
- [Recording a slide presentation with audio narration and recording, editing and uploading video](https://go.osu.edu/video-assignment-guide) (go.osu.edu/video-assignment-guide)

## Technology Support

For help with your password, university email, CarmenCanvas, or any other technology issues, questions or requests, contact the IT Service Desk, which offers 24-hour support, seven days a week.

- **Self Service and Chat:** [go.osu.edu/it](https://go.osu.edu/it)
- **Phone:** [614-688-4357 \(HELP\)](tel:614-688-4357)
- **Email:** [servicedesk@osu.edu](mailto:servicedesk@osu.edu)



# Grading and Faculty Response

## How Your Grade is Calculated

Assignment Category	Points
One report per week for 14 weeks (5 pts per report)	70
Seven quizzes; alternate weeks beginning in second week; two lowest quiz scores will be dropped.	15
Final examination	15
Total	100

See [Course Schedule](#) for due dates.

## Descriptions of Major Course Assignments

### Weekly Reports

**Description:** The significant assignments are short weekly reports submitted in Carmen on the Monday following a week of lectures and laboratories on the topic of the report. The topic for each assignment is identified in the Course Schedule. Since the objective of the weekly reports changes each week, a template for the weekly reports will be provided. The template will include a brief introduction, the objective of the assignment, brief description of background and information sources, an explanation and discussion of the topic, conclusions, and a list of research references. See the Course Schedule for additional details.

**Academic integrity and collaboration:** All written weekly reports must be the original work of the student.

### Quizzes

**Description:** Short quizzes will be given in class. Quizzes are scheduled on an alternate week basis. These 15-20 min quizzes will focus on information presented and discussed during previous week. The specific topics are identified in the Course Schedule.

**Academic integrity and collaboration:** All answers to quiz questions must be the original work of the student.

## Final Examination

**Description:** The final examination will take place in class during the assigned final examination time for this course. The exam will include questions based on information presented and discussed throughout the semester as identified in the Course Schedule.

**Academic integrity and collaboration:** All answers to examination questions must be the original work of the student.

## Late Assignments

Due dates for written reports are on Monday of every week beginning with the second week of the semester. In case of emergencies and other circumstances that prevent you from turning in an assignment on time, please contact Dr. Dennis Heldman as soon as possible by email. Official documentation (e.g., from a doctor's office or hospital or interviewer) must be provided. A penalty of 10% per day for late submission of weekly reports will be assessed up to one week; after 1 week late, the student will receive 0% for the assignment, unless a documented excuse is provided by the student.

## Instructor Feedback and Response Time

I am providing the following list to give you an idea of my intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

- **Preferred contact method:** First contact should be at Ohio State email address. Student will receive a response within **24 hours**.
- **Class announcements:** All important class-wide messages will be posted on the Announcements tool in CarmenCanvas.
- **Grading and feedback:** Grades for all assignments submitted before the due date will be posted within seven days. Additional feedback on assignment and grades will be arranged through an appointment. Assignments submitted after the due date may have reduced feedback and grades may take longer to be posted.

## Grading Scale

93–100: A  
 90–92.9: A-  
 87–89.9: B+  
 83–86.9: B  
 80–82.9: B-  
 77–79.9: C+

73–76.9: C  
 70–72.9: C-  
 67–69.9: D+  
 60–66.9: D  
 Below 60: E



# Other Course Policies

## Discussion and Communication Guidelines

- **Writing style:** Weekly reports should be written using good grammar, spelling, and punctuation.
- **Tone and civility:** Guidance for discussions on controversial topics will be provided during lecture sessions.
- **Cite sources:** References for information presented in weekly reports must be cited by using a complete reference or link.
- **Backing up documents:** Reports should be composed in a word processing program and saved before posting on the Carmen site.

## Academic Integrity Policy

See [Descriptions of Major Course Assignments](#) for specific guidelines about collaboration and academic integrity in the context of this class.

### Ohio State's Academic Integrity Policy

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's [Code of Student Conduct](#) ([studentconduct.osu.edu](http://studentconduct.osu.edu)), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

**If a student is suspected of committing academic misconduct, the instructor must (by university rules) report the misconduct to the Committee on Academic Misconduct.** If COAM confirms the violation, the university's Code of Student Conduct (i.e., committed



academic misconduct) results in sanctions for the misconduct could include a failing grade and suspension or dismissal from the university.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- [Committee on Academic Misconduct](http://go.osu.edu/coam) (go.osu.edu/coam)
- [Ten Suggestions for Preserving Academic Integrity](http://go.osu.edu/ten-suggestions) (go.osu.edu/ten-suggestions)
- [Eight Cardinal Rules of Academic Integrity](http://go.osu.edu/cardinal-rules) (go.osu.edu/cardinal-rules)

## Copyright for Instructional Materials

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

## Creating an Environment Free from Harassment, Discrimination, and Sexual Misconduct

The Ohio State University is committed to building and maintaining a community to reflect diversity and to improve opportunities for all. All Buckeyes have the right to be free from harassment, discrimination, and sexual misconduct. Ohio State does not discriminate on the basis of age, ancestry, color, disability, ethnicity, gender, gender identity or expression, genetic information, HIV/AIDS status, military status, national origin, pregnancy (childbirth, false pregnancy, termination of pregnancy, or recovery therefrom), race, religion, sex, sexual orientation, or protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment. Members of the university community also have the right to be free from all forms of sexual misconduct: sexual harassment, sexual assault, relationship violence, stalking, and sexual exploitation.

To report harassment, discrimination, sexual misconduct, or retaliation and/or seek confidential and non-confidential resources and supportive measures, contact the Office of Institutional Equity:

1. Online reporting form at [equity.osu.edu](http://equity.osu.edu),
2. Call 614-247-5838 or TTY 614-688-8605,
3. Or Email [equity@osu.edu](mailto:equity@osu.edu)

The university is committed to stopping sexual misconduct, preventing its recurrence, eliminating any hostile environment, and remedying its discriminatory effects. All university employees have reporting responsibilities to the Office of Institutional Equity to ensure the university can take appropriate action:

- All university employees, except those exempted by legal privilege of confidentiality or expressly identified as a confidential reporter, have an obligation to report incidents of sexual assault immediately.
- The following employees have an obligation to report all other forms of sexual misconduct as soon as practicable but at most within five workdays of becoming aware of such information: 1. Any human resource professional (HRP); 2. Anyone who supervises faculty, staff, students, or volunteers; 3. Chair/director; and 4. Faculty member."

## Diversity

The Ohio State University affirms the importance and value of diversity of people and ideas. We believe in creating equitable research opportunities for all students and to providing programs and curricula that allow our students to understand critical societal challenges from diverse perspectives and aspire to use research to promote sustainable solutions for all. We are committed to maintaining an inclusive community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among all members; and encourages each individual to strive to reach their own potential. The Ohio State University does not discriminate on the basis of age, ancestry, color, disability, gender identity or expression, genetic information, HIV/AIDS status, military status, national origin, race, religion, sex, gender, sexual orientation, pregnancy, protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment.

To learn more about diversity, equity, and inclusion and for opportunities to get involved, please visit:

- <https://odi.osu.edu/>
- <https://odi.osu.edu/racial-justice-resources>
- <https://odi.osu.edu/focus-on-racial-justice>
- <http://mcc.osu.edu/>

In addition, this course adheres to **The Principles of Community** adopted by the College of Food, Agricultural, and Environmental Sciences. These principles are located on the Carmen site for this course; and can also be found at <https://go.osu.edu/principlesofcommunity>. For additional information on Diversity, Equity, and Inclusion in CFAES, contact the CFAES Office for Diversity, Equity, and Inclusion (<https://equityandinclusion.cfaes.ohio-state.edu/>). If you have been a victim of or a witness to a bias incident, you can report it online and anonymously (if you choose) at <https://equity.osu.edu/>.

## Your Mental Health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing.

If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting [ccs.osu.edu](http://ccs.osu.edu) or calling 614-292-5766. CCS is located on the 4th floor of the Younkin Success Center and 10th floor of Lincoln Tower. You can reach an on-call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

For students in the College of Food, Agricultural, and Environmental Sciences, David Wirt, [wirt.9@osu.edu](mailto:wirt.9@osu.edu), is the CFAES embedded mental health counselor on the Columbus campus. To contact David, please call 614-292-5766. Students should mention their affiliation with CFAES if interested in speaking directly with David.

# Accessibility Accommodations for Students with Disabilities

## Requesting Accommodations

The university strives to make all learning experiences as accessible as possible. If academic barriers based on your disability including mental health, chronic or temporary medical conditions are experienced, the course instructors should be contacted immediately so options can be discussed. To establish reasonable accommodations, students should register with [Student Life Disability Services \(SLDS\)](#). After registration, students should meet with instructors as soon as possible to discuss accommodations and implementation in a timely manner.

## Disability Services Contact Information

- Phone: [614-292-3307](tel:614-292-3307)
- Website: [slds.osu.edu](http://slds.osu.edu)
- Email: [slds@osu.edu](mailto:slds@osu.edu)
- In person: [Baker Hall 098, 113 W. 12th Avenue](#)

## Accessibility of Course Technology

Online portions of this course requires use of CarmenCanvas (Ohio State's learning management system) and other online communication and multimedia tools. If additional services are needed, students should request accommodations as early as possible.

- [CarmenCanvas accessibility](http://go.osu.edu/canvas-accessibility) (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- [CarmenZoom accessibility](http://go.osu.edu/zoom-accessibility) (go.osu.edu/zoom-accessibility)



## UNIVERSITY RESOURCES

### **Grievances:**

According to University Policies, if you have a problem with this class, you should seek to resolve the grievance concerning a grade or academic practice by speaking first with the instructor or professor. Then, if necessary, take your case to the department chairperson, college dean or associate dean, and to the provost, in that order. Specific procedures are outlined in Faculty Rule 3335-7-23. Grievances against graduate, research, and teaching assistants should be submitted first to the supervising instructor, then to the chairperson of the assistant's department.

### **Content Warning:**

While I do not anticipate any upsetting content in this course, if needed, please take care of yourself while watching/reading the material (take a break, debriefing with a friend, contacting a Sexual Violence Support Coordinator at 614-292-1111 or Counseling and Consultation Services at 614-292-5766, and contacting the instructor if needed). Expectations are that we all will be respectful of our classmates while consuming media. Failure to show respect to each other may result in dismissal from the class.

### **Lyft Ride Smart at Ohio State:**

[Lyft Ride Smart at Ohio State](#) offers eligible students discounted rides, inside the university-designated service area, from 7 p.m. to 7 a.m. Each month, 10,000 discounted rides will be made available on a first-come, first-served basis with the average cost expected to be \$2 or less. Prices may be impacted by distance, traffic, time of day, special events and prime time surcharges. To qualify for program discounts, users must select "shared ride" when booking in the Lyft app. When using ride sharing, remember to visually confirm vehicle info/descriptions in the company app and ask the driver to say who they are picking up.

*The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.*



# Course Schedule

Refer to the CarmenCanvas course for up-to-date due dates.

Week	Potential Points*	Topics, Readings, Assignments, Due Dates
One	5 pts report	<p><b>Introduction to the food supply chain;</b> understanding the scope and complexity of the supply chain and the important role of unit operations in converting raw food materials into safe and high-quality consumer products in a sustainable manner.</p> <p><u>Background reading: NAS Report (2015)</u></p> <p><u>Assignment #1:</u> a report on the required operations for a specific food product selected from one of the five consumer food product categories.</p>
Two	5 pts report 3 pts quiz 8 total	<p><b>The role of preservation in a sustainable food supply chain.</b> An introduction to the concepts of food preservation and understanding the shelf life of a food product in the context of preservation. The use of reduced or elevated temperature and/or reduced water content to extend the time that a food has acceptable high quality.</p> <p><u>Background reading:</u> Understanding the difference between food safety and extended shelf life of a high-quality food. Fellows (2016)</p> <p><u>Assignment #2:</u> a report on the differences between the safety and the quality attributes for the food product selected for Assignment #1. <u>Quiz #1.</u></p>
Three	5 pts report	<p><b>An introduction to sustainability parameters; use of Life-Cycle Assessment (LCA) to quantify impacts of industrial operations on natural resource and the environment.</b> Recognizing the LCA parameters used to quantify sustainability of the food supply chain; energy demand, water footprint, greenhouse gas emissions, carbon footprint, food waste and other environmental impacts.</p> <p><u>Background reading:</u> Cacurachi, et al (2019); Morawicki, R.O. (2012)</p> <p><u>Assignment #3:</u> a report on the LCA parameters used to quantify the sustainability of the food product selected for Assignment #1.</p>



Week	Potential Points*	Topics, Readings, Assignments, Due Dates
Four	5 pts report 3 pts quiz 8 total	<p><b>The role of sanitation in the food supply chain; the importance of sanitary design of food contact surfaces. The role of regulatory agencies in ensuring a safe food supply.</b> The respective roles of FDA, USDA, state and local agencies in establishing and enforcing standards. The impact of regulations on sustainability parameters for the food supply.</p> <p>Background reading: Ridoutt and Pfister (2010)</p> <p><u>Assignment #4</u>: a report on the regulations and standards impacting the food product selected for Assignment #1.</p> <p><u>Quiz #2</u></p>
Five	5 pts report	<p><b>Handling and storage operations for raw food materials and ingredients; the use of water for washing of fruits and vegetables prior to fresh produce marketing.</b> Lecture will cover pumps used for bulk transport of liquid products, storage and transport of grain prior to manufacturing, handling and storage of raw meat products, and impacts of these operations on sustainability parameters and on food waste.</p> <p>Background Reading: Tassou (2014)</p> <p><u>Assignment #5</u>: a report on the contribution of raw material handling and storage on LCA parameters for the food product selected for Assignment #1.</p>
Six	5 pts report 3 pts quiz 8 total	<p><b>The role of refrigeration in the food supply chain; maintaining food quality and extending the shelf-life of food products.</b> Topics covered include the impacts of refrigeration on LCA parameters for a refrigerated food, illustrating the impact of the refrigerated food delivery systems from harvest or assembly of raw materials to the refrigerator in the home, the role of refrigeration in reducing food waste.</p> <p>Background reading: Heller and Koeleian (2003)</p> <p><u>Assignment #6</u>: a report on impacts of refrigeration on the LCA parameters for the food product selected for Assignment #1.</p> <p><u>Quiz #3</u>.</p>
Seven	5 pts report	<p><b>The role of heat exchangers in ensuring maximum thermal energy efficiency, including description of typical heat exchangers (conduction, convection, radiation, microwave) used throughout the food supply chain.</b> Steps to achieve maximum efficiency in use of thermal energy, including the efficiency of thermal energy exchange during food preparation at food service and in the home.</p> <p>Background reading: Heller and Koeleian (2000); Uhlin (1997).</p> <p><u>Assignment #7</u>: a report on thermal energy exchange impacts on the LCA parameters for the food product selected for Assignment #1.</p>

Week	Potential Points*	Topics, Readings, Assignments, Due Dates
<b>Eight</b>	5 pts report 3 pts quiz 8 total	<p><b>The use of thermal energy for preservation and preparation of food; extending shelf-life of a product by elevating the temperature to inactivate spoilage microorganisms and pathogens.</b> A discussion of blanching of solid foods, pasteurization of liquid foods, commercial sterilization of canned foods and final preparation of the food, and the impacts on LCA parameters. Food waste during preservation processes. Background reading: <u>Mogensen, et al (2012)</u>  <u>Assignment #8</u>: a report on impact of preservation on the LCA parameters for the food product selected for Assignment #1.  <u>Quiz #4</u>.</p>
<b>Nine</b>	5 pts report	<p><b>The frozen food supply chain; the operations required to remove thermal energy from food during the manufacturing of frozen foods, the energy requirements for transportation and low-temperature storage of a frozen food, including storage in the home.</b> Sustainability parameters for frozen foods; impacts on food waste. Background reading: Canning, et al (2010)  <u>Assignment #8</u>: a report on impact of food/ingredient freezing on the LCA parameters for the food product selected for Assignment #1.</p>
<b>Ten</b>	5 pts report 3 pts quiz 8 total	<p><b>The concentration and drying of food products and ingredients; the removal of water to reduce volume for storage and distribution of the product or ingredient.</b> An introduction to unit operations for concentration and drying of food. Impacts of water removal on LCA parameters and food waste. Operations associated with the manufacturing of bakery products. Background reading: Bevilacqua, et al (2007).  <u>Assignment #9</u>: a report on impact of concentration/drying on the LCA parameters for the food product selected for Assignment #1.  <u>Quiz #5</u>.</p>
<b>Eleven</b>	5 pts report	<p><b>The manufacturing of liquid food ingredients; an introduction to the operations used for mechanical separation and the membrane technologies for refined separation for liquid food ingredients.</b> Impacts on sustainability parameters and food waste. Applications to waste streams and reclamation of water from manufacturing operations. Background reading: McCarthy, et al (2015)  <u>Assignment #10</u>: a report on impacts of liquid food ingredient operations on the LCA parameters for the food product selected for Assignment #1.</p>

Week	Potential Points*	Topics, Readings, Assignments, Due Dates
<b>Twelve</b>	5 pts report 3 pts quiz 8 total	<b>The operations involving the extraction of food ingredients from solid raw materials; the grinding of grain for flour manufacturing; the extraction of oil from oil seeds.</b> Impact of extraction operations on LCA parameters and food waste. Background reading: Lundie and Peters (2005) <u>Assignment #12</u> : a report on the contribution of dry ingredients to the LCA parameters for the food product selected for Assignment #1. <u>Quiz #6.</u>
<b>Thirteen</b>	5 pts report	<b>The packaging and containers used for food products and ingredients throughout the food supply chain; packaging/container materials for liquid and solid foods.</b> The role of packaging for different food products. The LCA parameters for packaging materials, and the contributions of packaging to the LCA for the food product. The influence of packaging on food waste. <u>Background reading</u> : Leib and Gunders (2013) <u>Assignment #13</u> : a report on the impact of packing on LCA parameters for the food product selected in Assignment #1.
<b>Fourteen</b>	5 pts report 3 pts quiz 8 total	<b>Cleaning and sanitation throughout the food supply chain; an introduction to the materials and operations required to ensure a safe food supply.</b> Evaluating the contribution of cleaning and sanitation to LCA parameters, with attention to washing of raw food materials and the sanitation of food contact surfaces. Cleaning operations and waste streams. Background reading: Gleick and Palaniappan (2010); Ridoutt and Huang (2012) <u>Assignment #14</u> : a report on the contribution of cleaning and sanitation to the LCA parameters for the food product selected for Assignment #1. <u>Quiz #7.</u>
	15 pts	Final Examination. The final exam will take place during the scheduled final exam time for this course.

\*Two lowest quiz scores will be dropped.