

CHEN 1100: Gourmet Science

Exploring Chemistry, Biology, and Technology through Food

3 credit hours

Contact Information

Instructor: Dr. Kathryn (Katie) O'Harra

Instructor Email: katie.oharra@colorado.edu

Office Hours: (Based upon poll) **Jennie Smoly Caruthers Biotech - E1B25**

Monday: 1 - 2 pm, Thursday: 9 - 10 am, Friday: 11:30 am - 12:30 pm

Course Assistants/Teaching Assistants: Emma Sundberg (CA), Avery Holdren (CA), Savana Huskins (TA), Lorin Danielson (ATA)

Course Description

This course explores chemistry, biology, and technology fundamentals through food. Ingredients utilized in cooking and baking processes demonstrate a breadth of key science and engineering concepts, intertwined with social significance and historical context. Students will learn about the chemical behaviors and biological interactions of molecules in food, understand critical ratios and reactions in baking and cooking, survey techniques and relevant technology, evaluate industrial and agricultural developments, and analyze global impacts of trade and policy on food science and engineering.

Course Materials

Students will be assigned reading excerpts or data from various sources, provided via Canvas, including selections from:

Introduction to Food Engineering, R. P. Singh and D. R. Heldman

On Food and Cooking, Henry McGhee

How Baking Works, Paula Figoni

Understanding Baking, Joseph Amendola

Salt-Fat-Acid-Heat, Samin Nosrat

The Elements of Baking, Katarina Cermelj

Dessert Course, Benjamin Delwiche

Alternative modes of engagement and knowledge translation will include online simulations, scientific journal articles, news and emerging topics, historical texts, and recipes will supplement the aforementioned reading assignments.

Student Learning Outcomes

This course will focus on the creative and scientific foundation, technological innovations, and cultural significance exemplified through food. Students will:

- Utilize critical and creative thinking skills surrounding the science and technology behind baking and cooking processes.
- Interpret complex chemical roles, biological functions, composition of important ingredients.
- Demonstrate an understanding of key components, behaviors, stages, and reactions.
- Investigate heat transfer, quality control, instrumentation, scale and design basics, unit operations, and other intersections between food production and technological development.
- Apply principles of interdisciplinary research and collaboration, practice troubleshooting, engage in problem solving and data analysis.
- Recognize the social, historical, and cultural basis of food techniques and agricultural products.

Outline of Topics

Primer: Atoms, (Discrete vs. Macro) Molecules, Energy, Nutrients, etc.

Sensory Properties, Texture, Leavening

The Baking and Cooking Events and Reactions, Heat Transfer Influence

Composition and Behaviors of Ingredients; Chemical and Biological Significance of Food Molecules

- Milk and Dairy Products, Eggs, Alternatives
- A Survey of Common Fruits and Vegetables
- Edible Plants and Flavorings: Herbs, Spices, Tea, Coffee, Smoke, Extractions
- Grains, Legumes, Nuts, Seeds
- Wheat Flour and Gluten
- Doughs And Batters: Formulas, Order of Operations, Mixing
- Bread, Cakes, Pastry, Pasta

- Fats, Oils, Emulsifiers, Sauces
- Sugars, Chocolate, and Confectionery
- Thickening and Gelation Agents
- Meat, Fish, Shellfish

Utensils, Equipment, Techniques, Instrumentation: Materials and Technology

Agricultural Developments, Genetic Modification

Industrial Food Production, Quality Control

Influence of Trade, Ethics, and Policy in Food

Date	Day	Topic	Workshop	Assignments Due
21-Aug-25	Thursday	Introduction to the Course; Science of Food and Cooking, Heat Transfer, Basic Equipment and Events		
26-Aug-25	Tuesday	Sensory Properties Taste/Smell/Color/Flavor and Physical Properties, Texture/Leavening (Kinetics, Mixing Methods, Solutions)		
28-Aug-25	Thursday	Atoms, Molecules, Energy, and Nutrients; Cellular Respiration and Biochemistry of Food	WS1	
2-Sep-25	Tuesday	Ingredient Behavior and Functional Roles, Ratios in Recipes; Composition of Food: Water, Carbohydrates, Proteins, Fats	WS2	
4-Sep-25	Thursday	Major Reactions (Maillard, Caramelization, Denaturation, etc.), Physical vs. Chemical Changes	WS3	
9-Sep-25	Tuesday	Acids/Bases, Smoke, Salt, Layering, Color	WS4	
11-Sep-25	Thursday	Unit 1 Review, Key Ideas and Connections, Summary/Overflow	WS5	Homework 1
16-Sep-25	Tuesday	Midterm 1		
18-Sep-25	Thursday	Milk, Dairy Products and Alternatives (Fluid Flow, Pasteurization Techniques, Separation Processes Filtration/Membranes)	WS6	
23-Sep-25	Tuesday	Wheat Flour and Gluten, Grains, Structure and Function	-	
25-Sep-25	Thursday	Egg Products; Legumes, Soy; Allergens and Dietary Restrictions	WS7	
30-Sep-25	Tuesday	Fats, Oils, Nuts, Seeds, Emulsifiers, and Sauces	WS8	
2-Oct-25	Thursday	Sugars, Chocolate, and Confectionery (Macromolecular Structure/Reactions, Morphology, Centrifugation)	WS9	Homework 2
7-Oct-25	Tuesday	Thickening and Gelation Agents: Starch, Gelatin, Pectin (Macromolecular Structure and Assembly, Syneresis, Degradation)	WS10	
9-Oct-25	Thursday	NO CLASS, Reading Day		Homework 3
14-Oct-25	Tuesday	Doughs and Batters: Formulas, Mixing Methods, and Structure	WS11	
16-Oct-25	Thursday	Bread and Beverages, Fermentation Processes	WS12	Homework 4
21-Oct-25	Tuesday	Unit 2 Review, Key Ideas and Connections, Summary/Overflow	WS13	
23-Oct-25	Thursday	Midterm 2	WS14	
28-Oct-25	Tuesday	Cakes and Pastries: Aeration, Emulsification, Lamination, Tenderness	-	
30-Oct-25	Thursday	Pasta and Noodles (Analogous to 'Soft Materials' Processing, Extrusion and Calendering)	-	
4-Nov-25	Tuesday	Meat, Fish: Structure, Composition, Cooking Techniques (Protein Behaviors, Transformations, Risks)	WS 15	Homework 5
6-Nov-25	Thursday	Fruits and Vegetables: Composition, Variety, Common Uses, Notable Processes and Classification (Washing, Sustainability, Toxins)	-	Project Topics/Groups Due
11-Nov-25	Tuesday	Freezing, Refrigeration, Evaporation, Dehydration, and Preservation Processes (Historical Examples to Modern Technology, Significant Food Advancements enabled by Engineering Innovation)	WS16	
13-Nov-25	Thursday	Agricultural Developments and Genetic Modification, Climate and Crop Yield, Creative Technologies (i.e. cultured meats, precise fermentation)	WS17	
18-Nov-25	Tuesday	Unit 3 Review, Key Ideas and Connections, Summary/Overflow		
20-Nov-25	Thursday	Midterm 3	-	
25-Nov-25	Tuesday	NO CLASS, Fall Break	-	
27-Nov-25	Thursday	NO CLASS, Fall Break	-	
2-Dec-25	Tuesday	Industrial Food Production, Packaging Processes, Quality Control and Instrumentation	WS18	Homework 6
4-Dec-25	Thursday	Global Food Resources, Trade, Ethics, and Policy; Social, Cultural Influence; Waste and Ecological Impact	-	
11-Dec-25	Th	Final Block, 4:30 – 7 pm (Project Deadline)	-	Final Presentation/Project Due

Assignments, Assessment

Learning in this course will be assessed via short quizzes or problem sets (homework) on assigned material and readings, in-class participation activities or workshop exercises, exams (3 midterms), and one final project/presentation.

Online simulations, videos, instructor recorded demonstrations, theoretical experiments or *reactions from recipes* exercises, and videos will also be assigned, to reinforce chemical, biological, and technological concepts in a multimodal fashion.

Exam 1: Foundations of Food Science, Core Food Molecules and Reactions

Exam 2: Key Food Categories and Ingredients, Applications in Cooking and Baking

Exam 3: Industrial Tools and Technology; Social, Economic, and Ecological Factors

Grading Distribution

Midterm Exams (3): 30%

Homework (5): 25%

In-Class Workshops: 25%

iClicker Engagement: 5%

Final Project/Presentation: 15%

The lowest 5-10% of workshops and iClicker scores will be dropped (Exact # TBA). If an average > 75% is maintained for in-class engagement categories, the lowest of the three midterms can be dropped and the top two exams weighted accordingly.

Grade Ranges

A-, A: 90-93.9, 94-100

B-, B, B+: 80-83.9, 84-86.9, 87-89.9

C-, C, C+: 70-73.9, 74-76.9, 77-79.9

D-, D, D+: 60-63.9, 64-66.9, 67-69.9

F: < 60

ABET Alignment:

Students in this course will develop the ability to:

1. identify, formulate, and solve complex problems by articulating and applying principles of engineering, science, and mathematics through the lens of food.
2. see how engineering design has been applied and optimized through technology to protect food supply and produce solutions that meet specified need for sustenance, with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors relevant to food production and distribution.
3. create an inclusive, respectful, and collaborative environment surrounding the study of food, communicating with peers that represent an array of disciplines, experiences, and interests.
4. recognize broader ethical implications and professional responsibilities related to food engineering, from quality control for safety to environmental stewardship, which influence ecology, socio-economic factors, and global relationships.
5. conduct appropriate experimentation to observe and reinforce food science concepts, and learn to effectively analyze and interpret complex data.
6. acquire scientific literacy and apply new technical knowledge through the lens of food, using appropriate learning and research strategies.

Course Policies

- All homework is due at 11:59pm on respective due dates and must be submitted by this time. Without a formal extension/excuse (medical situation, emergency, etc. – contact Dr. O’Harra directly), late work will not be accepted.
- Workshop assignments must be submitted as noted. These will *either* be due in-person at the end of class or in certain cases and only when announced (if timing does not allow for completion/submission during class) will these have extended submission deadlines (11:59pm, same day).
- Unless otherwise noted, all work is to be submitted electronically on Canvas.
- An exceedingly high standard of professional quality and clarity is expected on homework, workshops, and project assignments. Understanding content and its applicability is elevated when you are also able to communicate this knowledge effectively.
- Exams may only be missed for valid medical reasons or official University business. Please give sufficient notice of any expected absences on exam days. Exams missed without communication and approved excusal are not subject to the above and are also exempt from the lowest midterm drop policy, and will be recorded as zeroes.
- Students may and are encouraged to use digital tools to support note-taking, studying, and practice (see AI policy).
- All electronic devices must run with the volume off during classes/workshops.
- Regular attendance is expected and highly encouraged due to the interactive and incentivized nature of our class meetings!

University Policies

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. Understanding the course’s syllabus is a vital part in adhering to the Honor Code.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: StudentConduct@colorado.edu. Students found responsible for violating the Honor Code will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Visit Honor Code for more information on the academic integrity policy.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or DSinfo@colorado.edu for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions on the Disability Services website.

If you have a temporary illness, injury or required medical isolation for which you require adjustment, contact Prof. O'Harra directly (katie.oharra@colorado.edu) to discuss options and potential resolutions.

Accommodation for Religious Obligations

Campus policy requires faculty to provide reasonable accommodations for students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Please communicate the need for a religious accommodation in a timely manner. In this class, you must notify and request these absences or accommodations *within the first week of class*, contact Prof. O'Harra directly (katie.oharra@colorado.edu), so that any adjustments or alternative assessments can be planned.

See the [campus policy regarding religious observances](#) for full details.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Classroom Behavior

Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, marital status, political affiliation, or political philosophy.

For more information, see the [classroom behavior policy](#), the [Student Code of Conduct](#), and the [Office of Institutional Equity and Compliance](#).

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits [protected-class](#) discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner abuse (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who have been subjected to misconduct can contact OIEC at 303-492-2127 or email CUreport@colorado.edu. Information about university policies, [reporting options](#), and [OIEC support resources](#) including confidential services can be found on the [OIEC website](#).

Please know that faculty and graduate instructors are required to inform OIEC when they are made aware of incidents related to these concerns regardless of when or where something occurred. This is to ensure that individuals impacted receive outreach from OIEC about their

options and support resources. To learn more about reporting and support for a variety of concerns, visit the [Don't Ignore It page](#).

Mental Health and Wellness

The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact [Counseling and Psychiatric Services \(CAPS\)](#) located in C4C or call (303) 492-2277, 24/7.

Free and unlimited telehealth is also available through [Academic Live Care](#). The [Academic Live Care](#) site also provides information about additional wellness services on campus that are available to students.

Acceptable Use of AI in this Class

Generative artificial intelligence tools—software that creates or reproduces text, images, computer code, audio, video, and other content—have become widely available. In this course, you may use Artificial Intelligence (AI) tools as a supplemental resource for studying and practice—such as reviewing concepts, understanding processes or reactions, exploring or expanding upon examples, or brainstorming approaches. However, unless explicitly stated otherwise, you may not use AI tools to generate, write, or complete any work submitted for grading, including homework, workshops, exams/quizzes, or the project.

When AI use is permitted for a specific assignment or task, you must clearly document and cite: the tool(s) used, what it was used for (e.g., code assistance, explanation of a concept), and how it influenced your work. If you're unsure whether AI use is allowed for a particular assignment or part of a project, ask the instructor before proceeding. Violations of this policy may be treated as academic misconduct under university guidelines.