



CUL-550: CULINARY SCIENCE

Effective Term

Fall 2026

BOT Approval Date

12/11/2025

Discipline

CUL - Culinary Arts

Course Number

550

Course Title

Culinary Science

Short Title

Culinary Science

Credit Status (CB 04)

D - Credit - Degree applicable

Units**Lecture Units**

1.00

Lab Units

2.00

Total Units

3.00

Hours**Lecture Contact Hours**

16-18

Out of Class Hours Lecture

32-36

Lab Contact Hours

96-108

Out of Class Hours Lab

0.00

Total Contact Hours

112 - 126

Total Out of Class Hours

32 - 36

Total Student Learning Hours

144 - 162

Is this an existing Extensive Lab?

No

Do you want to propose this for Extensive Lab?

Yes

Distance Education

No

Catalog Description

This course explores the scientific principles underlying modern culinary techniques and food preparation. Students will examine how ingredients interact, the chemistry of cooking methods, and the application of food safety and sanitation standards. Through hands-on experiments and practical applications, students will analyze the effects of temperature, pH, and molecular changes on various foods, developing a deeper understanding of how science informs culinary innovation. Emphasizing critical thinking and problem-solving, the course prepares students to apply scientific concepts to create innovative, safe, and high-quality culinary products in professional settings.

Requisites**Prerequisite(s)****Prerequisite(s) (must be taken before)**

CUL-500 (with a grade of C or better)

Codes**TOP Code (CB 03)**

1306.30* - *Culinary Arts

CIP Code

12.0509 - Culinary Science/Culinology.

Repeatability Code

No

Grading Option

Letter grade OR P/NP

Minimum Qualifications

Minimum Qualifications	And/Or
Culinary Arts/Food Technology	End

Learning Objectives**Learning Objectives****Learning Objective**

1. Analyze the chemical and physical interactions of ingredients during various cooking and processing techniques to understand their impact on food quality and safety.
2. Evaluate scientific data and experimental results related to food properties, demonstrating critical thinking and application of scientific principles to culinary contexts.
3. Design innovative culinary formulations that incorporate diverse ingredients and techniques, promoting creativity and cultural awareness in food science.
4. Interpret scientific literature and research findings to inform evidence-based culinary practices that accommodate a variety of dietary needs and preferences.
5. Apply safety protocols and sanitation standards effectively during laboratory experiments and food handling to ensure health and safety for all individuals.
6. Create experiments and studies that explore the influence of variables such as pH, temperature, and moisture on food stability.
7. Synthesize knowledge of food science and culinary techniques to develop inclusive menus or products that meet diverse dietary restrictions.

8. Critique experimental procedures and outcomes, providing constructive feedback that supports scientific inquiry and professional growth.
9. Demonstrate leadership by guiding peer groups through collaborative research projects while respecting diverse viewpoints and backgrounds.
10. Reflect on personal culinary practices and scientific understanding to foster continuous improvement and professional development.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome

1. Students will demonstrate evidence-based culinary science techniques by developing reproducible inventive recipes.
2. Students will design innovative culinary formulations by conducting experiments that manipulate variables such as pH, temperature, and moisture.
3. Students will critique scientific research articles and present their findings in both written and oral formats.

Content

Course Lecture Content

1. Introduction to Culinary Science and Its Foundations
 - a. Overview of culinary science
 - i. History and importance
 - b. Interdisciplinary nature
 - i. Food chemistry
 - ii. Microbiology
 - iii. Nutrition
 - c. Recognizing diverse culinary traditions and their scientific contributions
2. Ingredient Interactions and Food Chemistry
 - a. Proteins, carbohydrates, fats, and water interactions
 - b. Maillard reaction and caramelization
 - c. Impact of ingredients on flavor and texture development
3. Food Safety and Sanitation Principles
 - a. Microbial growth and control measures
 - b. Proper hygiene practices in food handling
 - c. Cultural hygiene practices
 - d. Dietary restrictions
4. Food Preservation Techniques
 - a. Canning, drying, fermentation, and freezing
 - b. Benefits and limitations of each method
 - c. Cultural significance of preservation methods across societies
5. Sensory Evaluation and Aesthetic Presentation
 - a. Principles of taste, aroma, texture, and appearance
 - b. Techniques for plate and product presentation
 - c. Valuing diverse aesthetic preferences and cultural expressions
6. Nutritional Science and Dietary Needs
 - a. Macronutrients and micronutrients
 - b. Special diets
 - i. Gluten-free, vegan, allergen-aware, cultural diets
 - c. Promoting inclusive culinary practices
7. Scientific Method in Culinary Innovation
 - a. Hypothesis formulation and experimental design
 - b. Data collection and analysis
 - c. Application
 - i. Developing new recipes and techniques
8. Ingredient Sourcing and Sustainability

- a. Ethical sourcing and local ingredients
 - b. Environmental impacts of food production
 - c. Supporting equitable supply chains and diverse food producers
9. Cultural Perspectives in Food Science
 - a. Exploring traditional and indigenous culinary techniques
 - b. Integration of cultural practices in modern cuisine
 - c. Promoting cultural humility and sensitivity
10. Technology in Culinary Science
 - a. Modern equipment
 - i. Sous vide, molecular gastronomy tools, fermentation chambers
 - b. Digital resources for research and recipe development
 - c. Responsible use of technology and intellectual property
11. Food Waste Reduction and Sustainability
 - a. Techniques for minimizing waste during preparation
 - b. Upcycling and creative reuse of ingredients
 - c. Addressing food insecurity
 - i. Supporting equitable food access
12. Innovation and Creativity in Culinary Science
 - a. Combining scientific principles with artistic expression
 - b. Developing unique flavor profiles and presentation styles
 - c. Incorporating diverse cultural ingredients and influences
13. Legal and Ethical Issues in Food Science
 - a. Food labeling laws and regulations
 - b. Ethical sourcing and fair labor practices
 - c. Respecting cultural intellectual property
14. Communicating Scientific Concepts
 - a. Writing professional reports and research papers
 - b. Presenting findings to diverse audiences
 - c. Interpersonal communication across cultural contexts
15. Leadership and Collaboration in Culinary Science
 - a. Team-based research projects and problem-solving
 - b. Leading with cultural humility and inclusiveness
 - c. Building equitable team dynamics
16. Final Project and Reflection
 - a. Designing a scientific culinary experiment or product
 - b. Incorporating diverse ingredients and cultural influences
 - c. Reflecting on personal growth, ethical considerations, and cultural humility

Course Lab Content

1. Introduction to Laboratory Skills and Safety
 - a. Proper sanitation and safety procedures
 - b. Correct use and maintenance of lab equipment
 - i. pH meters, thermometers, and microscopes
 - c. Set up a sterile workspace for experiments involving microbial analysis
2. Ingredient Interactions and Food Chemistry
 - a. Heat and pH adjustments
 - i. Protein coagulation
 - ii. Starch gelatinization
 - iii. Sugar caramelization
 - b. Maillard reaction
 - i. Browning carbohydrates, proteins, and sugars
 - c. Flavor compound development
 - i. Caramelization and browning processes
3. Food Safety and Sanitation Practices
 - a. Proper handwashing
 - b. Surface sanitization
 - c. Cross-contamination prevention techniques

-
- d. Testing microbial contamination on various food samples
 - e. Develop a sanitation checklist for food handling in a professional kitchen
4. Food Preservation Techniques
 - a. Fermented vegetables (e.g., sauerkraut or kimchi)
 - i. Monitor pH changes over time
 - b. Dehydration of fruits and vegetables
 - i. Recording moisture loss and microbial growth prevention
 - c. Test preservation methods through microbial assays
 5. Sensory Evaluation and Aesthetic Presentation
 - a. Taste and evaluate preserved foods and flavor-enhanced dishes
 - b. Plating techniques
 - i. Visual appeal of dishes
 1. Color, texture, and arrangement
 - c. Record sensory data
 - i. Analyze how presentation influences perception
 6. Nutritional Science and Dietary Needs
 - a. Analyze macro- and micronutrient content
 - b. Prepare and evaluate
 - i. Gluten-free, vegan, or allergen-aware recipes
 - ii. Document differences in ingredient behavior
 - c. Develop a nutritional profile for a culturally specific dish
 7. Scientific Method in Culinary Innovation
 - a. Designing and conducting experiments
 - i. Modify textures and flavors
 1. Thickeners and flavoring agents
 - b. Optimizing a recipe for specific dietary or sensory goals
 - c. Present findings
 - i. Written reports
 - ii. Taste-test feedback sessions
 8. Ingredient Sourcing and Sustainability
 - a. Field Exercises
 - i. Investigate the sourcing of local and sustainable ingredients
 - ii. Comparative analysis of environmental impacts of different ingredient options
 - b. Research Project
 - i. Recipe development
 1. Developing a proposal for sourcing ingredients ethically and sustainably
 9. Cultural Perspectives in Food Science
 - a. Preparing traditional dishes from diverse cultures
 - i. Examining unique ingredients and techniques
 - b. Analyzing the scientific principles behind traditional fermentation or preservation methods from different regions
 - c. Cultural significance of selected culinary practices
 - i. Document and present
 10. Technology in Culinary Science
 - a. Sous vide cooking proteins and vegetables
 - i. Compare results with traditional methods
 - b. Molecular gastronomy techniques
 - i. Spherification
 - ii. Foams and airs
 - c. Digital tools
 - i. Recipe formulation
 - ii. Data analysis
 11. Food Waste Reduction and Sustainability
 - a. Creating recipes incorporating food scraps or upcycled ingredients
 - b. Measuring waste reduction
 - i. Before and after implementing sustainable practices
 - ii. Developing a plan to minimize waste in a professional kitchen setting
 12. Innovation and Creativity in Culinary Science

- a. Developing new recipes
 - i. Combining scientific techniques and cultural ingredients
- b. Sensory testing
 - i. Innovative flavor and presentation concepts
- c. Document the development process from concept to final product
- 13. Legal and Ethical Issues in Food Science
 - a. Evaluating food labels for compliance and accuracy
 - b. Researching fair trade and ethical sourcing practices for ingredients
 - c. Intellectual property rights related to recipe development and innovation
- 14. Communicating Scientific Concepts
 - a. Preparing and delivering presentations
 - i. Explaining experimental results and scientific principles
 - b. Writing professional lab reports
 - i. Describing procedures, data, and conclusions
 - c. Creating visual displays
- 15. Leadership and Collaboration in Culinary Science
 - a. Team-designed research projects
 - b. Group discussions and experiments
 - c. Identifying strategies for equitable collaboration
 - i. Reflecting on team dynamics
- 16. Product development
 - a. Scientific principles
 - b. Cultural ingredients
 - c. Presenting results
 - i. Cultural sensitivity
 - ii. Personal growth
 - d. Critically evaluating project success
 - e. How to identify areas for future improvement

Methods of Instruction

Method

Lab Activities

Integration

Students will observe the instructor's demonstration of scientific techniques and processes related to food preparation, ingredient interactions, and preservation methods. They will then apply these principles by conducting experiments and preparing dishes that illustrate concepts such as enzyme activity, pH levels, fermentation, and emulsification. At the end of each session, students will present their experimental results and culinary creations for peer and instructor critique, and will have the opportunity to taste and analyze their dishes in comparison to others. Activities will also include collaborative research projects, developing food formulations, and designing presentation displays that highlight scientific and culinary principles.

Method

Lecture

Integration

The instructor will deliver lectures on a variety of topics related to food chemistry, microbiology, ingredient interactions, preservation methods, and safety standards. These lectures will utilize diverse instructional approaches, including interactive discussions, visual presentations, videos, and live demonstrations of scientific techniques. The content will build logically upon foundational principles introduced in earlier coursework, covering key concepts such as enzymatic reactions, Maillard browning, fermentation processes, emulsification, food safety protocols, and innovative food technologies. The goal is to deepen students' understanding of the scientific principles that underpin culinary practices and to foster critical thinking about food systems and processes.

Method

Observation and Demonstration

Integration

The instructor will demonstrate a variety of scientific techniques and processes, with students observing each step to understand the underlying principles before applying them in their own experiments or culinary preparations. The instructor will perform detailed, step-by-step demonstrations of methods such as ingredient analysis, fermentation procedures, emulsification, and heat transfer techniques, addressing questions to ensure clear comprehension. After the demonstrations, the instructor will observe students conducting their own experiments or preparing dishes, offering guidance and feedback to support individual skill development and understanding. These activities are designed to promote equitable learning outcomes by encouraging active observation, hands-on practice, and the application of scientific concepts to culinary challenges.

Methods of Evaluation**Method**

Class Participation

Integration

At each class session, the instructor will facilitate discussions on scientific principles, ingredient functions, food safety, and innovative culinary techniques relevant to that week's experiments and recipes. Topics will also include the cultural and historical significance of various food preservation and processing methods, as well as their applications in modern culinary practice. Student participation will be evaluated using the Participation Rubric, which emphasizes punctuality, preparedness, active engagement in experiments and discussions, contributions of ideas and insights related to food science concepts, and the ability to connect scientific principles to practical applications.

Method

Class Performance

Integration

At each class session, students will be evaluated on their technical skills, understanding of scientific principles, and the quality of their experimental or culinary projects. The instructor will assess how effectively students set up their workstations, adhere to safety and sanitation standards, and handle laboratory equipment and ingredients. Students will present their experimental results or developed recipes for critique, focusing on the accuracy of data collection, application of scientific concepts, innovation, and overall presentation. The instructor will evaluate each student's performance using the Performance Rubric, which considers their time management, problem-solving skills, professionalism, and the quality of their work and scientific reasoning throughout the activities.

Method

Exams/Tests

Integration

Students will be assessed through weekly formative quizzes as well as two comprehensive summative exams designed to evaluate their understanding and application of scientific concepts, techniques, and safety protocols covered in previous sessions. These assessments will measure a student's ability to critically interpret food chemistry principles, experimental methods, and food safety practices. All exam questions will be in an open-answer or short essay format to best gauge their comprehension, analytical thinking, and ability to connect scientific concepts to culinary applications. Students will be evaluated on the accuracy and clarity of their responses, their capacity to effectively communicate scientific reasoning, and how well they integrate new knowledge with prior learning and practical experiences in the laboratory.

Method

Final Performance

Integration

Students will complete a final practical assessment in which they will design and execute a culinary project or experiment that demonstrates the scientific principles and techniques learned throughout the course. Their final grade will be based on their analytical approach, technical execution, attention to detail, and the clarity of their presentation of findings. Evaluation will focus on the accuracy and thoroughness of their experimental methods, the quality of their data collection and analysis, the innovation and application of scientific concepts, and their adherence to safety and sanitation standards in the laboratory setting.

Method

Homework

Integration

Students will be assigned weekly homework that complements the scientific concepts and techniques covered in class. These assignments may include research on food chemistry principles, designing and conducting small experiments, analyzing ingredient interactions, or preparing reports on safety and preservation methods. Evaluation will focus on the completeness, effort, and accuracy of the work, as well as the student's ability to demonstrate an understanding of scientific principles and their application through detailed responses, data analysis, and reflective reports on experimental outcomes.

Method

Quizzes

Integration

Students will take weekly quizzes covering topics and techniques from the prior week, including food chemistry principles, ingredient interactions, safety protocols, preservation methods, fermentation processes, and culinary techniques. Quizzes will consist of open-ended questions that require critical thinking and reflection, asking students to explain scientific concepts, justify their experimental choices, and demonstrate their understanding of culinary science principles. Assessment will focus on the student's ability to clearly articulate the 'why' and 'how' behind each concept and their application of scientific techniques discussed in class.

Assignments**Assignment Type**

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Write an essay analyzing the role of fermentation in food preservation and flavor development. Include a brief history of fermentation practices across different cultures, explain the scientific principles behind fermentation, and discuss how fermentation is used today in modern culinary applications. Be sure to highlight specific examples such as yogurt, kimchi, or sourdough bread, and reflect on how understanding the science of fermentation can enhance culinary innovation and food safety.

Assignment Type

Other

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Research the field of molecular gastronomy. Describe its origins, historical development, and how it has influenced contemporary culinary practices. Explore key techniques such as spherification, foams, and gels, and discuss how understanding these scientific processes can enhance creativity, presentation, and texture in modern cuisine. Prepare a brief 3-5 minute presentation summarizing your findings to share with the class.

Assignment Type

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Research traditional and contemporary scientific techniques used in ingredient processing and preservation across different cultures. Write a 2-3 page essay discussing your findings, specifically addressing: Which techniques have been employed by various cultures, and what scientific principles underpin their use? How have these methods influenced or shaped the cuisines of those cultures? Include examples of how these techniques are still practiced or have evolved in modern culinary science. Consider how cultural values, resource availability, and environmental factors are reflected in these practices and their ongoing significance today. Be prepared to share your insights during the next class discussion, emphasizing the diversity and scientific basis of culinary techniques worldwide.

Assignment Type

Reading

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Read the first chapter of *Cooking as a Chemical Reaction: Culinary Science with Experiments* (Ozilgen, 2019). In this chapter, fundamental concepts about the chemical and physical reactions that occur during cooking are introduced, including how ingredients interact and transform under different conditions. Prepare to participate in an in-class discussion about how understanding these chemical processes improves culinary techniques, product development, and food safety. Topics will include the role of chemical reactions in flavor development, texture modification, and food preservation. Be ready to share your insights and questions to enhance your understanding of the scientific principles in everyday cooking practices.

Assignment Type

Other

In-class and/or outside of class

In-class

Formative or Summative

Summative

Assignment

In teams of 3-4, develop a comprehensive research-based presentation and practical demonstration on a specific food science concept, such as enzyme activity, fermentation, or the Maillard reaction. Your project will include a detailed explanation of the scientific principles involved, real-world culinary applications, and an experimental component demonstrating the concept in action. Each team member will be responsible for preparing and presenting one aspect of the project—either a mini-experiment, a visual presentation, or a live demonstration. The presentation should be suitable for an audience of peers and should include visual aids or samples where appropriate. Your project will be assessed using the rubric attached to this assignment in the CMS, which will evaluate understanding of scientific concepts, clarity of presentation, teamwork, creativity, and practical application.

Assignment Type

Other

In-class and/or outside of class

Outside of class

Formative or Summative

Summative

Assignment

Create a comprehensive digital portfolio documenting your work throughout the culinary science course. Your portfolio should serve as a personal collection of your learning journey and demonstrate your understanding of key scientific principles, techniques, and applications discussed in class. It must include the following components:

- Summaries and reflections on each major topic or experiment covered, highlighting your insights and understanding
- Experimental procedures and data from laboratory activities, including photographs or videos of your work, where applicable
- Analysis of scientific concepts applied in your projects, such as enzyme activity, emulsification, or heat transfer
- Examples of technical diagrams, sketches, or plate-up drawings illustrating your ideas or processes
- Any quizzes, writing assignments, or vocabulary glossaries completed during the course
- Additional materials such as lecture slides, articles, videos, or other resources you found helpful

Your portfolio should be well-organized, clearly labeled, and accessible for review. It will be assessed based on completeness, depth of reflection, understanding of scientific concepts, and presentation quality.

Course Materials**Textbooks**

Cooking as a Chemical Reaction: Culinary Science with Experiments, 2nd Edition. CRC Press, 2019.

Class Size Information**Class Size**

28

Class Size Category

J - Specialty lab

Diversity and Inclusion

Course Design and Materials: Course will incorporate diverse perspectives, authors, and examples that reflect a variety of cultures, identities, and lived experiences. Instructional materials will be reviewed regularly to ensure representation, inclusivity, and alignment with equity-minded practices across disciplines.

Inclusive Learning Environment: Instructors will establish classroom norms and policies that promote respect, civil discourse, and belonging in both online and face-to-face classes. Clear expectations for communication and engagement will support a learning space where all students feel valued and heard.

Accessible Instruction: Course content will be delivered using accessible design. Materials will follow accessibility guidelines within the CMS, including captioned media, readable document formats, and multiple means of engagement to support diverse learning.

Equitable Teaching Practices: Instructors will use transparent and grading criteria, varied assessment methods, and timely feedback to promote fairness and student success. Opportunities for revision, reflection, and multiple demonstrations of learning may be incorporated when appropriate to the discipline.

Culturally Responsive Pedagogies: Instructional strategies will encourage critical thinking about diverse perspectives and systems of power relevant to the course content. Faculty will foster opportunities for students to connect course material to real-world contexts.

Ongoing Reflection and Improvement: Faculty will engage in continuous professional development related to IDEAA principles and reflect on course practices using metacognition to identify opportunities for increased equity, inclusion, and accessibility.

Explain how diversity and inclusion(e.g., gender, culture/race, sexuality, etc.) is infused into the course.

The course is designed to be highly interactive and fosters an environment where students are encouraged to value and explore diverse perspectives. Students will investigate and experiment with ingredients and techniques rooted in various cultural traditions, gaining insight into their historical significance and contributions to the culinary sciences. Collaborative group work will promote creative problem-solving and respect for different cultural approaches to food and science. Each student's unique background and viewpoint will enrich the team's overall learning experience. Additionally, students will take on leadership roles, such as team coordinator or project lead, to develop skills in guiding diverse groups. During each lab review, students will share their approaches and findings within a respectful and supportive environment, discussing how cultural influences shape culinary practices and scientific applications.

Describe how assignments, instruction, evaluation, course content, and interactions are contextualized for diverse learners promoting an equitable course.

Students enter the culinary science course with diverse backgrounds, prior knowledge, and learning styles. To support equitable learning, instruction is designed to build from foundational concepts, ensuring all students develop a solid understanding before progressing to more advanced topics. The course accommodates varying skill levels by providing multiple modes of instruction—including discussions, multimedia presentations, hands-on demonstrations, videos, and readings—to meet different learning preferences. In the laboratory, students are assessed weekly on their individual growth, focusing on their understanding of scientific principles, experimentation, and technical skills. Assessments are personalized, encouraging reflection on their progress and understanding, and allowing each student to demonstrate mastery in ways that resonate with their strengths and experiences. This approach fosters an inclusive environment where all learners can succeed and develop critical scientific and culinary skills at their own pace.

Interactions

Explain how the course will incorporate student-to-student interaction.

Students will collaborate in small groups or pairs to design and conduct experiments, analyze data, and develop culinary solutions based on scientific principles. These group activities may include investigating ingredient interactions, developing new recipes through trial and error, or troubleshooting technical challenges in food processing. Students will assume leadership roles such as experiment coordinator or data analyst, responsible for assigning tasks like preparing materials, recording observations, and presenting findings. This interaction promotes effective communication, teamwork, and the sharing of diverse perspectives, allowing students to learn from each other's approaches and cultural insights while fostering a collaborative and inclusive learning environment.

Explain how the course will incorporate instructor-to-student interaction.

Every student receives individualized instruction during laboratory sessions, with the instructor demonstrating scientific techniques, experimental procedures, and safety protocols to the entire class. Instructors provide targeted guidance to individuals or small groups, addressing specific questions, troubleshooting challenges, and refining techniques in real-time. Throughout experiments and practical activities, the instructor offers immediate feedback on methodology, data collection, and analytical reasoning, supporting students in developing their scientific skills and confidence. During lectures and discussion periods, students also receive personalized feedback on their reports, presentations, and experimental design ideas, ensuring tailored support that nurtures each learner's strengths and promotes continuous growth in both culinary and scientific competencies.

Explain how the course will incorporate student-to-content interaction.

Students will actively engage with course content by reviewing instructional materials prior to each class, including scientific articles, laboratory protocols, videos, and textbook readings related to food chemistry, microbiology, and preservation techniques. They will prepare by creating notes, experimental design sketches, and process diagrams to facilitate practical application during laboratory activities. Throughout the course, students will analyze and interpret scientific data, ingredient interactions, and food processes, fostering a deeper understanding of culinary science principles and developing their ability to connect theoretical concepts with real-world applications.

Explain how the course will incorporate student-to-self interaction (metacognitive).

Throughout the course, students will engage in regular self-reflection to evaluate their understanding of scientific concepts, experimental techniques, and safety practices. After each lab or project, students will review their work by identifying what methods were effective, areas where they faced challenges, and strategies for improving their experimental design and analytical skills. This metacognitive approach encourages students to set personal learning goals, recognize their progress over time, and develop a deeper awareness of their growth as culinary scientists. Periodic self-assessments will be incorporated into the curriculum to foster critical thinking about their scientific reasoning and to promote continuous development of their technical and analytical abilities.