

SPU 27.1x

Science and Cooking: From Haute Cuisine to Soft Matter Science

This course will discuss concepts from the physical sciences, especially chemistry, that underpin both everyday cooking and haute cuisine. During each module we will visit, or be visited by, one or more world-famous chefs, who will show us the secrets of some of their remarkable creations. We will use these as inspiration to delve into the fundamental chemistry behind food and cooking. The chefs include José Andrés (*ThinkFoodGroup, Minibar, Jaleo*), Joanne Chang (*Flour Bakery, Myers and Chang*), Dominique Crenn (*Atelier Crenn*), Daniel Humm (*Eleven Madison Park*), Joan and Jordi Roca (*El Celler de Can Roca*), Enric Rovira (Master Chocolatier), Carme Ruscalleda (*Sant Pau*), and Bill Yosses (former White House Pastry Chef). There will also be demos and lectures by other leaders in the field, including Ferran Adrià (*El Bulli Foundation*), Dan Souza from America's Test Kitchen, authors Harold McGee (*On Food and Cooking, Keys to Good Cooking*) and Nathan Myhrvold (*Modernist Cuisine*), as well as food scientist Dave Arnold (*Cooking Issues*).

At the end of the course, students will be able to explain how a range of cooking techniques and recipes work, in terms of the chemical transformations of food.

Instructors

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Prerequisites

Knowledge of high school physics and chemistry will be useful, but not required. We want everyone to be able to start and successfully complete this course without prior knowledge. Background material will be supplied in the form of review videos and practice problems—though the course will be more challenging without a high school level knowledge of chemistry, students are encouraged to explore the review materials and use the discussion forums to ask questions. Your fellow students can be great teachers, too!

Course Overview

The course is divided into six modules, each focusing on a scientific topic and visiting chef(s). Every module includes interactive video sequences and practice problems, as well as a homework and a lab. Most learners should be able to complete the course requirements in 5-7 hours per module. There are no exams.

To pass the course, you will complete the homework and labs by the end of the course. In addition, you will carry out a final project in which you conduct your own scientific study of some recipe or aspect of cooking. You will perform both the labs and final project in your own kitchen, or visit a friend

or family member to complete the experiments together! Once you have finished the experiment for each module, you can eat the results of your lab and share them with your friends and family.

The table below outlines the scientific topics, visiting chefs, and labs.

Module	Visiting Chefs	Lab
Food components and flavor	Daniel Humm (Eleven Madison Park) Joann Chang (Flour bakery)	Calibrate your equipment, and make a cola drink!
Energy, temperature, and heat	Dave Arnold (Booker and Dax)	Heat transfer in beverages
Phase transitions	Joan Roca (el celler de can Roca)	Phase transitions of fats
Diffusion and spherification	Jose Andres (minibar) Dominique Crenn (Atelier Crenn)	Ceviche, diffusion in eggs
Heat transfer	Carme Ruscalleda (Sant Pau) Nathan Myhrvold (author, <i>Modernist cuisine</i>)	Molten chocolate cake
Candy and Chocolate	Joann Chang (Flour bakery) Enric Rovira (master chocolatier)	Final Projects!

Interactive Lectures

In each module, we present an interactive video sequence, interspersed with online exercises and practice problems to help you gauge your learning as you watch the videos. Participation in these online exercises does not contribute to your grade.

Textbooks

Two texts will be useful for this course; both are supplemental, not required. **Recommended, but not required**, readings will be posted from these books for each module.

On Food and Cooking, Harold McGee, Scribner, 2004 (2nd edition)
Science and Cooking: A Companion to the Harvard Course, 2015

On Food and Cooking will significantly enhance your understanding of this subject and serve as a truly invaluable resource and reference, both for this class and beyond. Harold McGee will join us throughout the class and give his insight into the subjects that we are studying.

Science and Cooking: A Companion to the Harvard Course is based on transcripts of the science videos and serves as a summary of the science that is covered in the course.

Homework

This class has five homeworks. All due dates are set at the end the course, to give everyone a chance to submit their work for credit despite busy schedules or having enrolled in the class late.

You can drop your lowest homework when calculating your final grade.

Labs

The first 5 modules each include a lab that allows you to experiment with the associated scientific concept in your own kitchen. As part of the lab you will make measurements and observations, and

submit these for credit. You will also complete different parts of a lab report for each experiment, so that you can think more about the labs and practice scientific writing, which you will need for the final project report. You can also opt to take a picture of your lab and share it with your peers. Since the labs illustrate concepts discussed in the lecture material for each module, we encourage you to work through them in conjunction with watching the lectures.

Final Projects

The last module of the course does not have a lab, but will instead be devoted to final projects. You will carry out your own scientific study of some recipe or aspect of cooking in your own kitchen, and focus on the kitchen science question that is of most interest to you.

Discussion Forum

Participation in the discussion forums is optional, and we encourage students to use the discussion forums to ask questions about concepts from lectures, lecture exercises and labs, and to post photos of their lab results each week. You should *not* directly discuss answers to homeworks or post walk-throughs of the solutions.

The course staff and Community Teaching Assistants who have taken the course in the past moderate the forums, and we encourage students to answer each other's questions and upvote helpful answers. For some useful tips on how to navigate the discussion forum, please see, ["Participating in Course Discussions" in the EdX Learner's guide.](#)

Grading

A passing grade in this class corresponds to successful of the assignments, with an average score of 60% or higher. The grade breakdown is as follows:

<i>Homework (5 total, drop lowest score)</i>	35%
<i>Lab (5 total, drop lowest score)</i>	35%
<i>Final project</i>	30%

Certification

Online learners who demonstrate mastery of SPU27x course materials with a passing grade may earn an ID verified certificate of completion, which EdX will issue for a fee.

Other books and resources

The following books cover various aspects of the science contained in the course:

- The Science of Good Cooking*, America's Test Kitchen
- The Science of Cooking*, Peter Barham
- The Science of Chocolate*, Stephen T. Beckett
- Cookwise*, Shirley Corriher
- Keys to Good Cooking*, Harold McGee
- The Curious Cook*, Harold McGee
- Modernist Cuisine*, Nathan Myhrvold, Chris Young, and Maxime Billet
- Ratio*, Michael Ruhlman

Several of the guest lecturers have written cookbooks, which may be of interest:

- A Day at El Bulli*, Ferran Adrià
- A Perfect Finish: Special Desserts for Every Occasion*, Bill Yosses
- Atelier Crenn: Metamorphosis of Taste*, Dominique Crenn
- Eleven Madison Park*, Daniel Humm and Will Guidara
- CR20: 20 Years of Sant Pau*, Carme Ruscalleda

Flour: Spectacular Recipes from Boston's Flour Bakery + Café, Joanne Chang
Flour, too: Indispensable Recipes for the Café's Most Loved Sweets and Savories, Joanne Chang
I Love New York: Ingredients and Recipes, Daniel Humm and Will Guidara
Liquid Intelligence: The Art and Science of the Perfect Cocktail, Dave Arnold
Made in Spain, José Andrés
Sous vide Cuisine, Joan Roca

For a more advanced discussion of the scientific topics in the course:
Physical Chemistry of Foods, Pieter Walstra