



Food Science



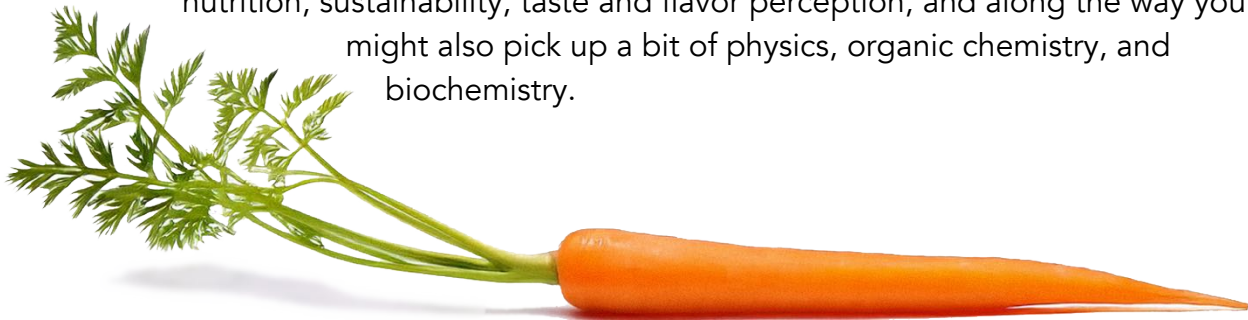
Developed by Michael Silver, CCE, CEPC, CRC

This is a 30-hour, self-paced course on food science for food professionals, home cooks, scientists, non-scientists, or anyone who works with food and wants to understand what's going on under the hood.

This online course represents over a thousand hours of curriculum development, including many improvements over years of teaching food science to food professionals, scientists, home cooks, and culinary and baking students.

The course covers many areas, including food molecules, heat, acids and bases, colors, flavors and aromas, flavor perception, water, salts, sugars and starches, colloids, lipids, proteins, fermentation, cultural aspects of food, nutrition, and sustainability.

The knowledge you'll gain through this course will help you understand food at a much deeper level, impacting decisions you make for cooking and baking, food preservation, nutrition, sustainability, taste and flavor perception, and along the way you might also pick up a bit of physics, organic chemistry, and biochemistry.



Course Structure

This course has 12 modules (including this introduction), each divided into sections.

There are two symbols used periodically in the text to highlight important areas:



An apple icon denotes a really important point.



Whenever you see the chili icon and this groovy font, it is an advanced note. This is material that is *not* required for the class, but that you may find interesting and useful. You can also get bonus points on the tests by learning this material.

Tests

Starting with Module 2, there is a pre-test at the beginning of the module and a knowledge check at the end. The pre-test is just for you to see what you know coming in. There is no minimum score, and your score is not counted.

You must earn a minimum score of 70 percent on the knowledge check at the end of the module to continue to the next section.

At the end of the course there is a final exam, and you must earn 80 percent to complete the course and earn the **ACF Food Science Specialized Certificate** (certificate and online badge) and 30 continuing education hours.

There are ten extra-credit questions in the final exam on the more advanced material in the course (including the optional advanced material mentioned above). If you answer any of these questions they will count toward your final score (whether correct or incorrect), but if you don't attempt a question, there is no penalty.

Here are examples of regular test questions:

What happens to food during slow freezing?

- A) Large ice crystals form, damaging cells
- B) Small ice crystals form, preserving texture
- C) The food's texture becomes firmer
- D) The proteins in the food denature and coagulate

What gives cooked chicken skin its crispiness?

- A) Collagen
- B) Keratin
- C) Myosin
- D) Actin

Why do marble countertops feel colder than wood?

- A) Marble remains at a lower temperature
- B) Marble absorbs heat through conduction
- C) Wood has lower density
- D) Marble has higher thermal conductivity

Here is an example of an advanced question:

What happens to myoglobin during cooking?

- A) It reacts with air and forms carboxymyoglobin
- B) It oxidizes and forms metmyoglobin
- C) It bonds oxygen and forms oxymyoglobin
- D) It forms cross-links with myosin and forms nitrosylmyoglobin

Also, consider each question carefully. Most of the questions are very straightforward, but some test critical thinking. For example, how many double bonds are in a saturated fatty acid? What exactly are HDL and LDL?

About the Course Developer

Michael Silver is a professional chef, baker, and food scientist, and he sits on the Board of Directors of the Washington State Chefs Association. He received his culinary training from the Culinary Institute of America and his baking and pastry training from Seattle Culinary Academy. He is a Certified Executive Pastry Chef (CEPC), Certified Research Chef (CRC), Certified Culinary Educator (CCE), and a certified food safety instructor (ServSafe). He is also a former EMT who did volunteer work in emergency medicine and dive medicine and taught for the Red Cross for many years.

A published author, Michael started his career as a technology manager and architect at Apple Computer, later founding his own technology company which has done major projects for Google (including building the YouTube studio), LucasFilm/Skywalker Sound, Hewlett-Packard, EA, Tesla, and many other companies. He has consulted to and built technology for the founders and CEOs of many of the top companies in the world along with many famous directors, actors, musicians, and athletes.

Michael consulted for NASA for four years, including working on the space program and writing the code to send the first email from space. He also supported the astronauts during this mission from the Flight Control Room. For his work with NASA on this and other projects, Michael was made an honorary Air Force Captain.

He studied molecular biology, genetics, and organic chemistry and did molecular biology research at Stanford University for two years.

Michael teaches food science, cooking, baking, chocolate-making (bean-to-bar), coffee, and other subjects at Seattle Central College. He co-founded an active chocolate manufacturing company, and he co-owns and co-operates a café/bakery that makes its own bean-to-bar chocolate in-house.

He spends much of his time in the development of [Chefs Village](#), a 501(c)(3) non-profit that teaches food science, cooking, baking, nutrition, sustainability, and related areas. All of his proceeds for this course are donated to his non-profit.

Glossary and Resources

Technical terms in the text are [highlighted in blue](#). These are typically defined in the text and can also be found in the extensive glossary (Section 1.2).

Additional interviews and resources can also be found at chefsvillage.org.



Course Objectives

By the end of this course, you will understand:

- How food molecules are constructed and how and why they interact.
- The different heat sources we use, transfer methods, properties of materials used to cook and bake, carryover cooking, and the many different meanings of “tempering.”
- How acids and bases work, how they affect foods and cooking, and how we can use them to our advantage in preparing foods and for flavor profiles.
- Functional groups and how they change the looks, smells, and tastes of foods.
- The many ways we use baking soda and various acids in the kitchen.
- What causes the different colors in foods, the changes to colors in foods, how to preserve and control colors, and how colors affect taste and nutrition.
- Flavors and aromas in foods and why they are there.
- Multisensory perception, cross-modal perception, and other fascinating topics.
- Protein leverage and the post-ingestive effects of food.
- All about water, solutions and solubility, osmosis, alcohol, specific heat, boiling point, vaporization, freezing, water activity, and food storage.
- The many types of salts (including table salt), and how they change foods.
- Sugars and Starches, including glucans, galactans, fructans, types and properties of sugar, sucrose, hydrocolloids, and the starch cycle.
- Colloids, emulsions, foams, and gels.
- Lipids, triglycerides, fats, phospholipids, waxes, terpenes, and steroids.
- Proteins: structure, how they are formed, gluten, egg foams, transglutaminase, collagen, myosin, elastin, keratin, denaturation, enzymes, and more.
- Nutrition, health, food safety, and sustainability.
- Bacteria, yeasts, and fermentation in foods and in biology.

Accuracy and Errors

I have done my best to balance accuracy and clarity in this course. In a few areas I simplify explanations or leave out advanced details that are unimportant for the study of food science in favor of “not-going-off-the-deep-end-iness.” Believe me, there is no end to how far down the rabbit hole you can go.

It is also possible that, while this course has been carefully edited, there are technical errors and/or typos. In addition, our understanding of science changes over time. If you find any mistakes or areas that are unclear, please email errors@chefsvillage.org.

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