Feature Book Review

Tastes Like Science: Using Food to Serve Up Savory Explorations

Review of: *On Food and Cooking: The Science and Lore of the Kitchen*, 2nd ed., by Harold McGee; 2004; 884 pp.; Scribner Press (New York); ISBN: 0-684-80001-2

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Food and cooking are intimate parts of daily life. Because of this familiarity they provide engaging and accessible entry points for scientific explorations by virtually any learner—from kindergarten through college and beyond. Consider just a few technically challenging concepts that can be intimidating to students and learners of any age: carbohydrate chemistry; conduction, convection, and radiation; enzymatic reactions; tissue structure; and energy. Yet, these concepts and many more are foundational to an informed appreciation of the commonplace experiences of food preparation. Because of the breadth of the science and multiple entry points encompassed by the science of cooking—levels from kindergarten through college, adult education, and teacher professional development—we find that food and cooking provide a rich stew of possibilities for injecting science into approachable explorations with broad appeal, a high comfort level, and often, at the end of class, a tasty product.

On Food and Cooking is an impressive blend of scientific breadth, depth, and clarity, entwined with practical application. Harold McGee's precise and articulate text explores the chemical, physical, and biological principles that are intrinsic to the production and preparation of food, the nature of the raw materials that comprise food, and the scientific foundations of the varied culinary techniques used in meal preparation. We have used this book as our main reference for the single and multiday hands-on "Food Science" workshops that we have taught for many years to middle school and high school teachers. After completion of the workshops, the teachers reproduce the hands-on explorations with their students at appropriate points in their curriculum. Universally, teachers report back to us that students normally intimidated by science find food and cooking an appealing way to explore scientific processes and learn scientific principles.

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DISCUSSION

At more than 800 pages, this book is a weighty, dare we say "meaty," tome packed with information. It is engagingly written and the scientific explanations are clear and concise.

As we have done, the reader may choose to use it specifically as a reference book and a source of inspiration for activity development. Numerous line drawings, diagrams, and tables help to illuminate the material. It is written for a general reader and the science pertinent to each topic is introduced at a basic level, but McGee builds on this foundation by layering greater and greater detail throughout each chapter.

The first thirteen chapters cover the gamut of foods and include: milk and dairy products; eggs; meat; fish and shellfish; vegetables; fruits; herbs, spices, tea, and coffee; seeds (grains, legumes, and nuts); cereal, doughs, and batters (breads, cakes, pastry, and pasta); sauces; sugars, chocolate, and confectionery; and wine, beer, and distilled spirits. Each of these chapters opens with a history of the food; the anatomy, structure (cellular and organismal), and physiology of the food; and notes on safety and safe handling. Each of these chapters ends with details of the various types of cooking and preparation common in that food category.

The last two chapters are particularly useful to the reader who is either new to or who has been away from basic chemistry, biochemistry, and physical science. For example, Chapter Fourteen, "Cooking Methods and Utensil Material," goes beyond merely describing cooking techniques. It describes, at a reductionist-pleasing level, the physical and chemical processes inherent to varied cooking methods, ranging from pressure cooking to deep frying and the pros and cons of one method over another. The biochemistry of browning reactions and their relation to the soluble and volatile molecules that interact to give us "flavor" are included. Forms of heat transfer (conduction, convection, radiation) and their roles in cooking are covered, along with the reasons for the differences in chemical reactivity and heat conductivity of commonly used cooking vessel materials. Chapter Fifteen, "The Four Basic Food Molecules," is a primer on the biochemistry of water, lipids, carbohydrates, and proteins and how and why these properties dictate the cooking method of choice. Finally, McGee includes a superb appendix titled "A Chemistry Primer" that succinctly introduces atoms, molecules, chemical bonds, energy, and the phases of matter.

To highlight the value of this book for teaching science, consider several examples. Chapter One, "Milk and Dairy Products," discusses ruminants, nutrients, lactose digestion, how the cow makes milk, the components of milk, and fermented and unfermented dairy products and ends with an extensive narrative on cheese and cheese making. We have conducted a variety of explorations based on this chapter. For example, making a simple coagulated cheese by adding lemon juice to heated milk encompasses the principles of protein structure and denaturation, micelle formation, and pH. Very young learners enjoy making this simple lemon cheese and learn that the "curds and whey" enjoyed by the nursery rhyme character, Little Miss Muffet, have a

basis in science. Scientifically sophisticated participants can delve into the composition of curds and whey (casein micelles and lactoglobulin, respectively) and conduct experiments around the unique properties of these proteins. For example, unlike most proteins, they do not denature with heat unless the milk has first been acidified. Casein micelles are revisited in the section on fermented products, revealing how their structural reorganization changes liquid milk into a fragile solid. If you aren't "into" cheese, you might consider engaging your latte-sipping undergraduates with McGee's enlightening discussion about creating the perfect foam for espresso-type drinks. We suspect that few of them have considered the roles of heat, steam, air, temperature, gravity, and the ideal interactions of these factors, in making the perfect foam.

Another highlight of the value of this book for teaching science is Chapter Five, which provides a general introduction to edible plants and includes details on plant cells and plant structure and a host of concepts ideally suited to hands-on explorations. For example, pH sensitive pigments, such as the anthocyanins in red cabbage, are easily isolated and used for experiments. Alternatively, making the Korean delicacy, kimchee, is a multicultural introduction to the concepts of density, osmosis, fermentation, and pH. Finally, the examination and dissection of fruits and vegetables (and their subsequent consumption) are ideal means to introduce plant structure, development, and tissue differentiation.

"Partial Thermal Degradation of Foamed Polysaccharides with Protein Inclusions," i.e., making peanut brittle, is a classic high school chemistry lab, as is the making of ice cream. McGee's chapters on "Sugars, Chocolate, and Confectionery," and "Milk and Dairy Products" offer excellent discussions relevant to these activities, ranging through freezing point depression, boiling point elevation, whipping, foaming, the role of temperature, and the role of sugar and other ingredients. "Sauces" includes more great chemistry connections with its thorough discussion and instructive illustrations on thickeners, including thickening with particles (a suspension), molecules (e.g., gravy), droplets (emulsions), and bubbles (foam).

This review does not even begin to scratch the surface of the wealth of information contained in *On Food and Cooking*. Although many other books and Web sites of this genre exist, this book is by far the most complete, scientifically detailed, and useful as an educational reference. From our experience, food and cooking are universally engaging, ideal venues to help students or learners of any age engage with science in a personal, comfortable, and delicious manner. Whether you are considering spicing up your college lectures, developing hands-on science explorations for students, or working with interested adults, *On Food and Cooking* will become an indispensable ingredient in your lab pantry.