

*Second Edition*

# THE SCIENCE OF WATER

Concepts and Applications

Frank R. Spellman



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# Preface

Hailed on its first publication as a masterful account for both the general reader and student, *The Science of Water* continues to ask the same questions: water, water, water ... water everywhere, right? In addition, it asks: the Earth's supply of finite water resources can be increased constantly to meet growing demand, right? Despite these absurdities, a belief actually does prevail that the Earth's finite water resources can be increased constantly to meet growing demand. History has demonstrated that consumption and waste increase in response to rising supply. However, the fact of the matter is that freshwater is a finite resource that can be increased only slightly through desalinization or some other practices, all at tremendous cost.

In addition to asking the same questions, this standard synthesis has now been completely revised and expanded for the second edition. The text still deals with the essence of water, that is, what water is all about. Further, while this text points out that water is one of the simplest and most common chemical compounds on Earth, it also shows water to be one of the most mysterious and awe-inspiring substances we know. Important to this discussion about water and its critical importance on Earth is man—man and his use, misuse, and reuse of freshwater and wastewater. Furthermore, this text takes the view that since water is the essence of all life on Earth, it is precious—too precious to abuse, misuse, and ignore. Thus, as you might guess, the common thread woven throughout the fabric of this presentation is water resource utilization and its protection.

The text follows a pattern that is nontraditional; that is, the paradigm (model or prototype) used here is based on real-world experience—not on theoretical gobbledygook. Clearly written and user friendly, this timely revision of *The Science of Water* builds on the remarkable success of the first edition. Still written as an information source, it should be pointed out that this text is not limited in its potential for other uses. For example, while this work can be utilized by the water/wastewater practitioner to provide valuable insight into the substance he/she works hard to collect, treat, and supply for its intended purpose, it can just as easily provide important information for the policymaker who may be tasked with making decisions concerning water resource utilization. Consequently, this book will serve a varied audience—students, lay personnel, regulators, technical experts, attorneys, business leaders, and concerned citizens.

The question thus becomes: Why a text on the science of water? This leads to another question: Is it not the case that water treatment, wastewater treatment, and other work with water are more of an art than a science? In answering this first question, it should be pointed out that the study of water is a science. It is a science that is closely related/interrelated to other scientific disciplines such as biology, microbiology, chemistry, mathematics, and hydrology. Therefore, to solve the problems and understand the issues related to water, water practitioners need a broad base of scientific information from which to draw.

To answer the second question, with a finite answer, it might be easier to bring up another question or situation—for the purist, an analogy. Consider, for example, the thoracic surgeon (thoracic surgery is the major league of surgery, according to a thoracic surgeon I know), who has a reputation for being an artist with a scalpel. This information may be encouraging to the would-be patient who is to be operated on by such a surgeon. However, this same patient may further inquire about the surgeon's education, training, experience, and knowledge of the science of medicine. If I were the patient, I would want her (the artful surgeon) to understand the science of my heart and other vital organs before she took the scalpel in hand to perform her artful surgery. Wouldn't you?

**Frank R. Spellman**

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# To the Reader

In reading this text, you are going to spend some time following a drop of water on its travels.

When you dip a finger in a basin of water and lift it up again, you bring with it a small glistening drop out of the water below and hold it before you.

Do you have any idea where this drop has been?

What changes it has undergone, during all the long ages water has lain on and under the face of the Earth?



Running Water. White Oak Canyon Trail, Shenandoah National Forest, Virginia. [Photo by Revonna M. Bieber (November 29, 2006).]

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# About the Author

**Frank R. Spellman, Ph.D.**, is an assistant professor in Old Dominion University's Environmental Health Division. He has a B.A. in public administration, a B.S. in business management, an M.B.A., and an M.S. and a Ph.D. in environmental engineering. He lectures on homeland security and health and safety topics throughout the United States and teaches water/wastewater operator short courses at Virginia Tech.

Dr. Spellman writes on a range of topics in all areas of environmental science and occupational health. Several of his texts have been adapted/adopted for classroom use at major universities throughout the United States, Canada, Europe, and Russia; two are currently being translated into Spanish for South American markets.

Dr. Spellman has been cited in more than 400 publications. He serves as a professional expert witness for Domina Law Group, Omaha, Nebraska, and he consults on homeland security vulnerability assessments (VAs) for water/wastewater facilities nationwide. He receives numerous requests to collaborate with well-recognized experts on publications in various scientific fields. He is a contributing author to *The Engineering Handbook*, 2nd edition, published by Taylor & Francis.