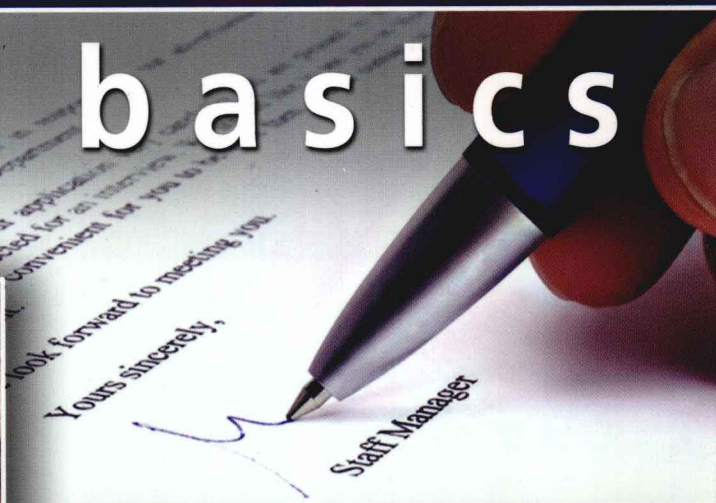


Second Edition

FORENSIC SCIENCE

the basics



Jay A. Siegel • Kathy Mirakovits

 CRC Press
Taylor & Francis Group

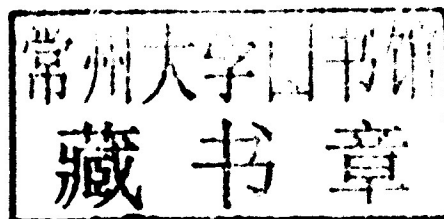


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Dedication

To my family, Maggie, Paul, and Sam. They are my reason for being. Can any legacy be as important? Thank you all for your love and support.

Jay Siegel

I dedicate this book to my father, Carl J. Busch, who always had faith in my accomplishments. He quietly supported and gently nudged me to push myself to the upper limits of my abilities.

Thank you, Dad. I hope you are smiling and applauding in Heaven.

Kathy Mirakovits

Foreword

If you were to ask middle school or high school teachers why they teach science, their answers might not display a specific love for a particular area of science such as physics or biology. The true love of teaching science stems from a thirst for problem solving and answering the questions of *why* and *how*.

When I first began teaching high school students nineteen years ago, I had a predescribed checklist of science knowledge that I thought students had to master in order to succeed in life. Within my first four months of teaching, I realized those factoids didn't matter to most kids. What became most important was the student's attitude toward science. Once students walked through my classroom doors as ninth graders they had already formed their views of science as either boring, fun, or something for boys to do. My goal for my students was to foster a love for problem solving, giving them a foundation of steps to begin to answer the why and how questions with confidence and perhaps a little enthusiasm. I knew I was on the right track when on the last day of school, one of my female students turned to me and said, "Thanks for a great year. For the first time in my life, I actually enjoyed science!"

Traversing through my career of teaching earth science, integrated science, agriculture biology, animal physiology, veterinary science, and now biotechnology, I have solidified my resolve that teaching high school students skills provides them the foundation they need to academically succeed in any content area. Forensic science naturally teaches students skills in observation, documentation, inquiry, literacy, communication, and investigation, all while connecting academics to the working world. Through the television experience of *CSI*, students make direct connections to careers through forensic science. Even though glamorized, they see a range of personalities performing as skilled lab technicians, crime scene investigators, medical examiners, and all areas of law enforcement. They see curiosity in action and the range of skills and aptitudes required to perform the specific duties of the job. *Forensic Science: The Basics* provides a much-needed resource for teachers and students. Each chapter is clearly mapped out with learning objectives and contains a wealth of current content information, examples and illustrations, a useful summary, self-evaluation at the end of each chapter, and additional resources for further comprehension. This book is critical for providing the content background necessary for students to understand before they complete any laboratory experience.

Forensic science is exciting to teach and learn, as it is the realistic application of all areas of science. Jay Siegel and Kathy Mirakovits have created a reliable and fundamental resource to add credibility to real world science in the classroom. I have worked with Kathy as a participant in her forensic workshops for teachers and enjoy her passion for science and applaud the professional commitment she has made to provide teachers with critical content and hands on training. I met Jay as a guest presenter at one of Kathy's workshops. I appreciate his understanding of the need to provide a user-friendly resource connecting the bridge between college level academia and middle and high school education.

Lori Steward

*Linden High School science teacher
Linden, California*

Preface

Forensic science has changed quite a lot since the first edition of *Forensic Science: The Basics*, was published in early 2007. Media coverage of the successes and failures of the criminal justice system and forensic science continues to increase as does public interest in science and the law. The Innocence Project has helped free more than 200 wrongly convicted people to date. The validity of some traditional forensic sciences such as fingerprints and firearms is being questioned by scientists, judges, and lawyers. The number of high school classes in forensic science as well as college degrees, both undergraduate and graduate, continues to increase. Case backlogs nationwide have risen to more than 500,000 and there is a shortage of qualified forensic scientists that is approaching 2,000. With all of these happenings, there continues to be a need for quality forensic science text and lab materials that provide students in high school and college with a solid education in forensic science that builds upon a firm foundation in the sciences. *Forensic Science: The Basics, Second Edition*, builds on the standard it set for introductory forensic science text books and goes it one better.

Forensic Science: The Basics keeps the basic structure of the book, taking students through the criminal justice and forensic science systems from crime scene to court. It builds a solid foundation of tools such as microscopy, spectroscopy, and separation sciences and then applies them to the analysis of both the familiar types of evidence such as DNA, drugs, and trace evidence, but still covers the not so commonly studied “-ologies”—pathology, anthropology, odontology, and entomology. The book is flexible and comprehensive enough to be used in a one- or two-semester class, giving the teacher maximum flexibility in topics to cover.

Even though the basic structure and chapters have stayed the same, there have been big changes in the second edition. First, there are now two authors. In addition to Dr. Jay Siegel, a forensic scientist and college educator for more than thirty years, Kathy Mirakovits has joined the team. She is one of the most experienced and dynamic secondary school teachers of forensic science in the United States. She not only teaches basic and advanced forensic science classes in Portage, Michigan, she also conducts workshops for teachers all over the country and at national and statewide science teachers’ meetings. She is also a consultant for a leading producer of forensic science education kits and has developed many of her own materials. She brings to *The Basics* the secondary school perspective that makes it even more relevant and appropriate for high school, community college, and university courses. She has also taken the best from her workshops and incorporated them into *Forensic Science: The Basics*. Each adopter will get a collection of laboratory exercises from the basic to the advanced, with detailed instructions as well as lists and sources of the materials needed. Other new features of *The Basics* include presentations of real cases that illustrate the various types of forensic evidence, a mini glossary at the beginning of each chapter, Web resources, mini lab exercises in most chapters, up-to-the-minute information about forensic science, many new figures and photos, and expanded questions at the end of each chapter. We are also planning a teacher’s edition of the book and access to informative Web resources of Taylor & Francis. We believe that *Forensic Science: The Basics* will meet and exceed your needs and expectations for text material in your introductory or advanced class in forensic sciences. Feel free to contact us with your questions and comments.

About the Authors

Jay Siegel is currently director of the forensic and investigative sciences program at Indiana University–Purdue University, Indianapolis, and chair of the department of chemistry and chemical biology. He holds a Ph.D. in analytical chemistry from George Washington University. He worked for three years at the Virginia Bureau of Forensic Sciences, analyzing drugs, fire residues, and trace evidence. From 1980 to 2004, he was a professor of forensic chemistry and director of the forensic science program at Michigan State University in the School of Criminal Justice. Dr. Siegel has testified as an expert witness more than two hundred times in twelve states, federal court, and military court. He is editor-in-chief of the *Encyclopedia of Forensic Sciences*, author of *Forensic Science: A Beginner's Guide* and *Fundamentals of Forensic Science*, and has had articles and papers published in more than thirty forensic science journals. In February 2009, he was named Distinguished Fellow by the American Academy of Forensic Sciences. In April 2009, he was named the Distinguished Alumni Scholar by his alma mater, George Washington University.

Kathy Mirakovits teaches forensic science and physics at Portage Northern High School in Portage, Michigan. She holds a master's degree in science education from Western Michigan University and a bachelor's degree in science education from Miami University. Kathy has also served as science department chairperson for six years at Portage Northern. She taught at the high school level in Ohio, California, and Michigan for almost twenty years, and during that time taught general science, physical science, chemistry, biology, Earth science, and physics. Additionally, Kathy conducts workshops across the United States for teachers who wish to learn the application of forensic science in a school curriculum. She has developed numerous forensic science educational products for a national science supplier and has led workshops at the National Science Teachers Association (NSTA) in forensic science. Kathy led the teacher steering committee for the Forensic Science Educational Conference sponsored by the American Academy of Forensic Science at Michigan State University in August 2008.

Kathy has served as president of the Michigan Chapter of the American Association of Physics Teachers (AAPT) and as a curriculum writer for the Michigan Department of Education. Currently, Kathy serves as director-at-large for the Michigan Science Teachers Association. She has received the RadioShack Science Teaching Award and was a state finalist for the Presidential Award for Excellence in Math and Science Teaching (PAEMST).

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PART I

Forensic Science and Investigation



1

Introduction to Forensic Science



Learning Objectives

1. To be able to define forensic science and describe its various areas
2. To be able to describe the major events in the history of forensic science and relate them to modern-day practice
3. To be able to describe the duties of a forensic scientist
4. To be able to describe the organization of federal, state, and local forensic science laboratories
5. To be able to diagram and describe the flow of evidence through a crime laboratory
6. To be able to describe the qualifications for becoming a forensic scientist
7. To be able to obtain information on careers in forensic science