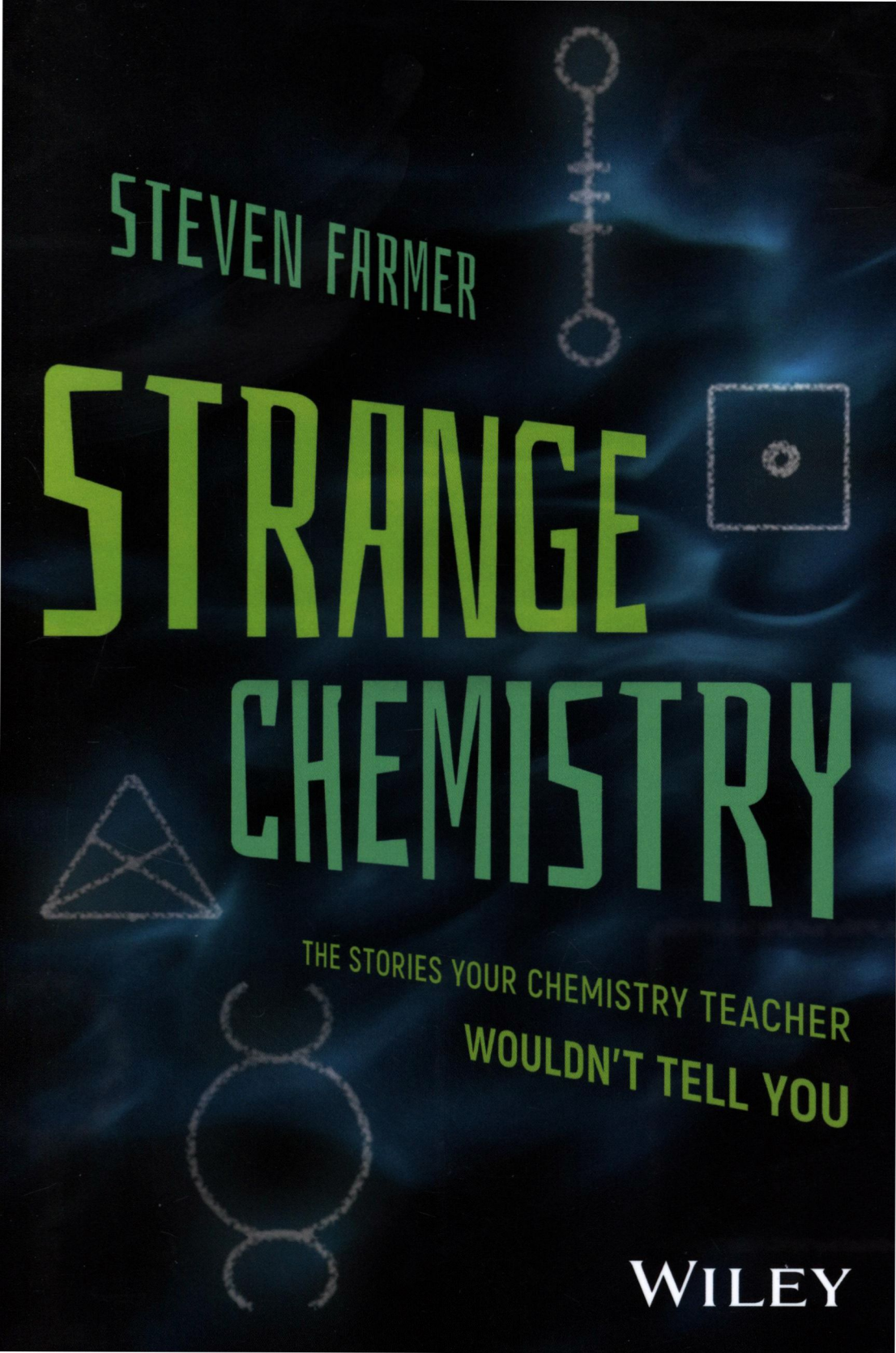
STEVEN FARMER
STRANGE CHEMISTRY
THE STORIES YOUR CHEMISTRY TEACHER WOULDN'T TELL YOU
WILEY

Did you know that many components of foods come from quite unexpected sources, for instance, Gummi Bears® are actually made from cows, Junior Mints® are shiny because they are coated with bug secretions, and many packaged luncheon meats have viruses added to them?

Strange Chemistry opens the audience's eyes to the extraordinary scientific secrets hiding in the everyday objects around them. The book covers broad subjects that touch on everyday life, including the chemistry of poisons, illicit drugs, explosives, foods, common household products, and radiation.

Readers will find the information not only intriguing, but also absorbing and edgy. Unlike other science interest books, *Strange Chemistry* focuses on the darker, wilder side of chemistry, which, unfortunately, most authors and chemistry teachers tend to avoid.

Helping readers increase chemistry knowledge in a fun and entertaining way, the book is perfect as a supplementary textbook or gift to curious professionals and novices.

STEVEN FARMER, Ph.D., has worked as a chemistry instructor at California State University, Sacramento and at University of California, Davis. Currently, he holds the position of Professor of Chemistry at Sonoma State University (SSU). Dr. Farmer is a seasoned teacher with over a decade of experience teaching general chemistry, organic chemistry, and advanced organic synthesis courses. He has earned six teaching awards, including the Sarlo Excellence in Teaching Award, which is given to only one of the over 500 SSU faculty each year. He performs research involving chemical education and is actively involved in giving outreach lectures to the public.

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STRANGE CHEMISTRY

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Strange Chemistry

The Stories Your Chemistry Teacher Wouldn't Tell You

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Strange Chemistry

Dedication

I would like to dedicate this book to my parents James and Margaret.

Throughout my whole life whenever I looked, you were there; ready to give me love and support, guidance and security, and praise and encouragement. You filled me with your dreams and showed me what it takes to succeed in life. Without you both none of the things I have accomplished would have been possible. I am truly blessed to have such incredible parents, and I love you both.

Preface

Growing up in Northern California was much more curious than one might think. Napa, being part of Northern California, was affected by the LSD (lysergic acid diethylamine) counterculture centered in Berkeley and San Francisco. LSD was everywhere and I recall multiple instances in high school where a classmate would admit to attending class under the influence of LSD and try to describe the effects. This seems very rebellious, but in one of the most tragic events of my life, a high school friend jumped in front of a car on the highway after ingesting LSD. He was killed instantly. This event had such a profound effect on me that it eventually drove me toward a career in chemistry – I needed to understand what had happened to my friend. How could the ingestion of a molecule cause such profound effects? Is awareness really just a fragile chemical process that can be so easily tricked?

After the mass closures of the 1980s, Napa State Hospital was one of the few remaining state run mental hospitals in California. If you have seen the movie *One Flew Over the Cuckoo's Nest*, it was filmed at Napa State Hospital. As a child, I would often wonder about the causes of mental illness. I was told that mental illness was the result of a "chemical imbalance" in the brain, but what did that really mean? Could a slight change in a chemical really change our perception of the world?

Similar to many scientists before me, my career in chemistry was driven by a quest to better understand some of the questions that haunted my childhood. Surely, obtaining a degree in chemistry would allow me to understand how hallucinogens work, or what causes mental illnesses. Unfortunately, I was wrong. Chemistry courses seemed to steer clear of any topic of an edgy, dangerous, or unusual nature. In fact, initially learning about these fascinating topics required a course outside the chemistry department. Eventually, a graduate elective course from a psychology department, called "Psychopharmacology," explained the chemical basis for the effect of hallucinogens and the causes of mental illness (I share what I learned in this book).

Later, when I became a chemistry instructor, I made it a point to share these and other stories. It was delightful to find that almost everyone found these

topics just as interesting as I did. As I collected new stories, I realized how much of this material was never discussed as part of the numerous chemistry courses required for my Ph.D. Roughly 90% of these stories contained in this book were learned after I graduated. This is where the subtitle of this book, "The stories your chemistry teacher wouldn't tell you" comes from. It seems that there is an overwhelming push to teach the fundamentals of chemistry while neglecting to show the utility of learning the material by connecting it to the real world. Particularly for organic chemistry, there seems to be an aversion of some of these topics, which I feel is because chemists do not want their science associated with anything that poisons you, blows you up, or gets you high. However, these are the topics that many people find exciting (as can be seen by looking at the plot of almost any action movie). Ask a nonchemist where chemicals appear in everyday life and inevitably the answer involves pharmaceuticals, toxins, or illicit drugs.

To share these stories with my students, I usually would take about 5–10 minutes each week to present one of the stories described in this book. For those of you who are teachers or who plan to be, I can say that these stories have been the largest source of positive feedback I have received from my students. Although there is an enormous amount of material that needs to be covered in a typical chemistry course, I say make the time for these extras. It is that important! On multiple occasions, students admitted to me that they only came to class that day so that they could hear the story. Many times, students would speak to me after the lecture to share how that day's story had touched them in some way. One student had been to the emergency room for an acetaminophen overdose, another had a stepfather who was addicted to opioids, and yet another was prescribed amphetamine to treat their attention deficit hyperactivity disorder (ADHD).

You will note that most of the presented stories are short and involve a question or a defined idea. This is done for two reasons: First, I love presenting these questions to my students and trying to evoke an answer from them. Putting students on the spot drives home how little they actually know about the world and how learning chemistry helps them understand their lives. I admit, few things have made me feel more educated than seeing a single simple question stump a classroom with over 400 students. Try it. You will find that very few people know the answers to the questions posed in this book. In addition, some of the cheeky answers I receive have become the highlights of my teaching. Second, I present the stories in a simple format because they will be easy to remember. Jokingly, I tell students to share these stories with their friends and family members so that they can prove that they are receiving an education at Sonoma State University. I am pleased to say that they do just that. An informal poll of my students showed that 90% of them had shared a story at least once, and 75% said that they shared these stories on a regular basis.

Students, like all human beings, want to understand the world around them – they may just not realize it. Telling stories that help students understand and connect to the world they see inspires them in a primal way, making them want to learn and keep coming back for more. This book contains the best stories I have collected over the last 10 years. If you are a teacher, try some of them out and see the profound effect they have on students. Even if you are not a teacher, read on, better understand the world around you, and see how truly strange chemistry can be.

Acknowledgments

To my loving wife, Joy: You are still the most beautiful woman I have ever seen. You are my muse, my life, and the air that I breathe. You are the personification of everything that makes me happy in this world. It was only your love that allowed me to face the adversity I have seen. You have been with me since the start of this journey and I cannot wait to see where life takes us.

To my brother, Richard: Thanks for being the oldest friend I have and for being the funniest person I know.

To my first college chemistry professor, Dr Steven Fawl: Thanks for all of those long talks in your office. Thanks for taking time out for someone who had absolutely no idea what he was going to do with his life. Of all my science professors, you seemed the most worldly and grounded. Your knowledge of chemistry seemed to let you understand the world and how it works. It was because of you that I decided to become a chemist.

To the students of Sonoma State University: Thanks for listening to all of my crazy stories and for continually reminding me why I love teaching so much.

To my colleagues in the chemistry department: Thanks for your help in vetting these stories.

To my agent, Priya Doraswamy of Lotus Lane Literary (lotuslit.com): Thanks for being one of the nicest people I have ever worked with and for helping me realize my dream.

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