Book Reviews

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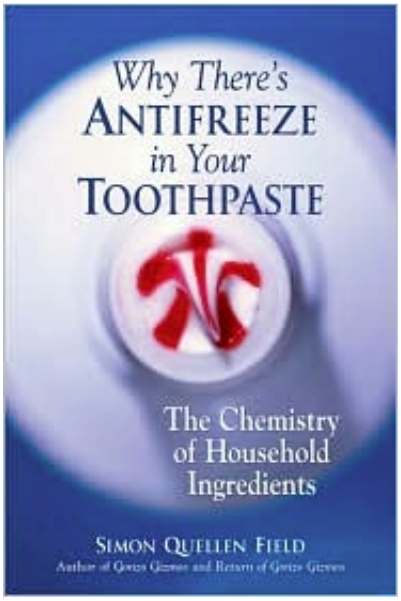
The following book reviews were written by NCSTA members and teachers. We hope to make this an ongoing feature in The Science Reflector. If you are an author who has a book you would like reviewed or a teacher who would like to write a review, please contact Beth Harris.

For more reviews and correlated activities check out the Science Literature Database from UNC-Wilmington.

Why There's Antifreeze in Your Toothpaste: the Chemistry of Household Ingredients
Simon Quellen Field, Chicago Review Press, 2007
ISBN 978-1556526978



This book provides a compilation of chemicals and additives in ordinary products found in most homes. Although it is not the sort of book a person might want to read for pleasure, it was very interesting and caused me to think of some personal experiences. For example, one day I realized that the margarine I purchased would not completely melt in the microwave. Right away I knew that was probably not the kind of thing I needed to eat. But it was not until I read about the fat substitutes that I learned that many of them are "nondigestible plastic." Reflecting on this piece of information, I have decided that I will use real butter from now on.

There are a few things I particularly like about this book. The author shows the molecular structure of the chemicals mentioned in the book. Because I am not a chemist, the diagrams enable me to better understand some of the explanations. I can see, for example, what is meant by "long-chain fatty acids." In some places, as in the section about polymers, Field gives a "chemistry lesson." The diagrams show as Field explains the differences between common polymers such as Plexiglas and Styrofoam. So, in my case, a picture really is worth a thousand words!

Another thing I like about the book it lists synonyms for the chemicals. I did not know that gelatin was also called "bone and skin extract" and "collagen." I always assumed they were completely different things! I do read the labels on food packaging and on personal items such as soap and shampoo. There are many ingredients that I have never been able to identify until now, and I recognized many of the names as I read this book. I actually used this book to compare a brand name shampoo and a store brand shampoo. The ingredients were almost identical when I took the synonyms into account. As a consumer, I find this information valuable.

I think the book is a wonderful resource for science teachers! As all educators know, it is often difficult to attract and maintain the interest of students. Many of the chemicals identified in the book have been mentioned in my middle school science class. So, this book can be used as a desk reference and as a springboard for lessons. My students like it when they think I am "off the topic," and they particularly enjoy it when the information I share is "gross" and "disgusting." I think taking a moment or two to insert information from the book into my instructional delivery is a way I can hold their attention a little longer. Also, students will become armed with a piece of knowledge that will enable them to make stronger connections to everyday life and cause deeper understanding to occur.

This book could also be useful in a classroom for management's sake. Most middle school science classes are heterogeneously mixed. Academically gifted students are frequently in classes with learning disabled students. While both types of student have talents and abilities that can be paired cooperatively to enhance everyone's success, there are many occasions when students work independently. A smart teacher knows he/she must have a "Plan B" for students who finish assignments before other students. This is the kind of book a student of just about any ability level could read and enjoy. Because it addresses common household products and each of the entries is short, it is the perfect for occupying a few minutes of student leisure. It also has entries of topics about which students are naturally curious, including nicotine and alcohol. I plan to add this to the independent reading library in my classroom.

The author, Simon Field, lives in Los Gatos, California. He is the president of Kinetic Microscience, a business that sells science toys. He has been dubbed the "Gizmo Guy." An interesting thing he shared about himself is that he takes the time to answer Email questions from kids. He explains how and why the toys work, but also handles general questions about science. His website contains videos and written instructions for making science toys at home. He guarantees the toys he describes will work every time, and they will work well. Field also writes computer programs for Google.

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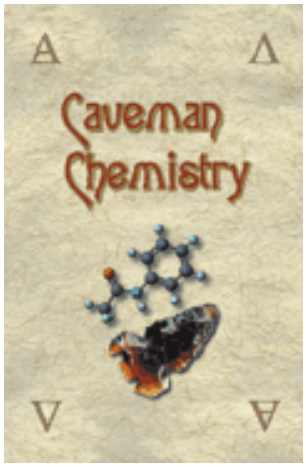
Caveman Chemistry: 28 Projects, from the Creation of Fire to the Production of Plastics
Kevin Dunn, Universal Publishers, 2003
ISBN 978-1581125665



We live in a world that is the product of technological advancement. But that is just the problem; we see the product, not the efforts to develop them. We strike a match and expect it to light; we clean the bathroom and expect the cleaners to dissolve the soap scum. Fabrics, plastics, batteries and photographic film are used daily but they are not appreciated for the difficulty in their conception, the beauty in their theoretical basis and the simplicity in their fabrication. Kevin Dunn, in his book *Caveman Chemistry*, has outlined a progression of chemical developments that impact our lives today in such a way that the importance of each, within an historical context, is more clearly understood.

The journey of *Caveman Chemistry* starts with the development of fire making and progresses ultimately to the discovery of plastics. Each chapter is divided into three parts: 1-An alchemical discussion of the technology to be explored by one or more of the elements, 2-A discussion of the modern understanding of chemistry involved and 3-The instructions for an experiment to explore this discovery. This framework is very effective on two levels. First, by considering the developments of mankind in a progressive fashion and by incorporating previous results in subsequent projects, the interconnected nature of the technologies is emphasized. Second, the elemental discussions in the first part of each chapter bring to the forefront the antiquity of each development.

The topics in the book are not new to anyone, they all impact us daily, but have we thought about them. Fire is the first developed; this is then used to fire pottery to make a crucible. The crucible is then used to make glass

and smelt metal. This is but one line of progression followed in *Caveman Chemistry*. The discussions about this line are very interesting. What are the issues of making fire? The crucible must have integrity, so how is this obtained? What method of smelting do different metals require? These and other questions are considered in the theoretical portion of each chapter.

The most interesting part of each chapter is the experiment. Most of the experiments can be performed using primarily household items (things from a grocery store). The idea of experimenting your way through the history of man, obtaining technology in the same order as our progenitors is very intriguing. This would be a class I would want to be a part of (apparently this book stems from a class the author teaches at a college).

The question now becomes, how is this book applicable to me? The answer is simply “in every way”. The way I view even the simplest object is different because I have a keener grasp of its history, not its physical history but its developmental history. Knowing the leaps of inspiration and the elapsed time each object is more venerable and purposeful. Instructionally, I see that many of the most profound developments of our civilization stem from simple means and can be reproduced by anyone with a little direction. Science has become more accessible and less dependent on high dollar equipment.

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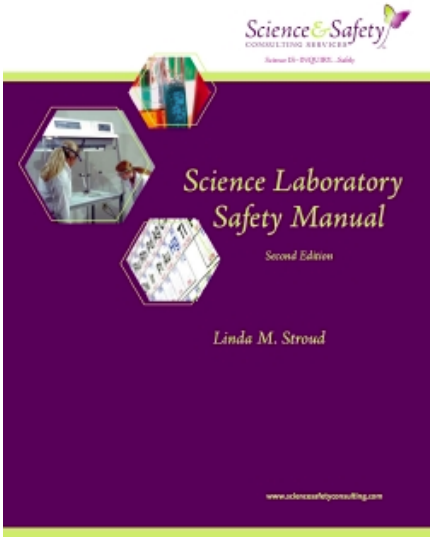
Science Laboratory Safety Manual. Second Edition
Linda M. Stroud, Science & Safety Consulting, Inc., 2008



Every science teacher, whether they work in elementary, middle or high schools; community colleges, or universities should be concerned about safety. Our goal should be to NEVER have an accident or unsafe situation in our laboratories, stock or preparation rooms. Unfortunately accidents do occur in North Carolina science classrooms and laboratories every year. As we begin a new academic year it seems only appropriate to take the time to make sure our facilities are properly set up, our stock rooms are organized safely and our policies and procedures are designed to do everything possible to help our students learn safely.

This year we have a new aid in designing, assessing and operating our classrooms in a safe manner. The second edition of Dr. Linda Stroud’s Science Laboratory Safety Manual was published earlier this year. While the first edition was referred to as a comprehensive safety reference, the new edition gives a whole new meaning to the term. I have spent the past few weeks trying to think of a question concerning science laboratory safety that I couldn’t find an answer to in this manual. So far, I have failed completely.

In some 364 pages, Dr. Stroud covers science safety from every point of view. Beginning with an overview of safety goals spelled out by the North Carolina State Board of Education and the Occupational Safety and Health Act she looks at the major topics of chemical management, facility planing and operation, personal protective equipment, safety staff development, and funding for safe science programs. Then Dr. Stroud discusses the necessity for safety training and motivation for students and teachers. In doing so she draws extensively on "Science Safety: A Status Report of North Carolina Schools" authored by Clara Stallings. The report was based in large part on science safety assessments from over 300 schools across North Carolina which were carried out by Stallings and Dr. Stroud. In the remaining pages of the first section of the manual Dr. Stroud lays out the basics of the federal law and provides statistics concerning the violations found when the Occupational Safety and Health Administration inspected in schools across the United States in 2007. She also lists the items looked for by OSHA inspectors during those school visits in addition to giving the mandatory reference for each required item. If you ever thought our schools were generally a safe working environment, this report will give you nightmares.

The second section of the manual considers the legal issues related to laboratory safety. Beginning with laws and regulations, Dr. Stroud deals with teacher liability issues in great detail. She then explains negligence as it applies to science teachers in tort law and explains in carefully sequenced detail what you need to do if an accident does happen in your classroom. This section concludes with selected example of accidents and their case histories to help you understand how courts consider negligence and apply it to educational situations.

With the statutory and legal areas related to science safety considered, Dr. Stroud turns to techniques for preventing accidents. This section begins with a discussion of the need for safety programs, contracts, rules, campaigns and orientations. At the conclusion of this section, she provides suggestions for student safety related activities and provides some 34 examples of typical accident situations to be discussed in your classroom to help students understand the need for calm and rational responses to such events The exercises are divided with 16 for K-5 students and the remainder for middle and high school students.

The last six sections of the manual are devoted to specific hazards, facilities and equipment. The first section deals with biohazards and radiation. Specific attention is paid to student practices. Biocontainment, safety practices, standard operating procedures, and contamination prevention barriers are discussed along with biosafety levels. She also discusses infectious diseases with special attention to EscherichiaColi (E. coli), Staphylococcusaurens (MRSA), molds, and blood borne pathogens. Decontamination is discussed and directions are provided for mixing decontamination solutions.

The use of animals in the classroom and laboratory has long been an area of concern for those of us working in the area of safety. Dr. Stroud has provided a detailed description of procurement procedures, housing, care (both during school and on weekends and holidays), handling of waste, first aid and animal handling protocols. A section is devoted to invertebrates, embryology, and dissection. Problems related to the release of non-indigenous organisms are also discussed. A subdivision of this section is devoted to problems which may occur when plants or mushrooms are misidentified. Protocols for handling plants are provided along with precautions and a table listing a number of plants which are hazardous showing their toxic parts and symptoms which suggest exposure. The last part of this section deals with all kinds of radiation. The uses and hazards presented by radioactive sources, and lasers are discussed along with recommendations for personal protective equipment.

One of the largest sections in the manual deals with chemical management. Dr. Stroud goes to great lengths to help the reader understand the various standards and classification systems applied to the storage, safe use and disposal of chemicals. The toxic effects of chemicals is explained along with precautions for handling reagents. Sections are also devoted to procurement, labeling, and dispensing of chemicals. The various chemical hazard rating systems are discussed and the most common chemical labeling systems are described and illustrated. Special attention to the arrangement and storage systems for chemicals are illustrated using the Fisher five color system, the J. T. Baker, the Flinn storage systems. ***It should be noted that an electronic database of chemicals is available to accompany this manual. The database lists more than 2,400 chemicals. The following information is provided for each substance: Name, Synonyms, Chemical Formula, CAS#, School Level, Maximum Quantity to Order, NFPA-H Health, NFPA-F Flammability, NFPA-I Instability, NFPA-O Other Hazard, Contact Danger Level, Personal Protective Equipment, Fisher Five Color Storage System Designation, J. T. Baker Color Storage Code, Flinn Scientific Compatible Storage System Designation, Shelf Life, Recommended Disposal Technique, EPA/Transportation Hazard Codes, Room Shelf, Quantity, Maximum Quantity, Date Received, MSDS On File, and MSDS Location.*** Extensive label illustrations and tables are provided in this section to assist the user in interpreting the information explained in the text and used in the accompanying database. The section concludes with a discussion of methods for disposal and recycling of chemicals, the handling of chemical leaks and spills is also discussed with special attention to the ongoing problem of mercury.

The facilities section spells out the laws and regulations governing school facilities and equipment along with considerations related to class size and the curriculum. Specific sections deal with ideal classroom/laboratory and stockroom/prep room design and with ventilation, labeling of hazards, electrical and fire safety. First aid is discussed beginning with the standards which govern the application of first aid in the classroom. Attention is paid to burns, chemical first aid, electrical accidents, biological first aid, physical trauma, asthma, diabetic attack, and allergic reactions. Special attention is paid in this area to first aid and legal immunity. North Carolina statutes are quoted related to the treatment of students with special medical conditions and the good Samaritan law is explained along with tables listing the laws in all 50 states. A table with poison control center locations and contact numbers is also provided.

A next section is devoted to laboratory glassware, hardware and equipment. The protocols for the use of glassware are provided. Specific attention is devoted to safety showers and eye washes and heat sources. Other equipment including refrigerators, vacuum pumps, centrifuges, microwave ovens, cryogenics, compressed gases, and cutting tools were also covered along with a description of prudent practices.

The last section in the manual deals with personal protective equipment (PPE). The laws and protocols to be followed related to eye protection are covered in detail. Ear protection, fume hoods, and body protection are also covered.

If you haven't guessed by now, this manual is probably the most comprehensive and detailed discussion of science safety ever compiled for use by teachers and administrators. It is written in clear and concise language and profusely illustrated both with examples including numerous narratives, 84 tables, and 17 illustrations. Twelve different appendices serve to round out the manual so that as I said at the beginning, I have been unable to think of a question related to safety I could not answer by referring to this manual. Linda Stroud has done a remarkable job of bringing together all the presently available information applicable to safety as it should be applied to teaching science in our schools. This book should be studied by science education professors and their students who will be teaching science in our schools in years to come. It should also be required reading every science teacher in grades K-12 , every principal who deals with science in our schools, and every central office supervisor, superintendent, and board member. When all these people become acquainted with the information in this manual. The task of teaching science safely in our schools will become an achievable goal.

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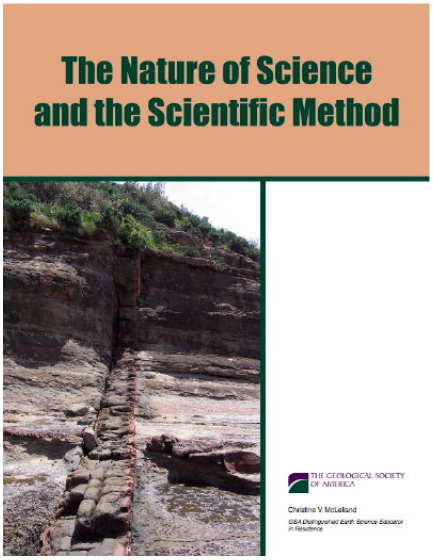
Retired Science Superviso, Past President NCSTA

The Nature of Science and the Scientific Method
Christine McLelland, The Geological Society of America, 2006, http://www.geosociety.org/educate/NatureScience.pdf



Many books and papers have been written in an attempt to explain the Nature of Science and it's methods to the general public. Few of those articles have been as successful as this paper published as a free download by the Geological Society of America. One of the more frequently cited other works dealing with these topics is the National Science Education Standards. The difference in readability is obvious where this article cites an occasional paragraph from the standards. This article lays out the basic ideas clearly and should be understandable by students from middle grade and up.

McLelland begins by defining science as "..a determination of what is most likely to be correct at the current time with the evidence at our disposal." She proceeds to list the assumptions on which scientific investigations are based and then deals with the "rules of Reasoning" by discussing the general steps followed in the majority of scientific investigations - observation, development of a question, formation of an hypothesis, experimentation, and evaluation. The discussion continues to define critical terms including fact, hypothesis and scientific theory or law.

McLelland spells out the difference between the commonly assumed meaning of the term theory and the actual meaning of the term in incredibly precise terms as follows. "Unfortunately, the common/non-scientific definition for theory ...is typically thought of as a belief that can provide behavior." "Because of this definition, some people wrongly assume scientific theories are speculative, unsupported, or easily cast aside, which is ver far from the truth. A scientific hypothesis that survives extensive experimental testing without being shown to be false becomes a scientific theory." McLelland concludes the discussion by using the demise of the theory of a geocentric universe to illustrate how new discoveries can invalidate existing theories

The paper concludes with a brief discussion of the application of the scientific method in the earth sciences. McLelland carefully spells out the differences in application of the scientific method to situations where laboratory experiments cannot be to test an hypothesis. The lack of a controlled environment and the need to use circumstantial evidence in developing explanations of natural phenomena. The summation of the paper is contained in a citation of Percy Brigmans Reflections of a Physicist in which he says the scientific method is what scientists do and that there are as many scientific methods as there are scientists.

The paper includes a bibliography and 20 talking points which you will find mst helpful in developing lessons and guiding discussions on this topic. This article should be required reading for every science teacher and high school science student

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