Hair Structure and Chemistry Simplified

Fourth Edition

John Halal

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by John Halal

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9 8 7 6 XXX 10 09 08 07
Printed in Canada

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Library of Congress Cataloging-in-Publication Data
Halal, John.
Hair structure and chemistry simplified / John Halal.—4th ed., rev.
p. cm.
Rev. ed. of: Milady's hair structure and chemistry simplified / Douglas D. Schoon. 1993.
ISBN 978-1-5625-3629-9
ISBN 1-56253-629-X
1. Hairdressing. 2. Hair—Care and hygiene. I. Schoon, Douglas D. Milady's hair structure and chemistry simplified. II. Title.
TT972 .H33 2001
646.7'24—dc21

2001028139

This book is dedicated to my wife, Marty,
and my daughters, Heather and Allison.

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Preface

Although chemistry is an essential part of everything that a professional hairstylist does, few have any real knowledge about the chemicals in the products they use or the countless chemical reactions that take place in a salon each day. In addition to the dangers to the hairstylist and the client, this lack of knowledge also limits the hairstylist's ability and perpetuates a negative image of hairstyling as a profession.

Most hairstylists are intimidated by chemistry because it's usually presented with formulas, chemical symbols, and long unpronounceable words that seem to be written in some exotic, foreign language. Old wives' tales and exaggerated marketing claims further confuse students by adding a wealth of misinformation, which may be easy to understand but is all too often incorrect. *Hair Structure and Chemistry Simplified, Fourth Edition* separates fact from fiction and clears up the confusion. The direct approach of this text overcomes the apprehension usually associated with learning chemistry. Hairstylists will find the information easy to understand and even easier to use. The easy to apply concepts presented in this text will empower hairstylists with understanding that will improve both the quality and the safety of their salon services.

Recent advances in cosmetic chemistry have transformed yesterday's hairdressers and barbers into today's hi-tech hairstylists. The traditional cold wave has a variety of new replacements. Hairstylists must now choose between acid, exothermic, no ammonia, no thio, and self-timing permanents. Old-fashioned hair dyes have been replaced with semi-permanent, demi-permanent and para-permanent hair colorants. Herbal powdered hair lighteners have replaced bleach and enzyme developers substitute for peroxide. Chemical services in today's modern salons have been turbocharged with high volumes of peroxide, chemical catalysts and color processing machines.

But all of these new products may not live up to their promises. Some can be dangerous, and some cost more—much more. Are they really worth the additional expense? Are they safe? How is a hairstylist to know which product to use and how to use that product safely? *Hair Structure and Chemistry Simplified, Fourth Edition,* helps students, as well as experienced hairstylists, select the right product from the flood of new products that were not available a few short years ago.

Learning the language of cosmetic chemistry, presented in this text, empowers hairstylists with an understanding of what's actually in those bottles and why it's there. With a little practice, hairstylists will learn to read and translate the ingredients listed, in small print, on the back of the bottle. Those who don't understand the language are relegated to reading only the exaggerated marketing claims prominently listed, in big print, on the front of the bottle.

Most hairstylists have little difficulty learning the intimate details of the mechanical tools of their trade: scissors, brushes, hot irons, and hairdryers. This revision applies that same level of understanding to their chemical tools: haircolorants, permanent wave solutions, chemical hair relaxers, chemical depilatories, shampoos, conditioners, styling aids, and sunscreens. Although these tools are every bit as important, they are usually less understood.

Hair Structure and Chemistry Simplified, Fourth Edition, is the most current, comprehensive and straightforward textbook of its kind. This text thoroughly explains the theory and application of many essential concepts that are simply not covered in other texts. New material has been added which includes the new products and services that are currently being performed in today's modern salons.

This revision has also eliminated some outdated material without sacrificing the integrity of the original text. Many photographs, drawings, and line art have been replaced with clearer images and better illustrations. New artwork has also been added that improves the visual representation of essential ideas.

The Glossary and Index has been expanded and the Appendix now includes information on product labeling along with samples of Material Safety Data Sheets and lists of product ingredients. A complete list of Key Terms has been added to the beginning of each chapter.

New material, not found in other texts, boldly presents the concept, importance, and relevance of pH in cosmetics. The section on emulsions and surfactants explains the dynamics of surface tension and distinguishes between the hydrophobic and hydrophilic properties essential for all emulsions. Advanced information on multiple phase and microemulsions (liposomes and nanospheres) is also included. The benefits and dangers of exposure to ultraviolet light are discussed, along with an explanation of sunscreens, Sun Protection Factor, and the new Federal Drug Administration monograph, which details their use. This book also draws attention to the dangers of mixing different chemicals, even those that may seem completely safe.

Hair Structure and Chemistry Simplified, Fourth Edition, will improve student comprehension and retention and provide graduates with a valuable resource to aid them throughout their career. Even the most experienced hairstylists will gain confidence and control as they learn to make intelligent, informed decisions about the chemical services they perform everyday in the salon. This text helps hairstylists avoid problems before they start and shows them how to correct small problems before they become big problems.

A complete supplement package, which has been updated to correspond with the revisions of the text, complements and reinforces all the key ideas.

Exam Review, ISBN: 1-56253-631-1. The Exam Review reinforces the text and permits instructors to monitor student learning easily. These multiple-choice questions quickly allow teachers to determine exactly which concepts have been learned and which still need attention. Answers are provided with the text, which allow for self-review and student practice.

Workbook, ISBN: 1-56253-630-3. The workbook questions are designed to provide a student activity that stimulates student thinking and expands the ideas presented in the text. Students learn to organize ideas and differentiate key points. Many of the questions in the workbook require answers in essay form.

Course Management Guide, ISBN: 1-56253-632-X. This consists of four sections that enable instructors to explore the text material with added confidence and in greater detail.

1. Answers to Workbook. Clear, concise answers clarify the concepts presented in the Workbook and facilitate grading by the instructor. These answers are not found in the workbook.
2. Answers to Textbook Review and Discussion Questions. Provides complete answers to the Review and Discussion Questions at the end of each chapter in the textbook. These answers are not found in the textbook.
3. Lectures and Lesson Plans. This section complements and expands the textbook. Instructors will find the in-depth information invaluable in the preparation of lectures and the presentation of key ideas that are presented in the textbook.
4. Classroom Experiments. These safe, simple experiments permit teachers to create unforgettable moments of learning that bring chemistry to life for students and instructors. When performed by the teacher as a presentation, these experiments grab and hold student attention. Many of the experiments are so simple, safe, and easy to do that supervised students can work in small groups, monitoring and recording their own progress.

ABOUT THE AUTHOR

John Halal began his career as a hairstylist over 30 years ago. In addition to John & Friends, Inc., his two successful salons in suburban Indianapolis, he also owns and operates International Concepts Beauty Supply and Honors Beauty College, Inc.

Halal is an active member of the National Cosmetology Association (NCA), the Salon Association (TSA), the Indiana Cosmetology Educators Association (ICEA), the American Association of Cosmetology Schools (AACS), the Beauty & Barber Supply Institute (BBSI), and the Society of Cosmetic Chemists (SCC).

John & Friends, Inc., was featured as the *Salon of the Month* by *American Salon Magazine* and has been selected, for the past three consecutive years, as one of *America's Top 200 Fastest Growing Salons* by *Salon Today Magazine*. John and

Friends, Inc., also received the Reader's Choice Award for *Best Salon* from Indianapolis Monthly Magazine. Halal's essay, *What a Difference a Decade Makes*, was chosen as one of the *Outstanding Call for Presentation Papers* by the BBSI. His classroom presentation received the award for *Outstanding Educational Program* from the Indiana State Cosmetologist Association.

Halal obtained his associate's degree, with highest distinction, from Indiana University and is currently completing his bachelor's. He has authored articles on a wide variety of topics and has been published in several professional trade magazines. He often travels, as a guest speaker, to address professional and consumer groups.

ACKNOWLEDGMENTS

I would like to thank the following individuals and companies who provided information and helped me with the research for this book. I wish to express my gratitude for their help.

Dr. Martin J. O'Donnell, Department of Chemistry, Indiana University, IN

Keith C. Brown, Ph.D., Director of Research Worldwide Beauty Care, Bristol Myers Squibb

TRI, Institute of Trichology.

REVIEWERS

I would also like to thank the following cosmetology professionals for their assistance and expertise in the preparation of this revision and reviewing the final manuscript.

Sharon S. Aresco, Vinal Technical High School, Middletown, CT

Sharon K. Barnard, KACC School of Cosmetology, Milford, IL

Kenneth W. Dennis, Alternative Hair Clinic, Columbia, SC

Cheryl Goostree, Univ School of Hair Technology, Bowling Green, KY

Patricia Martin, International School of Beauty, Inc., New Port Richey, FL

Robert Morey, Flint Institute of Barbering Inc., Flint, MI

Robin Ratliff, Gainesville School of Hairstyling, Gainesville, FL

Kerry Stroman, College of Hair Design, Lincoln, NE

Madeline Udod, Eastern Suffolk BOCES, Bellport, NY

Betty Walker, Carolina Academy, Gastonia, NC

Beth Wallace, Northwest-Shoals Community College, Phil Campbell, AL

Chapter 1 Science and Cosmetology

Key Terms

Cause and effect
Chemistry
Power of reasoning
Science
Scientific method
Technology

Learning Objectives

After completing this chapter, you should be able to:

- Understand what science is and is not.
- Use the three basic steps of the scientific method to improve learning.
- Explain the "cause-and-effect" relationship and its importance.
- Understand the difference between safe and dangerous experimentation.
- Distinguish between scientific breakthroughs and marketing sales tools.
- Find other sources of information and continuing education.

CHEMISTRY IN THE SALON

"Why should I study chemistry? I want to learn hairstyling, not chemistry." If you're like most hairstylists, you love learning about all the artistic aspects of hairstyling and can't wait for your next haircutting class. And although haircutting may seem much more important than chemistry, if you intend to shampoo, condition, color, perm, or relax hair successfully, chemistry is every bit as important.

What would happen if you didn't understand the inherent difference between a razor haircut and a scissor haircut? How would you decide which tool to use? Without an understanding of the geometry of a haircut how would you know the correct angles to hold and cut the hair? Imagine what would happen if you had to perform a haircut in the dark and couldn't see the hair or the scissors?

These may seem like extreme examples, but they aren't really. Hairstylists who perform chemical services without understanding the basic chemistry involved do not understand the chemical tools they are using. They are unable to "see" clearly what they are doing. It's not that different from cutting hair in the dark. In both cases, they are flying blind and are forced to rely on guesswork. Not being able to clearly see lowers the quality of salon services and causes inconsistent and erratic results. Nothing is worse than being lost in the dark and unable to see the way out.

Although the same level of excitement that's associated with hairstyling isn't usually attached to chemistry, there's no reason it can't be. With a basic understanding of salon chemistry, you will be able to select the right haircolor or permanent wave for even the most difficult client. You will be able to predict the results ahead of time accurately, the first time and every time. You will be able to identify and avoid most problems long before they become big problems. When problems do arise, you will be able to correct them quickly and easily with the confidence that comes from knowing. With a basic understanding of salon chemistry, you can eliminate guesswork, dissatisfied clients, and those recurring problems that just never seem to get resolved.

WHAT IS SCIENCE?

The word **science** is derived from the Latin *scientia*, meaning "knowledge." Science is the pursuit of knowledge about the universe around us. Scientific knowledge involves the ability to explain established facts, in terms of a physical cause for an observed effect. Chemistry, biology, physics, and geometry are examples of different kinds of science. In this book, we will study the science of chemistry.

WHAT IS CHEMISTRY?

Chemistry is the study of matter and its changes. Matter is the material and structure of the universe. Everything that we see, touch, taste, and smell is made of matter. Chemistry is often referred to as the "central science" because chemistry is essential to all other sciences.

WHAT IS TECHNOLOGY?

Technology is the use of scientific knowledge to manipulate nature. Technology provides hairstylists with all the tools used in a modern salon. You are probably familiar with physical styling tools, which create physical changes and include scissors, brushes, combs, hot irons, and hairdryers. Hairstylists also use chemical tools, which create chemical changes and include permanent wave solutions, haircolorants, hair relaxers, and chemical depilatories. Hairstyling would not be possible without science, chemistry, and technology.

THE SCIENTIFIC METHOD

The **scientific method** is a term used to describe the methodology of science. It is how science is done. This logical, objective approach to solving problems is based on three major steps:

1. **Observation**—Gathering facts by experimentation
2. **Reasoning**—Speculation or idea that explains the observation
3. **Testing**—Further experimentation to test and retest the idea

Observation

All learning is done through observation. You use observation every day in the salon when you evaluate the results of the services you perform. When a permanent wave turns out curlier than expected or a haircolor ends up darker than you thought it would be, you observed the results of your own experiments. If something goes wrong, the scientific method will help you to figure out what went wrong and how to correct the problem.

Accurate, detailed, systematic recordkeeping is essential to objective observation and the application of the scientific method. The purpose of observation is the collection of facts and the arrangement of those facts into a pattern that reveals the reason for the observed results. The importance of accurate records cannot be overemphasized. Hairstylists that fall victim to the dangers of bad record-keeping are forever doomed to repeat past mistakes.

Client records should include a complete evaluation of the length, texture, color, and condition of the hair, prior to the service and the results that are expected. Extra caution should be used to determine any previous problems or adverse reactions the client may have had in the past. This information must be reevaluated prior to each service since there may have been a change in the client's history or in the formulation of the product since it was last used. Also include in your records the method of application, the formula, processing time, and the results achieved.

OBSERVATION EXPERIMENT

As you read this page, most of the information collected by your eyes and ears is unconsciously filtered out and ignored. Try the following experiment and see how much you're missing.

Don't move your head or eyes from this page. Now concentrate on seeing the edges of the book while you continue to read. Now expand your vision awareness outward and see just what else your brain has been hiding as you read. Can you see your wrist, your arms, the floor, or walls? Now listen carefully—are there any sounds in the background that you didn't notice before? Do they sound a little different when you concentrate on them?

Your brain protects you from a constant battering of sights and sounds. It would be hard to live in today's world of noise and confusion if we had to see and hear *everything*. However, we must not allow our brains to get lazy; the brain may block out too much important information. Being more observant is simply paying closer attention. It is a way of telling the brain to notice more of what our eyes and ears are telling us.

Reasoning

The fastest, most powerful computers in the world cannot match a human's ability to reason. When you use any information to reach a conclusion or make a decision, you are using the **power of reasoning.** Reasoning turns observations into useful ideas. Reasoning increases your product knowledge and improves your techniques. Nothing will help you more in developing a successful cosmetology career than using your vast power of reason. If you keep accurate records and the results you observe weren't what you expected, you can use your power of reasoning to figure out why. Once you've determined what went wrong, you will be able to use reasoning to come up with a solution. Always remember to update your records and note any changes in the formula or procedure.

But if used incorrectly, reasoning can lead you astray. Many things that sound "reasonable" are actually false! It seemed reasonable to our primitive ancestors that stars were campfires and that the Earth was flat; however, we know now that this was false reasoning. Faulty reasoning is almost always based on poor observations. Many "old wives' tales" are examples of judgmental observations.

For instance, it is widely believed that long or braided hair grows faster. This belief is based on the false assumption that weight or pulling will cause hair follicles to produce keratin faster. In truth, neither has any effect on hair growth, but it sounds good. This myth was probably started by someone who thought it made sense. Be careful not to accept ideas or draw conclusions just because they sound good. Many advertisers take advantage of fallacies or myths by using fancy, "scientific" terms to fool the unsuspecting.

Use the power to reason and check with observations to find the truth, especially to analyze advertising claims. If a product is supposed to "last 50 percent longer" or "make hair feel silkier than the leading brand," test these claims and don't automatically accept them as fact.

Testing

The best way to test reasoning is by experimenting. An experiment allows a person to make good observations and draw conclusions about what was actually seen. In a sense, each time you try a new product or procedure, you are conducting an experiment. Based on the outcome of the personal evaluation, you will draw conclusions about a product's or procedure's success or failure.

Each experiment is a test of your ideas and knowledge. Every idea must be continually tested and retested. Each chemical service you perform and every change you make must be carefully observed and recorded. New information can be observed with each experiment that will test the correctness of your ideas. If we learn by our mistakes, we won't have to repeat them.

Too often, hairstylists are hesitant to try new things. It is easy to become set in one's ways, but this can hinder professional growth. A positive way to excel in the field of cosmetology is through experimentation. However, we must always consider the client's well-being and our own safety or liability. Testing products on swatches of hair is an excellent way to try a new one.

Proper experimentation with products or procedures should not be based on off-the-wall ideas or wild guesses. Clients do not appreciate this type of irresponsibility. Good experiments are based on previous observations and careful reasoning. The best ideas for experiments usually come from education and experience. Top-notch hairstylists are those who aren't afraid to experiment, but only in careful, controlled manner. Remember, the chemicals used for cosmetology services are tools and not toys! Treat them with the respect they deserve.

Cause and Effect

Although more emphasis is usually placed on the art of hairstyling, the practice of cosmetology is also a science. Science is very concerned with why things work (or don't work) and how to control them. Scientists study the causes of an event. Why something happens is very important. **Cause and effect** means that things don't just happen; there is a reason for everything. When you perform a service and get an unexpected result, attempt to solve the problem with reasoning through evaluation of the observations.

The easy answer is, "Oh, I'm having a bad day" or "Something must be wrong with your hair." Answers like this do not solve problems; they make it difficult to learn and grow. Using the scientific method with observation, reasoning, and testing provides the best road to finding the correct solution. Properly used, these three steps often remove chance or luck from professional services and replace them with understanding and expertise. The best hairstylists aren't lucky—they're knowledgeable!

EXPERIMENTS YOU SHOULD NOT PERFORM

Experimentation is fun and beneficial; however, it can create problems! Manufacturers go to great lengths to develop products that provide desirable effects. *Always* read and follow the manufacturers' instructions. It is very important to heed any warnings found on the label or in the product literature.

The wise hairstylist will check periodically for changes in directions or warnings. Manufacturers often discover improved techniques or learn new information about their products. Usually, these ideas are included in the packaging as revised instructions. Disregarding instructions can have serious consequences.

Often hairstylists will attempt to develop their own special blends by mixing together chemical products that were not specifically designed for mixing. It may seem fun and exciting, but it is not a wise practice.

Many chemicals form incompatible mixtures when blended. This means, when products are mixed, the blend could be hazardous. Some mixtures could catch fire, explode, release harmful vapors, or even cause a hairstylist or client to suffer a painful allergic reaction.

The classic example of incompatible blends is the practice of mixing chlorine bleach with ammonia products. This *deadly* combination releases gases which may kill or seriously injure people. It is best to never mix any chemical products without first checking with the manufacturer.

WHAT SCIENCE IS NOT!

We learned in the beginning of this chapter that science is the systematic study of our universe. A well-known scientific researcher, studying the growth of hair, once made the following statement about finding a cure for baldness, "If we are going to understand hair growth, we are going to do it through solid, methodical science."

Don't be impressed by such extravagant claims as *amazing new discovery, scientific breakthrough*, or *revolutionary new product*. These are advertising and marketing sales tools, not truly science. When you perform chemical services, don't depend on miracle products. Instead, trust in the scientific method, observation, reasoning, and testing. You'll be much more likely to get positive results.

Other Sources of Information

It is important to stay in touch with new information because products are constantly changing. New ideas or techniques emerge almost daily. Where can information be found to keep you on the cutting edge? Check the following:

1. Manufacturer- and distributor-sponsored educational classes. These are excellent sources for information.
2. Trade show educational classes. These are special sessions taught by the experts in the field.
3. Specialized schools that teach advanced topics; i.e., haircolor or haircutting seminars.
4. Trade magazines are often mostly advertisements, but if you thoroughly read through the pages, you'll often find a wealth of information on highly specialized topics.
5. Ask your instructors. If you show an interest in learning more than what the book has to offer, they will guide you to outside sources of information.
6. The appendix to this textbook.

Review Questions

1. What are the three basic steps of learning in the scientific method?
2. If you noticed that your client develops a rash each time you use permanent haircolor, which of these three basic steps did you use?
3. Give two examples of something that sounds reasonable but is actually false.
4. What is the difference between cause and effect? Give an example.
5. Why is it important to periodically reread the manufacturer's instructions?
6. Name three sources where you can find information found in the book or taught in class.

Discussion Questions

1. Science has radically changed our understanding of hair and skin. What futuristic products can you imagine might be developed in the next decade?
2. In what ways will scientific advancements change cosmetology? What should cosmetologists do to keep up with this new technology?