Student's guide to

Chemistry-

a modern introduction

BROOKS

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Chemistry

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PURPOSE OF THIS GUIDE

The purpose of this guide is to help you succeed at your first college chemistry course. All of the material in the guide is designed to parallel the text, "Chemistry: A Modern Introduction," by Brescia, Mehlman, Pellegrini and Stambler (BreMPS). We have written a students' study unit for each chapter of the BreMPS text.

Each unit begins with a list of performance objectives. A performance objective outlines something that you will need to be able to do to demonstrate your knowledge and understanding of the material. Page references to the BreMPS text are given with each objective. Of course, your professor may wish to modify this list of objectives and make additions, deletions, and adjustments. For the most part, however, you will be on safe ground if you can perform at the level recommended in these objectives. You can feel confident about your progress as you master each list. The unit will also spell out any background material you'll need to know before you tackle the new objectives.

Next, a written summary of the most important concepts of the text is provided. The summary will contain the information particularly worthy of your extra study efforts, and will conform to the unit's performance objectives. Major terms will be restated, and important formulas and definitions will be repeated. Several examples will be worked.

The last part of each unit will be devoted to practice problems and solutions. The questions will help you to determine whether or not you have met an objective. The solutions have been specifically designed to reinforce the examples of the BreMPS text. In each case, we have tried to approach the solution to a problem in exactly the same way that your text approached a very similar problem. Your answer to a practice problem should indicate that you have met a performance objective. It ought to look a great deal like one of the solutions of the text or the study guide.

No attempt has been made to cover the material designated as optional in the text.

CHEMISTRY AS A SUBJECT

Chemistry is not a difficult subject to learn, but it does take lots of time. In addition to a language for communication, such as English, chemistry uses two other languages: a unique symbolic language, and mathematical

language. For example, the symbol Cu refers to an atom or a definite quantity of the substance called copper; the equation $E_{cell} = E_{reduction} - E_{oxidation}$, as yet unfamiliar to you, summarizes a tremendous amount of our knowledge about the voltage we can hope to obtain from a chemical reaction conducted in such a way that electrical energy is made directly available. The languages of chemistry don't represent an insurmountable learning problem. However, they take time. With the enormous variety of materials which surround us in nature (air, water, brain tissue, glass, aspirin, and trees, for example), we are fortunate that chemists have discovered patterns in nature, and have devised means of classifying properties and conceptually relating materials according to their properties. Without these guidelines, chemistry would be a hopeless logjam of unrelated facts. Because the languages of chemistry are quite precisely defined, and because the properties of matter can be organized within the framework of characteristic patterns, we can proceed systematically to learn the subject of chemistry.

There are no uniquely easy routes to the goal of learning chemistry. This guide can help by repeating, by reinforcing, and by providing special emphasis. It cannot replace your text. It cannot reduce the heavy demands upon your time. It *can* organize the time and effort you spend on the course, and so produce a more satisfactory result.

STUDYING CHEMISTRY

Listening to Chicago, necking, watching television, eating hamburgers, and shooting the bull are fun activities, especially when compared with studying chemistry. Psychologists help explain why this is so. You receive a rapid immediate return of pleasure when participating in the first-named activities. Study usually rewards slowly – sometimes only with a final grade at the end of a course. Learning for the sake of learning provides only a small amount of pleasure to most people. Nevertheless, if you have set long-range objectives for yourself, such as a college degree or a profession, then you *must* learn how to study effectively. Understanding your responses to the stimuli of the outside world is essential if you are to succeed. In college, no one pushes or pulls you along. You must act as your own master. You must set up your own schedule of rewards and punishments for performance. Your college teachers will have several small rewards for you, such as occasional kindly words or amusing anecdotes, and a few big rewards, such as good recommendations and high grades. They will also have small punishments, such as critical words and dull lectures, and big punishments, such as poor grades and bad recommendations. The rewards and punishments are very different from learning goals, however. You should leave your first chemistry course with several well-defined skills and a few attitudes about how understanding chemical phenomena can help you better appreciate your daily life.

LEARNING TECHNIQUES AND WORK HABITS

Credit Hours. Reserve about 4 hours per week for each credit hour of work during a 15-week session. For 16 credit hours you'll need about 64 working hours to attend classes and to study. Being a college student is a full-time job!

Textbook. Scan through your text at the beginning of the course. Become familiar with its style, presentation, and content. It is wise to treat the text as a *tool to be heavily used.* Be prepared to make extensive marks and notes in your text. You may find it helpful to use other library texts which are designed for the same course.

Performance Objectives. Once you settle down to a routine in this course, you'll probably discover that familiarizing yourself with the performance objectives is the best point at which to begin effective study. These objectives will tell you where your lecturer is going, and what you are expected to get out of the text material.

Lectures. In spite of their relatively low efficiency, lectures remain second only to textbooks as primary educational tools. Take notes during a lecture. Don't copy down each and every word, but *copy and memorize* everything that is *repeated* by your lecturer. Read your lecture notes as soon after class as possible. Complete sketchy notes while the lecture is fresh in your mind. If possible, get together with some of your classmates to pool your lecture-note resources. Don't hesitate to sit in on extra lectures by other teachers if you find them rewarding. Never be shy about a visit to your prof, and never wait for points of confusion to clear up by themselves – they just never do!

"Desk" Sessions. We refer to a period of intensive concentration as a desk session. You need to find a place where you will not be distracted. You should not be hungry or thirsty – too warm or too cool – too tired or too fresh. You should have adequate lighting. All activities likely to compete with study must be removed from sight. Your room, the library, an empty classroom, a crowded bus or a shady spot under a tree may all be fine study places. At the same time, each may be totally unsuitable for you or your situation. Remember, you *must be comfortable* and *sources of distraction must be absent.* Desk sessions should be spaced by relaxation periods of at least 15-30 minutes, during which time you seek rewarding activity, such as chatting with a friend, eating a hamburger, or watching T.V. Try to limit desk sessions to 2 per day on a given subject. Try not to spend more than 7.5 hours per day at your books! Avoid daydreaming. During the early years of

your college career, never "spin your wheels" during a desk session. If something comes up that you can't grasp in 15-20 minutes, seek help.* Begin each session by reviewing the appropriate list of performance objectives.

Memory and Study Cards. Whether from the lecture, your text, or this study guide, many things will come up that require memorization. The quickest and safest route to a lasting memory is *frequent exposure to the material to be memorized.* Six sessions of review lasting 10 minutes each and separated by several hours are far superior to one 60-minute session. (The items you try to memorize late during a long session tend to crowd out those you learn early in that session! Frequent exposure helps to overcome this problem.) A convenient way to accomplish this exposure is to prepare 3 X 5 inch index cards. Each should contain just one or two concepts or definitions, or perhaps a sketch or an example of a solution to a problem. Self-testing, asking yourself questions, will help you remember over a longer period.

Chemistry Examinations. Your examination scores may not always indicate how much chemistry you have learned. However, high scores generally indicate that you know or have learned a lot, whereas low scores usually indicate very little learning.

A good examination contains no surprises if you have reached your performance objectives. Here are some suggestions for getting ready to take an exam:

Preparing for Brief Quizzes. Quizzes are designed to keep you at your work regularly, and to insure that no extremely bad gaps in your learning go unrecognized for a long period of time. Routine study habits, with a quick review of study cards as near quiz time as possible, should suffice in preparation for quizzes.

Preparing for Major Exams. Hour exams will require 6-8 hours of special preparation, including two or three desk sessions, and additional work with study cards. A final exam will require about four desk sessions, and about 3 hours on study cards. Begin one week before each exam, preferably by visiting the library to examine a file of old exams. The more old exams you can find, the better off you will be. Make sure you can work each of the old exam problems correctly. If you can't, find someone to help you. (Take any questions you don't understand to your prof.) Review your lecture notes, study cards, and problems. Try to make up sample test questions using the usual testing format. On the evening before the exam, try to relax! Take in a movie, go on a date or watch T.V. Don't plan on heavy study for the next day's exam.

*From a human expert – your teacher or teaching assistant, a classmate doing well in the course, or a recent graduate of the course.

Causes of Poor Performance. What are common causes of poor performance? Occasionally they include lack of study, bad luck on quizzes, and quiz panic. These are trivial, and are readily corrected by additional study. What are the long-term problems? Excessive dependence on a weak high school chemistry background (over-confidence) is a serious problem. Poor health can also become a factor. Many students forget about nutrition and sleep when they start out on college careers. If you find yourself tired, go to bed! If you find yourself cutting lots of classes for extra sleep, visit the student health service for help. Emotional problems are also causes. Sometimes troubles with family at home, worry about a relative or friend, financial problems, or romantic problems lead to poor performance. We can't help too much with these problems. Most often, however, we find the overriding emotional problem of a student to be that he (or she) has come to college to learn, but finds himself unable to decide what it is he wants to learn. Vocational guidance is often the cure for this problem.

When you are just beginning your career as a student, any changes that you make in your life style should be made slowly. If you are used to 10 hours of sleep each night, keep on sleeping 10 hours. If you are used to church on Sunday, keep attending. If you've never had beer before, don't start out on two quarts each night. If you are living away from home for the first time, you should expect to miss the accustomed warm routine of your family life. It is unwise to try to fill this void too quickly.

Above all, remember that professors and counselors are anxious to have you talk with them *whenever* you feel that you need help and guidance. Those of us who teach for a living are paid to deal with poor performance, regardless of its causes!

Acknowledgments

Dr. Frank Brescia is a chemistry teacher who has actively addressed himself to the problem of helping students to learn modern chemistry. When I was asked to prepare a students' guide for the Brescia, Mehlman, Pellegrini and Stambler text, I accepted enthusiastically. I considered it an excellent opportunity to contribute to and learn from a student-oriented project.

At the time this opportunity arose, however, I was in the midst of a move from Texas A & M University to the University of Nebraska. Fred Sicilio, my writing partner, was immersed in administrative duties and declined the opportunity of joining me on the project. For this reason, the demands of the project were unusually severe and the effort and cooperation of several persons must be acknowledged. Mrs. Arlyne Sarquis read the draft of each section. The sections were then reviewed by Dr. Eugene Rochow. Because all of us were new to the project, Frank Brescia provided the greatest amount of and most detailed insight into the revision of our presentation. Revised drafts were typed into manuscript form by Mrs. Charlotte Rouquette and Mrs. Joellen Trenckmann under stringent deadlines. The United States Postal Service also was extremely cooperative.

Many others should be acknowledged too. My reviewers' families were strained by the rigorous reviewing schedule. My family, Helen, Dan, and Eileen, deserve special note not so much for the many hours they lived without me, but for the few hours they bore with me each day.

I especially acknowledge the ten-thousand-plus Texas Aggies I have known as students over the last six years. Most of these delightful young people would have derived considerable benefit from the materials which are a part of the Brescia, Mehlman, Pellegrini and Stambler project. Moreover, in a very personal way, these Aggies have caused me to focus much of my own effort on behalf of first year college chemistry students.

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INTRODUCTION

PERFORMANCE OBJECTIVES

As a result of studying Chapter 1, you should be able to

1. Use you own words to explain the terms: controlled experiment, law of nature, theoretical model. (p. 2-3)
2. Define the term chemistry in your own words. (p. 3)
3. Define the terms: matter, states of matter, mass, inertia, force, phase, weight. (p. 3)
4. Use the International System of Units (SI units) to describe such physical quantities as length, volume, and mass. (pp. 4-12)
5. Use conversion factors to change from other units into SI units and vice versa. (pp. 4-12)
6. Explain what is meant by the terms accuracy and precision in measurement; also, be able to use the technique of reporting values for both measured and calculated quantities with the proper number of significant figures. (pp. 12-14)
7. Use exponential numbers to write numbers consistent with the appropriate number of significant figures. (pp. 14-17)
8. Define and distinguish the terms: heat, energy, temperature. (pp. 17-21; 22-23)
9. Convert Fahrenheit degrees to Celsius degrees and vice versa. (pp. 21-22)
10. Know the relation between heat (energy) and work, and know the meaning of the terms potential energy and kinetic energy. (p. 23)
11. Cite several properties that are useful in identifying (characterizing) matter. (pp. 23-24)
12. Define the terms: homogeneous, heterogeneous, physical change, chemical change, filtration, distillation, pure substance, chromatography. (pp. 25-28)