

**A LABORATORY GUIDE  
FOR A TWENTY  
WEEKS COURSE IN  
GENERAL CHEMISTRY**

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A Laboratory Guide for a Twenty Weeks Course in General Chemistry by George Willard Benton

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A  
LABORATORY GUIDE

FOR A

TWENTY WEEKS COURSE

IN

GENERAL CHEMISTRY

CONTAINING

DETAILED INSTRUCTIONS FOR THE SUCCESSFUL PERFORMANCE  
OF OVER 150 EXPERIMENTS IN GENERAL INORGANIC  
CHEMISTRY, AND USEFUL TABLES OF REF-  
ERENCE FOR PUPIL AND TEACHER.

BY

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## P R E F A C E.

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THE LABORATORY METHOD of teaching chemistry is thoroughly established. Its superiority over the old lecture methods has been and is being constantly demonstrated, in the increased use of text-books and manuals introducing chemical principles in simple form, and in the encouragement of teachers who see in the Laboratory the means of high development on approved pedagogical grounds.

This method implies the adaptation of the chemical course to the capacity of the average pupil, not only as to apparatus and chemicals, but in the far more important matter of the comprehension of results and the development of great principles. Simplicity in the former respect is attained by the use of materials whose handling is least involved and complex. Success in reaching results and conclusions lies in the correct use of the facts observed.

In the course, of which these experiments are a part, little use is made of the lecture-room experiment and only an occasional lecture is introduced as a rounding-up or development step, *following* the work in laboratory and quiz. The experiments themselves are simple, but reasonable. The book is not a compilation, except in so far as all books on the elements of chemistry are, of

necessity, compilations. Again, it is not a book for the teacher, but eminently one for the pupil. A good teacher will be able to furnish a bright pupil with any amount of supplementary work. The teacher's business in the laboratory is to direct, the pupil's, to do the work. It is believed that contact with the *thing* itself is essential for the best development; and it is equally essential that the sequence of fact and conclusion should be attained by the natural process of observation followed by discussion. In this belief the pupil is led to discover, as far as practicable by purely inductive processes, the main truths of the science, the question marks occurring at intervals inviting to the making of many of his own questions. Experimentation is followed by quiz and discussion, with a sprinkling of recitation from the text, not omitting references to reliable authorities.

In this way the pupil not only is unconsciously led to adopt methods of logical thinking, and to come into touch with chemical principles and methods of determining them, but, on the other hand, is saved the distasteful task of *repeating* experiments which have been already seen and discussed in the lecture-room. Such repetition would necessarily lack the enthusiasm and zest of originality; the ingenuity of the pupil would constantly suffer from dearth of action, and the whole work become mechanical.

The use of the note-book should be confined to the laboratory, that its statements, right or wrong, may be free from "bookish" phrases, and represent the pupil's own work. The form of the notes must necessarily vary with the experiment and the individuality of pupil



and teacher. Neat, concise, logical, and complete notes should be insisted upon from the start, and will soon become the habit of the careful student.

The favorable criticisms of many officers and teachers in High Schools throughout this and other States, have induced the writer of these experiments to put them in permanent form, in the hope that their use may be extended, and their influence upon elementary chemical education may be marked and of a high order.

It is a pleasure at this time to acknowledge the assistance received from Mr. JAMES. H. SHEPARD, author of "Shepard's Chemistry," from whose admirable book much of the material has been adapted, and to which reference is constantly made; from Mr. HUGH BRYAN, Assistant in Chemistry, Indianapolis High School, in the preparation of the manuscript; and Mr. M. E. CROWELL, Instructor in Physics, of the same school, in the criticism of manuscript and proof. The obligations of the writer are also due Mr. E. F. HOLDEN, of Melrose, Mass.; Mr. T. PHOENIX, New Britain, Conn.; Mr. T. W. SMITH, Indianapolis High School No. 2; Mr. W. W. GRANT, Providence, R. I.; Mr. M. A. BRANNON, Fort Wayne High School, and many others who have by their criticisms aided in the presentation of the book in its present form.

G. W. B.

INDIANAPOLIS, Aug. 10, 1893.



## FOR THE PUPIL.

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1. This book must not be taken from the laboratory without permission. Statements written in it must represent your own laboratory work and conclusions.

2. Write in ink on the fly-leaf of the book, your name, division, desk, and drawer in the laboratory.

3. Each pupil is held responsible for the condition of his desk and apparatus, and is required to leave everything clean and in good order.

4. Each pupil should have a good pencil, a clean towel, old cloths for cleaning purposes, an apron, a tin or other metal box with matches, and blank paper for miscellaneous use.

5. To clean a test-tube, rinse it thoroughly with water using a brush if necessary. If this does not leave it clean, use a little conc. hydrochloric or nitric acid, or if necessary, both at once, and then rinse with plenty of water. A tube will clean with one-tenth the time and trouble if not allowed to stand until dry. Brushes must not be used with acids.

6. Pupils should be, and are, held responsible for all unnecessary or careless breakage.

7. Glassware should be drained, not wiped, on the inside. Before heating, tubes and flasks should be dry on the outside.