

**A MANUAL OF
EXPERIMENTS IN
ELEMENTARY SCIENCE.
TEACHER'S EDITION**

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A Manual of Experiments in Elementary Science. Teacher`s Edition by Francis D. Curtis

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BY

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PREFACE

THIS MANUAL OF EXPERIMENTS IN ELEMENTARY SCIENCE consists of a STUDENT'S MANUAL comprising guide outlines, and a TEACHER'S MANUAL in which are given full directions and explanations regarding all manipulation, answers to all the questions in the STUDENT'S MANUAL, diagrams, and additional hints and suggestions intended to make the book a complete, convenient mentor.

The outlines are adapted for use with classes in the upper grammar grades, the junior high school, and the first and second years of the high school.

The Manual can be used with any text dealing with beginning science, whether general science, physiography, agriculture, nature study, or physiology; or it can be made the basis of reference or syllabus courses without text, in any of the above subjects. It also correlates with courses in domestic science.

In schools where two or more elementary or second-year courses are offered, the Manual may be used by the same students two successive years.

The Manual can be used in accordance with the demonstration plan, the individual plan, or the partnership or group plan of laboratory course.

The book contains a large number of outlines from which the teacher can select; there are one hundred forty-six fully outlined experiments, besides occasional alternates and many suggested experiments.

The outlines in this Manual follow what is coming to be recognized as the logical method of presenting any experiment in science: Purpose or Object, Materials or Apparatus, Method or Observation, Conclusions or Deductions, Discussion, and Diagram. The experiments, therefore, furnish foundation training in the inductive method, which the student will develop more fully in subsequent laboratory courses.

Great pains have been taken in writing these outlines to insure that the student may deduce *unassisted* the "Conclusions" from the "Purpose" and "Method." It will be noted, therefore, that the "Purpose" is in every case a *definite* statement, the intent of which the student can understand; results are almost certain to be disappointing when a class attempts to perform an experiment of which the purpose is left to be inferred, is stated merely as a word or vague phrase, or is not mentioned at all. Legitimate assistance is given the student in arriving at his "Conclusions" by the guide questions under "Conclusions" in the outlines.

The advantage of having the Manual published in *two books* is paramount. The outline which the student follows should contain no hint of what he is expected to observe; but only the skeleton outline can be free from such hints. It is equally important, moreover, that the manual provided for a teacher's guidance contain an altogether different kind of material from that in the pupil's manual.

Particular effort has been made, in writing this Manual, to make the book entirely adaptable for use as a *demonstration manual*, since a demonstrational course for beginners (first-year and perhaps second-year high school, junior high, and upper grammar grades) has certain striking advantages:

1. When the teacher demonstrates, there is no confusion or loss of time in distributing materials, or in awkward handling of apparatus by students.

2. There is no scattering of effort, such as results from a *novice's* attempts to read a set of printed directions, to perform the operations indicated, and then to refocus his thoughts upon what it all means.

3. The student sees only correct and accurate manipulation; if performing the experiment for himself, he develops an amazing number of false leads. Without conscious effort on his own part, moreover, the beginner under the demonstration plan is helped to acquire proper ideals regarding how laboratory experimentation should be done, since he sees only the teacher's skillful demonstrating.

4. The entire class is working upon the same experiment at the

same time; the instructor's attention is entirely free, therefore, for supervising the reports as the students write them.

5. If a school already has a course in either physics or chemistry, or both, the expense of equipment for a demonstrational course is practically nothing.

6. If a school has no laboratory equipment whatever, the cost of equipping for any first-year laboratory course in which a demonstration manual is used is very little, for one set of apparatus serves any number of students or classes.

In schools where the *partnership or individual laboratory plan* is followed, this Manual, with its skeleton outlines, presents the following unique advantages over the manual which gives more extensive directions for the student:

1. It is sometimes comparatively easy for a student, if he wishes to do so, to write up his reports from a *complete* outline of directions, when he has not done all (or any) of the work. But skeleton outlines furnish him no clue to what is used as apparatus, or what is done with it.

2. Discouragement and diminishing interest are the inevitable results, when a *beginner* is confronted with several pages of unfamiliar printed directions.

3. The skeleton outline tends to make the student observe more carefully, since he knows that he will be expected to write up the "Method" entirely without any guidance from the manual.

4. The report written up from *full* printed directions is frequently more or less a paraphrase of the text, with change of mode and tense. But the skeleton outline compels the student to arrange and express his ideas for himself without assistance, and there are therefore as many *different* reports and — what is much more important — *original* reports, as there are students in the class.

5. No matter how complete are the printed directions in a manual for beginners, the teacher is compelled to direct the work, and to explain and supplement the printed directions. It is easier and requires much less time, therefore, for a *beginner* to follow directions given orally by the instructor, especially if the instructor parallels his directions with demonstrations of his own.

6. It is seldom that the instructor wishes to give to the class

all of any *complete* student outline, and he is therefore required to indicate to the class certain portions to be supplemented or omitted, more or less confusion being the inevitable result. But this objection cannot apply to the skeleton outline.

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FRANCIS D. CURTIS

CONTENTS

EXPERIMENT	PAGE
1. PARALLELS OF LATITUDE	1
2. MERIDIANS OF LONGITUDE	2
3. LONGITUDE AND TIME	2
4. STANDARD TIME AND INTERNATIONAL DATE LINE	5
5. CAUSE OF SEASONS	6
6. ROTATION AND REVOLUTION OF THE MOON	9
7. PHASES OF THE MOON	10
8. LINEAR METRIC MEASUREMENTS	13
9. VOLUMETRIC METRIC SYSTEM DRILL	15
10. GRAPHIC REPRESENTATION OF FORCES	16
11. GRAPHIC DETERMINATION OF RESULTANT OF TWO FORCES	17
12. LEVER OF THE FIRST CLASS	19
13. LEVER OF THE SECOND CLASS	20
14. LEVER OF THE THIRD CLASS	20
15. WORK (PULLEYS)	22
16. EFFICIENCY	23
17. MECHANICAL ADVANTAGE	23
18. VOLUME OF AN INSOLUBLE SOLID	24
19. DENSITY OF AN INSOLUBLE SOLID	24
20. DENSITY OF A LIQUID	25
21. EFFECT OF HEATING AND COOLING A SOLID	26
22. EFFECT OF HEATING AND COOLING A LIQUID; PRINCIPLE OF THE THERMOMETER	27

EXPERIMENT	PAGE
23. EFFECT OF HEATING AND COOLING A GAS	27
24. PURIFICATION OF WATER BY FILTERING	29
25. PURIFICATION OF WATER BY DISTILLATION	29
26. BOILING POINT ON A THERMOMETER	32
27. FREEZING POINT ON A THERMOMETER	34
28. SOLUTIONS (SOLIDS IN WATER)	35
29. SOLUTION (AIR IN WATER)	35
30. CONDITIONS UNDER WHICH CRYSTALS FORM	36
31. CONVECTION IN AIR	38
32. CONVECTION IN LIQUIDS	39
33. CONDUCTION OF HEAT BY METALS	40
34. RELATIVE SPEED OF CONDUCTION AND CONVECTION IN WATER	40
35. RELATIVE HEAT CONTENT (SPECIFIC HEAT)	43
36. CAPILLARITY	45
37. DIFFUSION OF LIQUIDS AND SOLUTIONS	46
38. DIFFUSION OF GASES WITH EACH OTHER	47
39. WEIGHT OF AIR	49
40. PRESSURE OF AIR (ALTERNATIVE)	49
41. THE SIMPLE BAROMETER	51
42. THE SIPHON	53
43. AIR PRESSURE AND THE LIFT PUMP	55
44. DEW POINT	57
45. FROST POINT	59
46. RELATIVE HUMIDITY	59
47. FOG	63
48. STUDY OF A DAILY WEATHER MAP	64
49. STUDY OF A WEEK'S WEATHER MAPS	65