Laboratory Manual
Science
Class IX
The National Council of Educational Research and Training (NCERT) is the apex body concerning all aspects of school education. It has recently developed textual material in Science for the secondary stage which is based on the National Curriculum Framework (NCF) 2005. NCF-2005 recommends that children’s experience in school education must be linked to the life outside school so that learning experience is joyful and fills the gap between the experience at home and in community. It recommends to diffuse the sharp boundaries between different subjects and discourages rote learning. The syllabi and the textual material developed recently is an attempt to implement this basic idea. The present Laboratory Manual will be complementary to the Science textbook for Class IX. It is in continuation to the NCERT’s efforts to improve upon comprehension of concepts and practical skills among students. The purpose of this manual is not only to convey the approach and philosophy of the laboratory course to students and teachers but also to provide them appropriate guidance for carrying out experiments in the laboratory. This manual is supposed to encourage children to reflect on their own learning and to pursue further activities and questions. Of course the success of this effort also depends on the initiatives taken by the principals and teachers to encourage children to carry out experiments in the laboratory and to develop their own thinking and nurture creativity.

The methods adopted for performing the practicals and their evaluation will determine how effective this practical book will prove to make the children’s life at school a happy experience, rather than a source of stress and boredom. This laboratory manual attempts to provide space to opportunities for contemplation and wondering, discussion in small groups, and activities requiring hands-on experience. It is hoped that the material provided in this manual will help students in carrying out laboratory work effectively and will encourage teachers to introduce some open-ended experiments at the school level.

Yash Pal
Chairman
National Steering Committee
National Council of Educational Research and Training

New Delhi
21 May 2008
THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC and to secure to all its citizens:

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949, do HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.
The Laboratory Manual in Science for Class IX is in continuation of our efforts in implementing the recommendations of National Curriculum Framework 2005 (NCF-2005). This manual is complementary to the Class IX Science textbook and aims at enhancing children’s comprehension of scientific concepts as also acquiring basic experimental skills. In the learning of science emphasis is on the enquiry approach and hands-on experience instead of lecture method alone. The recommendations of NCF-2005 on Teaching of Science encourage experimental work and introduction of carefully designed experiments. Schools may also be given a choice to select experiments according to the available infrastructure, cultural and environmental resources. At the secondary stage experimental work, often involving quantitative measurement as a tool to verify theoretical principles should form an integral part of the curriculum. This manual covers selected topics in the broad themes of Materials, The World of Living, and Moving Things, People and Ideas. It is an integrated approach to science at this stage. In this manual, a coherent coverage of scientific concepts manifesting themselves in our daily life. It is aimed at motivating the reader to design an experiment, to make observations methodically and to draw logical conclusions. The experiments are designed to expose the learners to basic tools and techniques of scientific investigations.

Based on the science curriculum up to Class IX, forty-four experiments are given in this manual. All experiments conform to a general format that includes – aim, theory, materials required, procedure, observations, results and discussion, precautions, and questions. The questions are aimed at testing learner’s understanding of concepts underlying the experiment. Several experiments also include ‘a note for the teacher’ that suggests viable alternatives and clarifies certain anticipated difficulties while performing the experiment. Further, applications are also quoted at several places to relate the concepts to daily life situations. Some experiments have been left open-ended for teachers to innovate, modify and improve. Teachers may adapt or adopt these experiments for facilitating their teaching-learning processes.

It is a pleasure to express my thanks and gratitude to all those who have been involved at all stages during the development of this manual. I acknowledge the efforts of Dr. Gagan Gupta, Coordinator of this programme and members of the team who contributed to the development and finalisation of the manual. I especially thank Prof. Krishna Kumar, Director, and Professor G. Ravindra, Joint Director, NCERT for their administrative support and keen interest in the development of this manual. I am also grateful to the participating teachers and subject experts in the review workshop for their comments and suggestions which have helped in the refinement of this manual. We warmly welcome comments and suggestions from our readers for further improvement of this manual.

HUKUM SINGH
Professor and Head
Department of Education in Science and Mathematics
LABORATORY MANUAL DEVELOPMENT COMMITTEE

A.C. Borah, Reader, North East Regional Institute of Education, Shillong
A.K. Mohapatra, Reader, Regional Institute of Education, Ajmer
Anjni Koul, Lecturer, National Council Educational Research and Training, New Delhi
B.K. Sharma, Professor, National Council Educational Research and Training, New Delhi
C.V. Shimray, Lecturer, National Council Educational Research and Training, New Delhi
P.K. Durani, Professor, National Council Educational Research and Training, New Delhi
R.K. Parashar, Reader, Regional Institute of Education, Bhubaneswar
S.V. Sharma, Lecturer, Regional Institute of Education, Ajmer
Sunita L. Varte, Lecturer, National Council Educational Research and Training, New Delhi
V.V. Anand, Reader, Regional Institute of Education, Mysore

MEMBER-COORDINATOR
Gagan Gupta, Reader, National Institute of Education, New Delhi
ACKNOWLEDGEMENTS

The National Council of Educational Research and Training (NCERT) acknowledges the valuable contribution of the individuals and organisations involved in the development of this laboratory manual. The Council also acknowledges the valuable contribution of the following academics for reviewing and refining the manuscripts of the laboratory manual: Amina Ansari, TGT, Sardar Patel Vidyalaya, Lodhi Colony, New Delhi; I.P. Aggarwal, Professor, Regional Institute of Education (NCERT), Bhopal; Sanjeev Bansal, Lecturer, Ahlcon Public School, Mayur Vihar, Delhi; M.N. Bapat, Reader, Regional Institute of Education (NCERT), Bhopal; Alok Chaturvedi, Lecturer, DAV College, Ajmer; R.S. Dass, Vice-Principal (Retd), BRMB Senior Secondary School, Lajpat Nagar, New Delhi; Johnson David, PGT (Retd), Rajkiya Pratibha Vikas Vidyalaya, Suraj Mal Vihar, Delhi; Rupamanjari Ghosh, Professor, School of Physical Sciences, Jawaharlal Nehru University, New Delhi; J.S. Gill, Professor (Retd), DESM, NCERT, New Delhi; Lalit Gupta, TGT, Government Boys Senior Secondary School, Hastsal, New Delhi; Seema Gupta, TGT, Somerville School, Noida; Raji Kamlasanan, PGT, DTEA Senior Secondary School, R.K. Puram, New Delhi; Kanhiya Lal, Principal (Retd), Directorate of Education, New Delhi; Charu Maini, PGT, Amity International School, Gurgaon; Meeta Purkayastha, PGT, New State Academy Senior Secondary School, Pitampura, New Delhi; A.K. Seth, Vice-Principal, B.R. Government Sarvodaya Bal Vidyalaya, Shahdara, Delhi; R.S. Sindhu, Professor, DESM, NCERT, New Delhi; and Abinash Kumar Singh, PGT, Kendriya Vidyalaya, Janakpuri, New Delhi.

The Council also acknowledges the efforts of Ritu Jha, DTP Operator and Achal Kumar, Proof Reader for helping in shaping this laboratory manual. The contributions of the Publication Department in bringing out this laboratory manual are also duly acknowledged.
CONTENTS

FOREWORD iii
PREFACE v
INTRODUCTION 1
  1.1 General Laboratory Facilities 3
  1.2 Preparing Students for Laboratory Work 6
  1.3 General Laboratory Rules 7
  1.4 First Aid Treatment 9
  1.5 Recording of Experiment 10

UNIT I
MATERIALS 13

1. To study the different parts of a simple (dissecting) microscope. 13
2. To study the different parts of a compound microscope. 16
3. To determine the density of a liquid (other than water) by using a spring balance and a measuring cylinder. 21
4. To determine the density of a non-porous solid (insoluble and denser than water) by using a spring balance and a measuring cylinder. 25
5. To show that gases are readily compressible and liquids are not. 29
6. To study the changes in state of sublimate solids on heating. 32
7. To study the process of evaporation. 35
8. To determine the boiling point of water and melting point of ice. 37
9. To prepare a saturated solution of common salt in distilled water and to determine its solubility at room temperature. 41
10. To prepare a solution of common salt of 10% composition by mass. 46
11. To separate the components of a mixture of sand, common salt and ammonium chloride. 49
12. To prepare solutions of various substance and to identify them as true solutions and suspensions. 53
13. To prepare a colloidal solution of sulphur and differentiate it from a true solution or from a suspension on the basis of transparency and filtration.

14. To study the process of separation of a mixture of two immiscible liquids.

15. To separate a mixture of two miscible liquids by simple distillation.

16. To differentiate between a mixture (containing two components) and a pure compound.

17. To verify the law of conservation of mass in a chemical reaction.

UNIT II

THE WORLD OF LIVING

18. To prepare a stained, temporary mount of onion peel and to study the cells.

19. To prepare a temporary mount of human cheek epithelial cells, and to study its characteristics.

20. To study the phenomenon of osmosis.

21. To study plasmolysis in leaf epidermal peels of Rhoeo or Tradescantia.

22. To test the presence of starch in a given food sample and metanil yellow in pigeon pea.

23. To study parenchyma and sclerenchyma tissues in plants by preparing temporary slides.

24. To identify and study striated muscle fibre and nerve fibre in animals.

25. To study the characteristics of Spirogyra, Agaricus, moss, fern, Pinus and an angiosperm plant.

26. To prepare herbarium sheet of a flowering plant.

27. To study the features and draw diagrams of earthworm, cockroach, bony fish and bird.

28. To compare the external features of monocot and dicot plants.

29. To study the life cycle of a mosquito.

30. To study the life cycle of malarial parasite.

31. To collect and study symptoms of diseases in locally available crop plants.
UNIT III

MOVING THINGS, PEOPLE AND IDEAS

32. To plot distance–time \((s - t)\) and graph for an object moving with a uniform speed from a given set of \(s\) and \(t\) data and to determine the speed of the object.  

33. To plot the speed–time \((v - t)\) graph for an object moving with uniform accelerations from a given set of \(v - t\) data and to determine the acceleration of the moving object and the distance moved by the object.  

34. To study the third law of motion using two spring balances.  

35. To study the variation in limiting friction with mass and the nature of surfaces in contact.  

36. To verify Archimedes’ principle.  

37. To establish the relation between the loss in weight of a solid when fully immersed in (i) tap water; (ii) strongly salty water, with the weight of water displaced by it by taking at least two different solids.  

38. To plot temperature–time graph for a hot object as it cools.  

39. To study the effect of amplitude on the time period of a simple pendulum.  

40. To study the variation in time period of a simple pendulum with its length.  

41. To study the effect of mass on the time period of a simple pendulum.  

42. To determine the speed of a transverse pulse propagated through a stretched string.  

43. To determine the speed of a longitudinal pulse propagated through a stretched slinky.  

44. To study the reflection of sound.  

APPENDIX

117

122

128

133

139

144

149

153

158

163

168

173

180

184