

SCIENCE

TEXTBOOK FOR CLASS IX



0964



एन सी ई आर टी
NCERT

राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

ISBN 81-7450-492-3

First Edition

February 2006 Phalgun 1927

Reprinted

November 2006	Kartika 1928
November 2007	Kartika 1929
January 2009	Magha 1930
December 2009	Pausa 1931
November 2010	Kartika 1932
December 2011	Pausa 1933
October 2012	Asvina 1934
October 2013	Asvina 1935
December 2014	Agrahayana 1936
December 2015	Agrahayana 1937
February 2017	Phalgun 1938
December 2017	Pausa 1939
December 2018	Pausa 1940
October 2019	Ashwina 1941

PD 750T BS

© **National Council of Educational Research and Training, 2006**

₹ **150.00**

Printed on 80 GSM paper with NCERT watermark

Published at the Publication Division by the Secretary, National Council of Educational Research and Training, Sri Aurobindo Marg, New Delhi 110 016 and printed at SDA Print 'N' Pack, D-19, Sector-B1, Tronica City Industrial Area, Loni, District Ghaziabad- 201 102 (U.P.)

ALL RIGHTS RESERVED

- No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of the publisher.
- This book is sold subject to the condition that it shall not, by way of trade, be lent, re-sold, hired out or otherwise disposed of without the publisher's consent, in any form of binding or cover other than that in which it is published.
- The correct price of this publication is the price printed on this page. Any revised price indicated by a rubber stamp or by a sticker or by any other means is incorrect and should be unacceptable.

OFFICES OF THE PUBLICATION DIVISION, NCERT

NCERT Campus
Sri Aurobindo Marg
New Delhi 110 016 Phone : 011-26562708

108, 100 Feet Road
Hosdakere Halli Extension
Banashankari III Stage
Bengaluru 560 085 Phone : 080-26725740

Navjivan Trust Building
P.O.Navjivan
Ahmedabad 380 014 Phone : 079-27541446

CWC Campus
Opp. Dhankal Bus Stop
Panihati
Kolkata 700 114 Phone : 033-25530454

CWC Complex
Maligaon
Guwahati 781 021 Phone : 0361-2674869

Publication Team

Head, Publication Division	: Anup Kumar Rajput
Chief Editor	: Shveta Uppal
Chief Production Officer	: Arun Chitkara
Chief Business Manager	: Bibash Kumar Das
Production Assistant	: Sunil Kumar

Cover

Nidhi Wadhwa

Layout and Illustrations
Digital Expressions

FOREWORD

The National Curriculum Framework (NCF), 2005, recommends that children's life at school must be linked to their life outside the school. This principle marks a departure from the legacy of bookish learning which continues to shape our system and causes a gap between the school, home and community. The syllabi and textbooks developed on the basis of NCF signify an attempt to implement this basic idea. They also attempt to discourage rote learning and the maintenance of sharp boundaries between different subject areas. We hope these measures will take us significantly further in the direction of a child-centred system of education outlined in the National Policy on Education (1986).

The success of this effort depends on the steps that school principals and teachers will take to encourage children to reflect on their own learning and to pursue imaginative activities and questions. We must recognise that, given space, time and freedom, children generate new knowledge by engaging with the information passed on to them by adults. Treating the prescribed textbook as the sole basis of examination is one of the key reasons why other resources and sites of learning are ignored. Inculcating creativity and initiative is possible if we perceive and treat children as participants in learning, not as receivers of a fixed body of knowledge.

These aims imply considerable change in school routines and mode of functioning. Flexibility in the daily time-table is as necessary as rigour in implementing the annual calendar so that the required number of teaching days are actually devoted to teaching. The methods used for teaching and evaluation will also determine how effective this textbook proves for making children's life at school a happy experience, rather than a source of stress or boredom. Syllabus designers have tried to address the problem of curricular burden by restructuring and reorienting knowledge at different stages with greater consideration for child psychology and the time available for teaching. The textbook attempts to enhance this endeavour by giving higher priority and

space to opportunities for contemplation and wondering, discussion in small groups, and activities requiring hands-on experience.

The National Council of Educational Research and Training (NCERT) appreciates the hard work done by the textbook development team responsible for this book. We wish to thank the Chairman of the advisory group in science and mathematics, Professor J.V. Narlikar and the Chief Advisor for this book, Professor Rupamanjari Ghosh, School of Physical Sciences, Jawaharlal Nehru University, New Delhi, for guiding the work of this committee. Several teachers contributed to the development of this textbook; we are grateful to them and their principals for making this possible. We are indebted to the institutions and organisations which have generously permitted us to draw upon their resources, material and personnel. We are especially grateful to the members of the National Monitoring Committee, appointed by the Department of Secondary and Higher Education, Ministry of Human Resource Development under the Chairmanship of Professor Mrinal Miri and Professor G.P. Deshpande, for their valuable time and contribution. As an organisation committed to systemic reform and continuous improvement in the quality of its products, NCERT welcomes comments and suggestions which will enable us to undertake further revision and refinement.

New Delhi
20 December 2005

Director
National Council of Educational
Research and Training

TEXTBOOK DEVELOPMENT COMMITTEE

CHAIRMAN, ADVISORY GROUP FOR TEXTBOOKS IN SCIENCE AND MATHEMATICS

J.V. Narlikar, *Emeritus Professor*, Chairman, Advisory Committee Inter University Centre for Astronomy & Astrophysics (IUCCA), Ganeshbhind, Pune University, Pune

CHIEF ADVISOR

Rupamanjari Ghosh, *Professor*, School of Physical Sciences, Jawaharlal Nehru University, New Delhi

MEMBERS

Anjni Koul, *Lecturer*, Department of Education in Science and Mathematics (DESM), NCERT, New Delhi

Anupam Pachauri, 1317, Sector 37, Faridabad, Haryana

Anuradha Gulati, *TGT*, CRPF Public School, Rohini, Delhi

Asfa M. Yasin, *Reader*, Pandit Sunderlal Sharma Central Institute of Vocational Education, NCERT, Bhopal

Charu Maini, *PGT*, DAV School, Sector 14, Gurgaon, Haryana

Dinesh Kumar, *Reader*, DESM, NCERT, New Delhi

Gagan Gupta, *Reader*, DESM, NCERT, New Delhi

H.L. Satheesh, *TGT*, DM School, Regional Institute of Education, Mysore

Madhuri Mahapatra, *Reader*, Regional Institute of Education, Bhubaneswar, Orissa

Puran Chand, *Jt. Director*, Central Institute of Educational Technology, NCERT, New Delhi

S.C. Jain, *Professor*, DESM, NCERT, New Delhi

Sujatha G.D., *Assistant Mistress*, V.V.S. Sardar Patel High School, Rajaji Nagar, Bangalore

S.K. Dash, *Reader*, DESM, NCERT, New Delhi

Seshu Lavania, *Reader*, Department of Botany, University of Lucknow, Lucknow

Satyajit Rath, *Scientist*, National Institute of Immunology, JNU Campus, New Delhi

Sukhvir Singh, *Reader*, DESM, Regional Institute of Education, Ajmer, Rajasthan
Uma Sudhir, *Eklavya*, Indore

MEMBER-COORDINATOR

Brahm Parkash, *Professor*, DESM, NCERT, New Delhi

ACKNOWLEDGEMENTS

The National Council of Educational Research and Training is grateful to the members of the Textbook Development Team, whose names are given separately, for their contribution in the development of the Science textbook for Class IX. The Council also gratefully acknowledges the contribution of the participating members of the Review Workshop in the finalisation of the book: P.K. Bhattacharya, *Professor*, DESM, NCERT; Anita Julka, *Reader*, DEGSN, NCERT; Tausif Ahmad, *PGT*, New Era Sr. Sec. School, New Delhi; Samarketu, *PGT* in Physics, JNV, MESRA, Ranchi; Meenakshi Sharma, *PGT* in Biology, SVEM, Ankleshwar, Gujarat; Raji Kamlasan, *PGT* in Biology, DTEA SNSU School, R.K. Puram, New Delhi; Meenambika Menon, *TGT* in Science, Cambridge School, Noida; Lalit Gupta, *TGT* in Science, Govt. Boys Sr. Sec. School No. 2, Uttam Nagar, New Delhi; Manoj Kumar Gupta, *Lecturer* in Chemistry, Mukherji Memorial Sr. Sec. School, Shahdara, Delhi; Vijay Kumar, *Vice-Principal*, Govt. Sarvodaya, Co. Edu. Sr. Sec. School, Anand Vihar, Delhi; Kanhaya Lal, *Principal* (Retd.), Deptt. of Education, GNCT of Delhi, Delhi; K.B. Gupta, *Professor* (Retd.), NCERT, New Delhi; Kuldeep Singh, *TGT* in Science, JNV, Meerut; R.A. Goel, *Principal* (Retd.), Delhi; Sumit Kumar Bhatnagar, Department of Education, GNCT of Delhi, Delhi.

Acknowledgements are due to M. Chandra, *Professor and Head*, Department of Education in Science and Mathematics, NCERT, New Delhi for providing all academic and administrative support.

The Council also gratefully acknowledges the support provided by the APC Office of DESM, administrative staff of DESM; Deepak Kapoor, *Incharge* Computer Centre, DESM; Saima, *DTP Operator*; Mohd. Qamar Tabrez, *Copy Editor*; Mathew John and Randhir Thakur, *Proofreaders*. The efforts of the Publication Department, NCERT are also highly appreciated.

CONTENTS

	<i>FOREWORD</i>	<i>iii</i>
Chapter 1	MATTER IN OUR SURROUNDINGS	1
Chapter 2	IS MATTER AROUND US PURE?	14
Chapter 3	ATOMS AND MOLECULES	31
Chapter 4	STRUCTURE OF THE ATOM	46
Chapter 5	THE FUNDAMENTAL UNIT OF LIFE	57
Chapter 6	TISSUES	68
Chapter 7	DIVERSITY IN LIVING ORGANISMS	80
Chapter 8	MOTION	98
Chapter 9	FORCE AND LAWS OF MOTION	114
Chapter 10	GRAVITATION	131
Chapter 11	WORK AND ENERGY	146
Chapter 12	SOUND	160
Chapter 13	WHY DO WE FALL ILL?	176
Chapter 14	NATURAL RESOURCES	189
Chapter 15	IMPROVEMENT IN FOOD RESOURCES	203
	ANSWERS	216 – 218

Our National Anthem

*Jana-gana-mana adhinayaka, jaya he
Bharata-bhagya-vidhata.
Punjab-Sindh-Gujarat-Maratha
Dravida-Utkala-Banga
Vindhya-Himachala-Yamuna-Ganga
Uchchhala-jaladhi-taranga.
Tava shubha name jage,
Tava shubha asisa mage,
Gahe tava jaya gatha.
Jana-gana-mangala-dayaka jaya he
Bharata-bhagya-vidhata.
Jaya he, jaya he, jaya he,
Jaya jaya jaya, jaya he!*

Our National Anthem, composed originally in Bangla by Rabindranath Tagore, was adopted in its Hindi version by the Constituent Assembly as the national anthem of India on 24 January 1950.



Quest for Truth

True education is that which helps us to know the atman, our true self, God and Truth. To acquire this knowledge, some persons may feel the need for a study of literature, some for a study of physical sciences and some others for art. But every branch of knowledge should have as its goal, knowledge of the self. That is so in the Ashram. We carry on numerous activities with that aim in view. All of them are, in my sense of the term, true education. Those activities can also be carried on without any reference to the goal of knowledge of the self. When they are so carried on, they may serve as a means of livelihood or of something else, but they are not education. In an activity carried on as education, a proper understanding of its meaning, devotion to duty and the spirit of service are necessary. The first necessarily brings about development of the intellect. In doing any piece of work, however small, we should be inspired by a holy aim and, while doing it, we should try to understand the purpose which it will serve and the scientific method of doing it. There is a science of every type of work — whether it be cooking, sanitation, carpentry or spinning. Everybody who does his work with the attitude of a student knows its science or discovers it.

— *From a microfilm of the Gujarati: M.M.U./II, 10 July 1932 (CW 50, p. 182)*

...We are living in the midst of death, trying to grope our way to Truth. Perhaps it is as well that we are beset with danger at every point in our life, for, in spite of our knowledge of the danger and of our precarious existence, our indifference to the source of all life is excelled only by our amazing arrogance.

....My intellect rebels against the destruction of any life in any shape whatsoever. But my heart is not strong enough to befriend these creatures, which, experience has shown, are destructive. The language of convincing confidence, which comes from actual experience, fails me, and it will continue to do so, so long as I am cowardly enough to fear snakes, tigers and the like.

— *(YI, 17 July 1927, p. 222)*

THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a ¹**[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 ²[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.**

1. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)