

Exploration

Textbook of Science for Grade 9



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NCERT

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

0906 – Exploration

Textbook of Science for Grade 9

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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 : *M.V. Srinivasan*

Chief Editor : *Bijnan Sutar*

Chief Business Manager : *Amitabh Kumar*

Chief Production Officer (In charge) : *Deepak Jaiswal*

Production Assistant : *Ashwani Machra*

Cover, layout and illustrations

*Fajruddin
Junaid Digital Arts*

Foreword

The National Education Policy (NEP) 2020 envisions an education system that is firmly rooted in India's cultural and intellectual wisdom, values, and ethical traditions. The rich intellectual heritage simultaneously enables learners to engage meaningfully with the complexities and possibilities of a rapidly changing world. The National Curriculum Framework for School Education (NCF-SE) 2023 provides concrete expression to this vision by laying out a coherent curricular pathway across various stages of schooling that nurtures critical thinking, creativity and sensitivity, along with the values and dispositions that are needed for responsible citizenship in an interconnected global society.

Learners have progressed through the foundational, preparatory and middle stages, where their inherent potential has been nurtured holistically. Now, they enter the secondary stage with enhanced capacity for reflection, reasoning, enquiry, and self-expression. Spanning across Grades 9 to 12, also known as the adolescent stage, it marks a crucial period in the intellectual and personal growth of the students. It prepares them to engage with abstract ideas, complex social realities, ethical dilemmas and the expanding universe of knowledge, while deepening their understanding of the self and the world around them.

The NCF-SE 2023 recommends that the curriculum for Grades 9–10 equips students with the skills that are needed to grow as they advance in their lives. Students can use these skills for reasoning, argumentation, and effective communication. It endeavours to enhance their analytical and descriptive capabilities to prepare them for the challenges and opportunities that await them. A diverse curriculum, covering ten subjects; three languages—including at least two languages native to India, Science, Mathematics, Social Science, Art Education, Physical Education and Well-being, Individuals in Society or Environmental Education, and Vocational Education promotes their holistic development.

As per the NCF-SE 2023, science education at this stage aims to develop scientific temper, critical thinking, and problem-solving skills. It emphasises connecting scientific concepts to everyday life enabling students to understand and apply knowledge meaningfully. The framework promotes inquiry-based learning, environmental awareness, and values, such as curiosity, objectivity, and respect for evidence making science learning engaging, relevant, and learner-centred.

Exploration, the textbook of science for Grade 9, aligns with the NEP 2020 and the NCF-SE 2023 by promoting experiential and inquiry-based learning. It encourages students to ask questions, make predictions, analyse information, and draw logical conclusions. The textbook presents science as

an evolving body of knowledge shaped by collective effort and continuous refinement. By integrating concepts from physics, chemistry, biology, and earth science, it fosters a holistic understanding of science, and highlights the interrelationship between science, technology and society.

Through hands-on activities, real-life examples, and collaborative learning experiences, the textbook strengthens creativity, logical reasoning, and decision-making skills. It nurtures curiosity, cooperation, respect for life, and concern for the environment. While *Exploration* serves as a central learning resource, it also invites students to engage with a broader world of books, media, digital archives, libraries, and community knowledge. The role of teachers, parents, and school libraries is, therefore, pivotal in nurturing a rich culture of reading, dialogue, and independent exploration at this stage. The textbook integrates technology through the use of QR codes in each unit, which provide additional reading material and resources.

The National Council of Educational Research and Training acknowledges the contributions of the Textbook Development Team, subject experts, pedagogues, practising teachers, reviewers, and all others who have supported the development of this textbook. We hope *Exploration* inspires learners to think critically, communicate with confidence, and participate thoughtfully in the intellectual and social life of our nation and the world. We welcome suggestions and feedback from all its users for further improvement in the subsequent editions.

New Delhi
February 2026

Dinesh Prasad Saklani
Director
National Council of Educational
Research and Training

About this Book



You may have enjoyed learning science through your textbooks *Curiosity* during the middle stage. You may have realised that science is not just about answers; it begins with questions. This indicates that you have begun to develop an interest in learning and exploring science. As you continue this journey, this ongoing cycle of questioning and discovery becomes a natural part of how you grow and understand the world. By the end of Grade 8, you would have successfully developed all the competencies outlined in the NCF-SE 2023 for the middle stage.

Building on this strong foundation, the Grade 9 science textbook has been developed in alignment with the NEP 2020 and the NCF-SE 2023 to support a deep understanding and sustained interest in science. *Exploration*, the title of the science textbook for Grade 9, means investigating the unknown by observing, posing questions, and experimenting to understand and discover the world around us. This textbook is designed to help you learn topics related to the world of matter, its interactions and properties at the atomic level; the physical world, and the scientific principles and laws that govern it; the structure and function of the living world at the cellular level, and the interconnectedness between organisms and their environment.

The main aim of the science textbook, *Exploration*, is to engage you in understanding the processes of science and discovering new information. The emphasis is on integrating topics from biology, chemistry, physics, earth science, and other curricular areas, such as environmental education, value education, and inclusive education. The goal is to help you learn through real experiences and not by simply memorising facts. After going through this book, we hope you will become a responsible and sensitive member of society.

Exploration contains 13 chapters. Each chapter includes engaging activities, thought-provoking questions, and clear illustrations to support your learning. The design, layout, and cover page visually communicate curiosity, exploration, and the nature of science. It provides a visual overview of the scientific concepts that may be covered in the textbook. The first chapter, 'Exploration: Entering the World of Secondary Science', provides guidance on examining scientific concepts more closely and carefully. It makes you aware of scientific language, scientific ideas, and their appropriate use for clear, unambiguous communication. It also helps to understand the world around us more systematically through experimentation. This chapter encourages you to appreciate how science connects naturally with mathematics, technology, arts, and social sciences. It motivates you to ask focused questions, design and try

out simple experiments to help answer them, and use your observation, exploration, and investigation skills to understand that Science is not merely a subject, but a way of looking at the world. This chapter provides a friendly introduction to your science journey at the secondary stage.



The page numbers of the textbook have been thoughtfully designed, framed by a **magnifying glass** and a **compass**. What might these symbols represent? Try to guess—but their meaning will be revealed in the first chapter.



Each chapter begins with a **thought-provoking image** related to the title of the chapter, designed to capture your attention and connect the scientific concepts you learn with everyday life. It encourages you to think, explore, and uncover its meaning as you read.



3

Tissues in Action



Think It Over

- How is the study of cells and tissues significant for understanding the life processes and human health?

Life begins when a single cell divides itself several times to give rise to a large number of cells. These cells gradually form the skin (protection), muscles (movement), bones (support), nerves (control and coordination), and all other organs. This process is so intricate that it is considered one of nature's greatest engineering marvels. Researchers have been trying to understand, replicate and modify this process for human welfare. So, it is essential to understand the natural biological processes that govern growth and development in plants and animals. What are the cells that come together to form tissues? Why do some tissues grow faster than others? How do tissues do their work?



9

Properties of Matter



Think It Over

- Water can be obtained from various sources. Are all these samples of water chemically identical?

In Chapter 8, Journey Inside the Atom, you explored the structure of the atom. You also studied subatomic particles, viz., electrons, protons and neutrons, in terms of their discoveries, properties and locations in the atom. You also learnt that atoms with an octet of electrons in their valence shell are stable. Atoms can lose, gain or share electrons to achieve an octet of valence electrons.



6

How Forces Affect Motion



Think It Over

- Why does a canoe move forward when the canoeist pushes water backwards with their paddle and why does it move faster when they push harder?

In Chapter 4, you learnt to describe the motion of an object in terms of its position, velocity and acceleration. But you did not consider what causes motion. Is there an underlying cause for a change in position and velocity of an object? What is the nature of this cause? Do all motions require a cause? In this chapter, we will investigate what causes changes in the motion of objects. We will also discuss Newton's three laws of motion and learn how to apply them.



13

Earth as a System: Energy, Matter, and Life



Think It Over

- How does the warming of Arabian Sea waters affect the southwest monsoon in India?

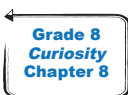
Life on Earth is powered by a constant flow of energy and matter. The Sun is the main source of energy. In addition, the Earth's hot interior and chemical reactions in the air, water, and rocks also drive the flow of energy and matter. During the middle stage in Curiosity (Grades 6–8) and in earlier chapters of this textbook, you explored these ideas.



Think It Over

Each chapter includes a few **Think It Over** questions that encourage you to reflect deeply and explore new ideas. Some of these questions are open-ended and thought-provoking, often framed as why, what, or how questions, to promote critical thinking and curiosity. You may not find immediate answers to all of them, but do not worry; you will be able to explore these questions as you progress through the chapter. These questions help deepen your curiosity and provide insight into the process of science. In fact, several questions may arise in your mind and we hope that you may find answers as you go through the chapters.

Let us take a look at the approach used in this textbook. It is activity-based. These activities are designed to reflect how science works, offering both intellectual and hands-on experiences. They promote teamwork and are inclusive. You are expected to explore concepts by performing activities and seeking guidance from teachers, especially during experiments involving heating devices, corrosive chemicals, microscopes, and similar equipments. In some activities, **Safety first** or precautions are provided to ensure you work safely, particularly when using flammable, corrosive, hot, sharp, or breakable materials. These precautions help prevent accidents, ensuring that everyone can enjoy the activities while learning safely. Teachers are expected to pay special attention while supporting children with special needs and to encourage peer interaction. **Notes** are added at various places to provide additional information, explorations, or clarifications without interrupting the main text. They may help you better understand the content.



At various places in the text, you may find **Grade of the textbook**, **Name of the textbook**, **Chapter number** as an icon, which helps you remember what you already know and link it to new concepts.



Next Level Up will make you aware that there is still more to know about the topic, which you will learn in higher grades.

Several concepts bridge science with other subjects and these interconnections can be explored by accessing the textbooks of different subjects through the provided website link: <https://ncert.nic.in/textbook.php>



Pause and Ponder

Questions are provided after each section or sub-section for self-assessment. These questions help you assess your understanding and reflect how much you have learnt. Many of them encourage critical thinking, reflection on your own ideas, and critical analysis of concepts. In addition, solved numerical examples are included wherever necessary to clarify concepts.



Threads of Curiosity

Some challenging ideas, additional information, interesting facts, and other enriching content are featured in boxes labelled **Threads of Curiosity**. These boxes are designed to encourage curiosity through interesting observations, thought-provoking questions, and fascinating insights.



Ready to Go Beyond

These boxes contain advanced concepts that explore the topic in more depth. The information in these boxes also applies scientific principles and knowledge to real-world contexts, showing how science has contributed to societal development. The intention is to present you with an opportunity to think and explore somewhat beyond the text, and you may feel the urge to continue your scientific expedition at higher levels.



Bridging Science and Society

Bridging Science and Society highlights how science has helped solve real-world problems. This includes improving health, protecting the environment, advancing technology, and enhancing the overall quality of life. By understanding these, you may learn how scientific concepts can be used to become responsible and informed citizens.

India's Scientific Contributions

It traces how individuals and institutions have nurtured scientific temper, showcasing achievements that have shaped society from ancient times to the present.



Think as a Scientist

In most of the chapters, you will find **Think as a Scientist** boxes, where you can explore the experiment further by making modifications or trying different approaches. It will help you investigate more deeply and allow new questions to emerge. These boxes connect theory with real-world applications by using models to make complex ideas easier to understand.

Meet a Scientist

The chapters also feature a section called **Meet a Scientist**, where you can learn about the contributions of Indian and international scientists related to the topic. These sections include brief biographies and show how scientists have made a difference. Additionally, an interesting element incorporated in some chapters is the introduction of striking examples from Indian contexts to promote rootedness among learners, as envisaged in the NEP 2020.



What if...

It presents hypothetical situations or open-ended questions, which may encourage you to think creatively and apply scientific concepts to new situations. Such questions may also involve ethical issues, helping you reflect on the social responsibility and values associated with scientific developments.



The Quest Continues ...

It highlights unanswered questions where current scientific understanding is still being explored. It will give you an idea that science is an ongoing process, and that scientists are still actively exploring and seeking answers to these questions.



At a Glance

This section provides a summary of the chapter, offering an overview of its main points and reinforcing the key ideas discussed.



Each chapter also includes **Keywords** embedded within the text that highlight important concepts, helping you understand ideas clearly and think critically. These keywords also outline procedures used in scientific activities.



Revise, Reflect, Refine

The exercises at the end of each chapter, titled **Revise, Reflect, Refine**, include a variety of questions of different forms and formats, offering a challenging and engaging learning experience. These questions also help to assess the competencies learners developed in each chapter. Teachers are encouraged to use questions similar to those in this section for evaluation purposes.

The Journey Beyond

A key feature of the book is **The Journey Beyond**, which includes activities and projects designed to encourage positive interaction with classmates, experts, teachers, parents, and the community. These activities motivate you to gather information from diverse sources and draw your own conclusions. This approach makes science more interesting, challenging, meaningful, and closely connected to real life. Some activities and projects may require prior preparation.

The last page (epilogue), **Ready for New Horizons?** revisits key ideas and looks ahead to the exciting science of Grade 10.

Special care has been taken to simplify the language without losing the rigour of science, so that the concepts can be understood easily. The textbook is one way to learn, but you should also explore and observe your surroundings. Information and Communication Technology (ICT) can further enhance learning when used appropriately. Quick Response (QR) codes and hyperlinks in the textbook provide access to interactive resources allowing learners to explore at their own pace.

How to stay safe while exploring and gathering information from the internet?

- Use strong passwords that include letters, numbers, and symbols.
- Never share your passwords with anyone, not even friends.
- Avoid clicking on unknown links and pop-up advertisements.
- Do not download applications or files from unknown or untrusted websites.
- Never share personal details, such as your phone number or address.
- Always log out after using email or other online accounts.
- Inform your teacher or a trusted elder in your family if you come across anything online that makes you feel unsafe.

These steps help you stay **safe**.

Protect your information online!

Friends! Science is full of wonders and there is always more to explore. That is why *Exploration* motivates you to keep searching, investigating, and discovering new ideas and knowledge.

Textbook Development Team

National Syllabus and Teaching Learning Material Committee (NSTC)

1. M. C. Pant, *Chancellor*, National Institute of Educational Planning and Administration (NIEPA), **(Chairperson)**
2. Manjul Bhargava, *Professor*, Princeton University, **(Co-Chairperson)**
3. Sudha Murty, Acclaimed Writer and Educationist
4. Shekhar Mande, Former *Director General*, CSIR; *Distinguished Professor*, Savitribai Phule Pune University, Pune
5. Sujatha Ramdorai, *Professor*, University of British Columbia, Canada
6. Shankar Mahadevan, Music Maestro, Mumbai
7. U. Vimal Kumar, *Director*, Prakash Padukone Badminton Academy, Bengaluru
8. Surina Rajan, *IAS (Retd.)*, Haryana; Former *Director General*, HIPA
9. Chamu Krishna Shastri, *Chairperson*, Bharatiya Bhasha Samiti, Ministry of Education
10. Sanjeev Sanyal, *Member*, Economic Advisory Council to the Prime Minister (EAC–PM)
11. Gajanan Londhe, *Head*, Programme Office, NSTC
12. Rabin Chhetri, *Director*, SCERT, Sikkim
13. Pratyusa Kumar Mandal, *Professor* in History and *Dean Instruction*, RIE, Mysuru
14. Dinesh Kumar, *Professor* in Zoology and *Dean Research*, NCERT, New Delhi
15. Kirti Kapur, Former *Professor*, Department of Education in Languages, NCERT, New Delhi
16. Ranjana Arora, *Professor* and *Head*, Department of Curriculum Studies and Development, NCERT, **(Member-Secretary)**

CONSTITUTION OF INDIA

Part III (Articles 12 – 35)

(Subject to certain conditions, some exceptions
and reasonable restrictions)

guarantees these

Fundamental Rights

Right to Equality

- before law and equal protection of laws;
- irrespective of religion, race, caste, sex or place of birth;
- of opportunity in public employment;
- by abolition of untouchability and titles.

Right to Freedom

- of expression, assembly, association, movement, residence and profession;
- of certain protections in respect of conviction for offences;
- of protection of life and personal liberty;
- of free and compulsory education for children between the age of six and fourteen years;
- of protection against arrest and detention in certain cases.

Right against Exploitation

- for prohibition of traffic in human beings and forced labour;
- for prohibition of employment of children in hazardous jobs.

Right to Freedom of Religion

- freedom of conscience and free profession, practice and propagation of religion;
- freedom to manage religious affairs;
- freedom as to payment of taxes for promotion of any particular religion;
- freedom as to attendance at religious instruction or religious worship in certain educational institutions.

Cultural and Educational Rights

- for protection of interests of minorities;
- for minorities to establish and administer educational institutions;
- saving of certain Laws 31A–31D.

Right to Constitutional Remedies

- by issuance of directions or orders or writs by the Supreme Court and High Courts for enforcement of these Fundamental Rights.



Textbook Development Team

CONTRIBUTORS

Shekhar C. Mande, FNA, FASc, FNASc, Former *Director General*, CSIR; *Distinguished Professor*, Bioinformatics Centre, Savitribai Phule Pune University; *Honorary Distinguished Scientist*, National Centre for Cell Science, Pune (**Chairperson, Curricular Area Group: Science**)

Arnab Bhattacharya, *Centre Director*, Homi Bhabha Centre for Science Education (HBCSE), Tata Institute of Fundamental Research (TIFR), Mumbai; *Senior Professor*, Department of Condensed Matter Physics and Material Science, TIFR, Mumbai (**Team Leader and Leader, Physics Sub-group**)

R. Shankar, *Adviser*, International Geoscience Education Organisation, *Coordinator*, International Earth Science Olympiad; Former *Professor*, Mangalore University, Mangaluru (**Leader, Earth Science Sub-group**)

Saroj Ghaskadbi, Former *Senior Professor*, Savitribai Phule Pune University, Pune (**Leader, Biology Sub-group**)

Uday Maitra, *Honorary Professor* and INSA *Senior Scientist*, Indian Institute of Science, Bengaluru (**Leader, Chemistry Sub-group**)

Anjni Koul, *Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi (**Member Convenor, Curricular Area Group: Science and Coordinator, Chemistry Sub-group**)

Rachna Garg, *Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi (**Coordinator, Physics Sub-group**)

R. R. Koireng, *Professor*, Department of Curriculum Studies and Development, NCERT, New Delhi (**Coordinator, Earth Science Sub-group**)

Sunita Farkya, *Professor* and *Head*, Department of Education in Science and Mathematics, NCERT, New Delhi (**Coordinator, Biology Sub-group**)

Abhay Kumar, *Associate Professor*, Central Institute of Educational Technology, NCERT, New Delhi

Adithi Muralidhar, *Scientific Officer*, Homi Bhabha Centre for Science Education, TIFR, Mumbai

Amit Bhattacharya, *Associate Professor*, Ramjas College, University of Delhi, Delhi

Anand Arya, *Associate Professor*, Regional Institute of Education, NCERT, Ajmer

Animesh Kumar Mohapatra, Former *Professor*, Department of Education in Science and Mathematics, RIE, NCERT, Bhubaneswar

Apala Chakraborty, *Principal*, The Future Scholars Academy CBSE School, Kolkata, West Bengal

Arun Pratap Sikarwar, *Associate Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi

Ashish Kumar Srivastava, *Assistant Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi

C. V. Shimray, *Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi

Charu Maini, *Principal*, DAV Public School, Sector 49, Gurugram, Haryana

Divya Haridas, *Professor*, Department of Physics, Keshav Mahavidyalaya, University of Delhi, Delhi

Fanindra Sharma, *Educator and Consultant*, Chanakya University, Bengaluru

Gauri Roy, *PGT (Physics)*, Demonstration Multipurpose School, Regional Institute of Education, NCERT, Mysuru

Hrishikesh Baruah, *Principal*, K.C. Das Commerce College, Guwahati

Indrani Das Sen, *Scientific Officer*, Homi Bhabha Centre for Science Education, TIFR, Mumbai

Jaya P. Swaminathan, *Teacher Developer*, Royal Society of Chemistry, Bengaluru

Karthick Balasubramanian, *Scientist E*, Agharkar Research Institute, Pune

Linto Alappat, *Assistant Professor*, Christ College Autonomous, Irinjalakuda, Thrissur, Kerala

Mayuri Rege, *Reader*, Homi Bhabha Centre for Science Education, TIFR, Mumbai

Mridula Arora, *Principal*, Navyug School, Sarojini Nagar, New Delhi

Munindra Ruwali, *Associate Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi

Neeraja Dashaputre, *Principal Technical Officer (Education)*, Indian Institute of Science Education and Research, Pune

P. V. Raghavendra, *Associate Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi

Pankaj Jain, *Director*, Academic and Operations, Seed2Sapling Education Foundation, Bengaluru

Pooja Gokhale Sinha, *Assistant Professor*, Sri Venkateswara College, University of Delhi, New Delhi

Poonam Katyal, *Former TGT*, Zeenat Mahal Sarvodaya Kanya Vidyalaya, Jafrabad, Delhi

Praveen Pathak, *Scientific Officer*, Homi Bhabha Centre for Science Education, TIFR, Mumbai

Puja Goyal, *PGT (Chemistry)*, Government Model Senior Secondary School, Chandigarh

Pushpa Tyagi, *Former Head of Department (Physics)*, Sanskriti School, Chanakyapuri, New Delhi

Pushp Lata Verma, *Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi

Ravijot Sandhu, *PGT (Chemistry)*, Navyug School, Laxmibai Nagar, New Delhi

Ravindra Kumar Parashar, *Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi

Ruchi Verma, *Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi

Sarita Kumar, *Professor*, Acharya Narendra Dev College, University of Delhi, Delhi

Sarita Vig, *Professor*, Indian Institute of Space Science and Technology (IIST), Thiruvananthapuram

Sekar Venkatraman, *Head of Department*, Isha Home School, Coimbatore

Shashibhal Pandey, *Associate Professor*, CHM College, Ullasnagar

Shirish Pathare, *Scientific Officer*, Homi Bhabha Centre for Science Education, TIFR, Mumbai

Smita Chaturvedi, *Assistant Professor*, Interdisciplinary School of Science, Savitribai Phule Pune University, Pune

Sudesh Kumar, *Associate Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi

Surhud More, *Professor*, Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune

T. A. Viswanath, *Former Associate Professor*, Goa University, Goa

Tarun Choubisa, *Chief Consultant*, Programme Office, NSTC

Ved P. Arya, *Assistant Professor*, Regional Institute of Education, NCERT, Ajmer

Vijay Singh, *Former Professor*, Homi Bhabha Centre for Science Education, TIFR, Mumbai

Reviewers

Manjul Bhargava, *Professor*, Princeton University; *Co-Chairperson*, NSTC

Anurag Behar, *CEO*, Azim Premji Foundation; *Member*, National Curriculum Framework Oversight Committee

Gajanan Londhe, *Head*, Programme Office, NSTC

Ankush Gupta, *Associate Professor*, Homi Bhabha Centre for Science Education, TIFR, Mumbai

B. K. Sharma, *Former Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi

Charu Dogra, *Professor*, Ramjas College, University of Delhi, Delhi

Dinesh Kumar, *Professor*, Department of Education in Science and Mathematics, NCERT, New Delhi

Ginni Singh, *Consultant*, Programme Office, NSTC

K. K. Arora, *Former Professor*, Zakir Husain Delhi College, University of Delhi, Delhi

K. V. Sridevi, *Associate Professor*, Regional Institute of Education, NCERT, Ajmer

Lakshmy Ravishankar, *Former Professor*, KET's V.G. Vaze College of Arts, Science and Commerce, Mumbai

Monika Koul, *Professor*, Hansraj College, University of Delhi, Delhi

Mrinal Shah, *Director*, Curriculum and Assessment, Seed2Sapling Education Foundation, Bengaluru

M. S. Sriram, Former *Professor* and *Head*, Department of Theoretical Physics, University of Madras, Chennai and *President*, K.V. Sarma Research Foundation, Chennai

P. C. Agarwal, *Professor* and *Joint Director*, National Council of Educational Research and Training, New Delhi

Preeti Khanna, *Rehabilitation Professional* (Visual Impairment), National Association for the Blind, New Delhi

Saket Bahuguna, *Assistant Professor* (Linguistics), Central Institute of Hindi, Delhi Centre, Ministry of Education, Government of India

Sanjay P. Sane, *Professor*, National Centre for Biological Sciences, TIFR, Bengaluru

Sanjiv Kumar, Former *Professor*, School of Sciences, Indira Gandhi National Open University, New Delhi

Santosh Gharpure, *Professor*, Indian Institute of Technology Bombay, Mumbai

Sarthak Parikh, *Assistant Professor*, Department of Physics, Indian Institute of Technology, New Delhi

Satyajit Rath, *Visiting Professor*, Indian Institute of Science Education and Research, Pune

Savita Ladage, Former *Professor*, Homi Bhabha Centre for Science Education, TIFR, Mumbai

Shubha Tole, *Distinguished Professor*, Department of Biological Sciences, TIFR, Mumbai

Sujata Bhargava, Former *Professor*, Savitribai Phule Pune University, Pune

Surendra Ghaskadbi, Former *Scientist G*, Agharkar Research Institute, Pune

Vijay Sarda, Former *Associate Professor*, Zakir Husain Delhi College, University of Delhi, Delhi

V. B. Bhatia, Former *Professor*, Department of Physics and Astrophysics, University of Delhi, Delhi

Viswajanani J. Sattigeri, *Head*, CSIR-Traditional Knowledge Digital Library Unit, New Delhi

Yukti Sharma, *Professor*, Department of Education (CIE), University of Delhi, Delhi

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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)