Exploration

Textbook of Science for Grade 9

0906

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

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Textbook of Science for Grade 9

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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 *Exploratio*n 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.

Dinesh Prasad Saklani
Director
National Council of Educational
Research and Training

New Delhi
February 2026

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.

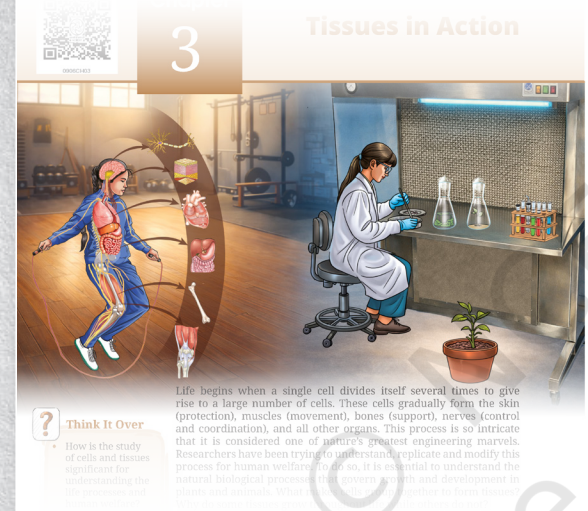
The main aim of the science textbook, *Exploration*, is to engage you in understanding the processes of science and discovering new information. The emphasis is on integrating topics from biology, chemistry, physics, earth science, and other curricular areas, such as environmental education, value education, 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.

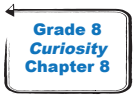
Each chapter begins with a **thought-provoking image** related to the title of the chapter, designed to capture your attention and connect the scientific concepts you learn with everyday life. It encourages you to think, explore, and uncover its meaning as you read.



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

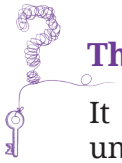
In most of the chapters, you will find **Think as a Scientist** boxes, where you can explore the experiment further by making modifications or trying different approaches. It will help you investigate more deeply and allow new questions to emerge. These boxes connect theory with real-world applications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

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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.

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Contents

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.**

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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)