Mathematics

Textbook for Class VI

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

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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 Committee responsible for this textbook. We wish to thank the Chairperson of the advisory group in Science and Mathematics, Professor J.V. Narlikar and the Chief Advisor for this textbook, Dr. H.K. Dewan for guiding the work of this committee. Several teachers contributed to the development of this textbook; we are grateful to 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 Chairpersonship of Professor Mrinal Miri and Professor G.P. Deshpande, for their valuable time and contribution. As an organisation committed to the 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.

Director

New Delhi
20 November 2006

National Council of Educational
Research and Training

Rationalisation of Content in the Textbooks

In view of the COVID-19 pandemic, it is imperative to reduce content load on students. The National Education Policy 2020, also emphasises reducing the content load and providing opportunities for experiential learning with creative mindset. In this background, the NCERT has undertaken the exercise to rationalise the textbooks across all classes. Learning Outcomes already developed by the NCERT across classes have been taken into consideration in this exercise.

Contents of the textbooks have been rationalised in view of the following:

- Overlapping with similar content included in other subject areas in the same class
- Similar content included in the lower or higher class in the same subject
- Difficulty level
- Content, which is easily accessible to students without much interventions from teachers and can be learned by children through self-learning or peer-learning
- Content, which is irrelevant in the present context

This present edition, is a reformatted version after carrying out the changes given above.

Textbook Development Committee

CONSTITUTION OF INDIA

Part IV A (Article 51 A)

Fundamental Duties

Fundamental Duties – It shall be the duty of every citizen of India —

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes, rivers, wildlife and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement;

(k) who is a parent or guardian, to provide opportunities for education to his child or, as the case may be, ward between the age of six and fourteen years.

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The book was reviewed by Rahul Sofat, *PGT* Mathematics, Air Force Golden Jubilee School, Subroto Park, New Delhi; Gurpreet Bhatnagar, CBSE Resource Person; A. K. Wazalwar and Til Prasad Sarma, DESM, NCERT, New Delhi.

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 educational institutions wholly maintained by the State.

Cultural and Educational Rights

- for protection of interests of minorities to conserve their language, script and culture;
- for minorities to establish and administer educational institutions of their choice.

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.

A Note for the Teachers

Mathematics has an important role in our life, it not only helps in day-to-day situations but also develops logical reasoning, abstract thinking and imagination. It enriches life and provides new dimensions to thinking. The struggle to learn abstract principles develops the power to formulate and understand arguments and the capacity to see interrelations among concepts. The enriched understanding helps us deal with abstract ideas in other subjects as well. It also helps us understand and make better patterns, maps, appreciate area and volume and see similarities between shapes and sizes. The scope of Mathematics includes many aspects of our life and our environment. This relationship needs to be brought out at all possible places.

Learning Mathematics is not about remembering solutions or methods but knowing how to solve problems. We hope that you will give your students a lot of opportunities to create and formulate problems themselves. We believe it would be a good idea to ask them to formulate as many new problems as they can. This would help children in developing an understanding of the concepts and principles of Mathematics. The nature of the problems set up by them becomes varied and more complex as they become confident with the ideas they are dealing in.

The Mathematics classroom should be alive and interactive in which the children should be articulating their own understanding of concepts, evolving models and developing definitions. Language and learning Mathematics have a very close relationship and there should be a lot of opportunity for children to talk about ideas in Mathematics and bring in their experiences in conjunction with whatever is being discussed in the classroom. There should be no obvious restriction on them using their own words and language and the shift to formal language should be gradual. There should be space for children to discuss ideas amongst themselves and make presentations as a group regarding what they have understood from the textbooks and present examples from the contexts of their own experiences. They should be encouraged to read the book in groups and formulate and express what they understand from it.

Mathematics requires abstractions. It is a discipline in which the learners learn to generalise, formulate and prove statements based on logic. In learning to abstract, children would need concrete material, experience and known context as scaffolds to help them. Please provide them with those but also ensure that they do not get over dependent on them. We may point out that the book tries to emphasise the difference between verification and proof. These two ideas are often confused and we would hope that you would take care to avoid mixing up verification with proof.

There are many situations provided in the book where children will be verifying principles or patterns and would also be trying to find out exceptions to these. So, while on the one hand children would be expected to observe patterns and make generalisations, they would also be required to identify and find exceptions to the generalisations, extend patterns to new situations and check their validity. This is an essential part of the ideas of Mathematics learning and therefore, if you can find other places where such exercises can be created for students, it would be useful. They must have many opportunities to solve problems themselves and reflect on the solutions obtained. It is hoped that you would give children the opportunity to provide logical arguments for different ideas and expect them to follow logical arguments and find loopholes in the arguments presented. This is necessary for them to develop the ability to understand what it means to prove something and also become confident about the underlying concepts.

There is expectation that in your class, Mathematics will emerge as a subject of exploration and creation rather than an exercise of finding old answers to old and complicated problems. The Mathematics classroom should not expect a blind application of ununderstood algorithm and should encourage children to find many different ways to solve problems. They need to appreciate that there are many alternative algorithms and many strategies that can be adopted to find solutions to problems. If you can include some problems that have the scope for many different correct solutions, it would help them appreciate the meaning of Mathematics better.

We have tried to link chapters with each other and to use the concepts learnt in the initial chapters to the ideas in the subsequent chapters. We hope that you will use this as an opportunity to revise these concepts in a spiraling way so that children are helped to appreciate the entire conceptual structure of Mathematics. Please give more time to ideas of negative number, fractions, variables and other ideas that are new for children. Many of these are the basis for further learning of Mathematics.

We hope that the book will help ensure that children learn to enjoy Mathematics and explore formulating patterns and problems that they will enjoy doing themselves. They should learn to be confident, not feel afraid of Mathematics and learn to help each other through discussions. We also hope that you would find time to listen carefully and identify the ideas that need to be emphasised with children and the places where the children can be given space to articulate their ideas and verbalise their thoughts. We look forward to your comments and suggestions regarding the book and hope that you will send us interesting exercises that you develop in the course of teaching so that they can be included in the next edition.

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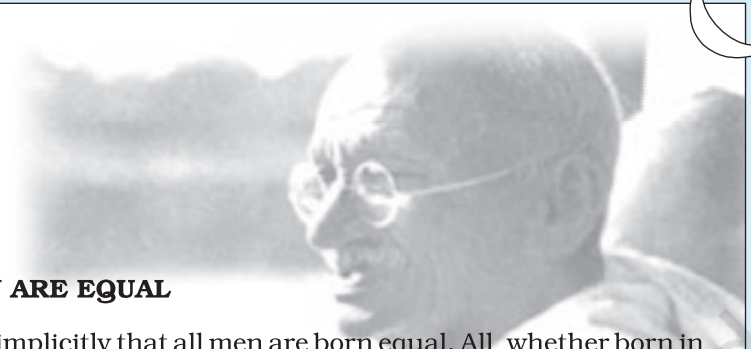

ALL MEN ARE EQUAL

"I believe implicitly that all men are born equal. All whether born in India or in England or America or in any circumstances whatsoever have the same soul as any other. And it is because I believe in this inherent equality of all men that I fight the doctrine of superiority which many arrogate to themselves."

"I have fought this doctrine of superiority in South Africa inch by inch, and it is because of that inherent belief that I delight in calling myself a scavenger, a spinner, a weaver, a farmer and a labourer."

"I consider that it is unmanly for any person to claim superiority over a fellow being. He who claims superiority, at once forfeits the claim to be called a man."

M. K. Gandhi

Such teachers still exist in India. (It should not be necessary to sound the warning that I am not speaking here of spiritual teachers who have the power to lead the aspirants to liberation.) Such teachers have no use for flattery. Respect for them must be natural and so is the love of the teacher for his pupil. That being so, the teacher is ever ready to give, and the pupil equally ready to receive. Ordinary things we may and do learn from anyone. For example, I may learn a great deal from a carpenter with whom I have nothing in common and who may even have many faults. I just buy from him the requisite knowledge even as I buy from a shopkeeper my needs. Of course, here too, a certain kind of faith is necessary. I must have faith in the knowledge of carpentry of the carpenter from whom I want to learn it. If I lack that faith, then it is clear I cannot learn anything from him. But devotion to a teacher is a different matter. Where education aims at the building of character, the old teacher-disciple relation is absolutely necessary. In the absence of a feeling of devotion to the teacher, the building of character must become difficult of achievement.

The Problem of Education : p. 155.