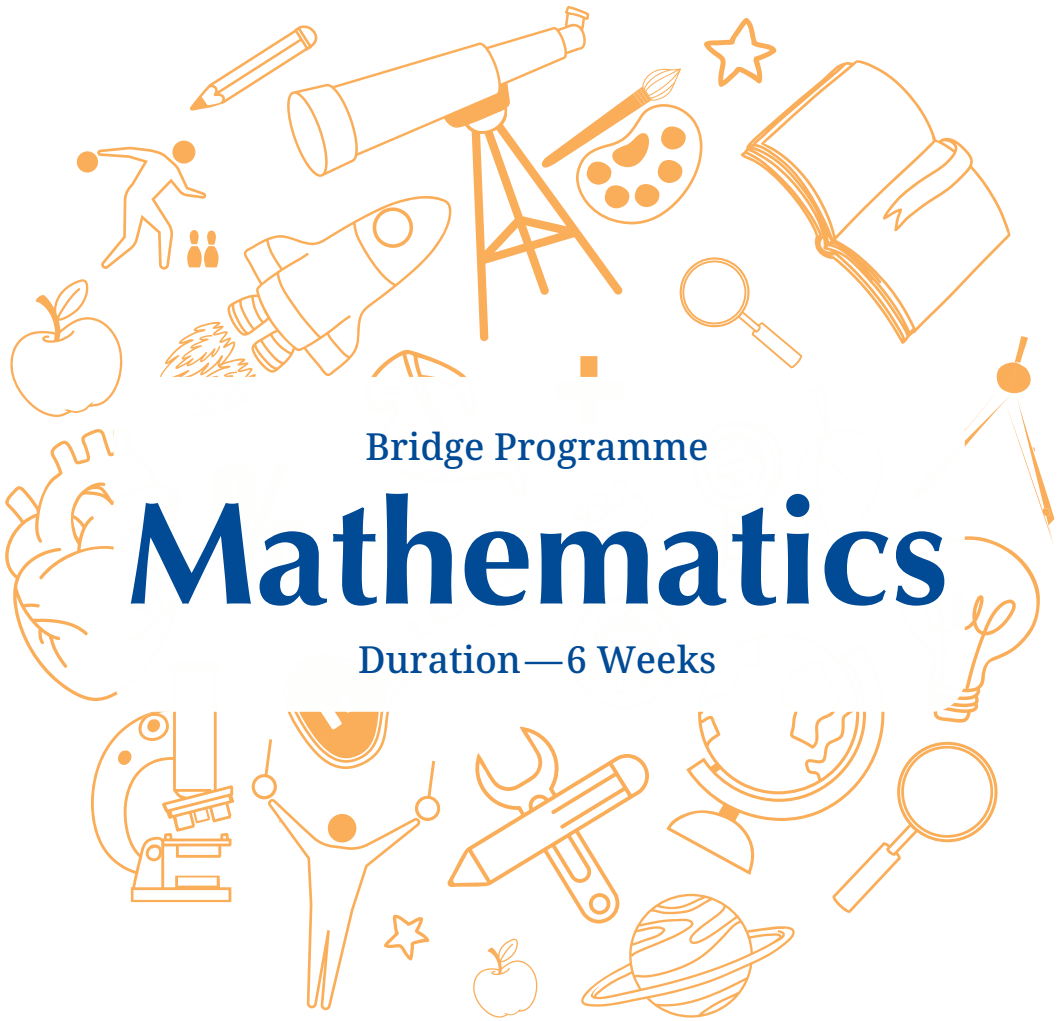
Bridge Programme

MATHEMATICS

FOR GRADE 8

Duration—6 Weeks



Bridge Programme

Mathematics

Duration—6 Weeks

GRADE 8

BRIDGE PROGRAMME—MATHEMATICS
Duration—6 Weeks

First Edition
March 2025 Chaitra 1947

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
Bangaluru 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*

Cover Design
Fatma Nasir

From the Director's Desk

Dear Students and Teachers,

The National Council of Educational Research and Training (NCERT) welcomes all students stepping into Grade 8, the culminating year of the Middle Stage. This grade marks a significant transition, as we align our educational practices with the transformative vision of the National Education Policy (NEP) 2020 and the National Curriculum Framework for School Education (NCF-SE) 2023.

Our commitment is to provide a learning experience that is joyful, innovative, and deeply rooted in Indian ethos. The new syllabus and teaching-learning material are designed for experiential, discovery-based, and inquiry-driven learning, making education a truly enriching journey. However, we know that our students are transitioning from the old curriculum which differs from this new approach. To bridge this gap and ensure a smooth and effective transition, we have developed a comprehensive six-week Bridge Programme across all subject areas, including Mathematics.

This Bridge Programme is designed to prepare students for the innovative pedagogical approaches and content that await them in Grade 8. It provides detailed guidelines for teachers and engaging activities for students, ensuring a holistic development. As Grade 8 serves as a bridge to the Secondary Stage, it is vital for laying a strong foundation for future learning.

We believe that after successfully completing this Bridge Programme, students will be well-equipped to fully appreciate and benefit from the new textbooks and other teaching-learning material. I earnestly urge all teachers to embrace the spirit of NEP 2020, fostering a culturally rooted, experiential education that resonates with the ethos of *Vasudhaiva Kutumbakam* — "The world is one family." This is the first step in our journey, and together, we can demonstrate to the entire education fraternity the power of collaboration and teamwork in delivering quality education to every student.

Let us embark on this journey with dedication and enthusiasm, ensuring that every student experiences the joy of learning and achieves their full potential.

Dinesh Prasad Saklani
Director
National Council of Educational Research and Training

Development Team

Advice and Guidance

Dinesh Prasad Saklani, *Professor* and *Director*, NCERT

Manjul Bhargava, *Professor* and *Co-chairman*, National Syllabus Teaching Learning Committee (NSTC)

Anurag Behar, *Member*, National Curriculum Frameworks Oversight Committee (NOC)

Gajanan Londhe, *Head*, Programme Office, NSTC

Ranjana Arora, *Professor* and *Head*, Department of Curriculum Studies & Development (DCS&D) NIE, NCERT

Members

Madhu B., *Assistant Professor*, RIE, Mysuru

Patanjali Sharma, *Assistant Professor*, RIE, Ajmer

Rishikesh Kumar, *Assistant Professor*, DESM, NCERT, New Delhi

T.P. Sarma, *Professor*, DESM, NCERT, New Delhi

Shiv Kumar, *Member*, Program Office, NSTC

Sridhar Srivastava, *Professor* and *Joint Director*, NCERT, New Delhi

Vijayan. K., *Professor*, Department of Curriculum Studies and Development, NCERT, New Delhi

Ashutosh K. Wazalwar, *Professor*, DESM, NCERT, New Delhi
(Member-Coordinator)

Acknowledgements

The National Council of Educational Research and Training (NCERT) acknowledges the continuous support of Vijayan K., *Professor*, DCS&D, NCERT; Binay Patnaik, *Chief Consultant*, Programme Office, NSTC; and Shalu Tiwari, *Assistant Professor*, DCS&D, NCERT, in the development of this bridge programme.

The Council gratefully acknowledges the valuable contributions of the following participants in the review workshop of the Bridge Month Programme, who provided their insightful inputs during the programme—Bina Prakash, *Sr. PGT* Mathematics, Campion School, Bhopal; Jaspal Kaur, *TGT* Mathematics, SOE, Sector 17, Rohini, Delhi; Ravi Raxit Sharma, *TGT* Mathematics, GCMS, New Seelampur, Delhi; Shaily Choudhary, *TGT* Mathematics, GGSSS, Khajoori Khas, DOE, Delhi.

Special thanks are also due to Manju Mhar, *Senior Research Associate (SRA)*; Sushmita Joshi, *Senior Research Associate (SRA)*; Kishore Singhal, *DTP Operator;* and Mansi Rastogi, *Graphic Designer*, DESM, NCERT for their contributions.

The efforts of Ilma Nasir, *Editor* (Contractual); Ariba Usman and Talha Faisal Khan, *Proofreaders* (Contractual), Publication Division, NCERT are also appreciated. The NCERT gratefully acknowledges the contributions of Surender Kumar, *In charge,* DTP Cell; Ajay Kumar Prajapati and Rani, *DTP Operators* (Contractual), Publication Division, NCERT for their efforts.

The NCERT extends its sincere appreciation to all individuals and organisations who have contributed directly or indirectly to this project.

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.**

---

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)

Mathematics

Bridge Programme for Grade 8
Duration — 6 Weeks

Context

As a follow up of National Education Policy 2020 (NEP 2020), National Curriculum Framework for Foundational Stage (NCF-FS 2022) and National Curriculum Framework for School Education (NCF-SE 2023), NCERT is in the process of developing syllabi and textbooks for all grades of school education in a phased manner. Up till now, NCERT has developed textbooks of Grades 1, 2, 3 and 6 in two phases. The Grade 1 and 2 textbooks have already been introduced in the year 2023–24 and Grade 3 and 6 textbooks have been introduced in the year 2024–25. In the third phase, NCERT is currently developing syllabi and textbooks for Grades 4, 5 and Grades 7 and 8 to be introduced in the year 2025–26. In the academic year 2025–26, Grade 4 and 5 students will get new textbooks. Grade 4 students will be able to link new textbook with Grade 3 curriculum as they have already been exposed to new curriculum in the lower grade. However, Grade 5 students may need more time to understand the new pedagogical perspective and competency based content and exercises. The Grade 5 students may experience a gap in the curriculum, what they studied in Grades 3 and 4 and what they will study in Grade 5. The same will be the case for Grade 8 students, who will get new textbooks but have studied their Grades 6 and 7 of the old curriculum.

In this context, there is a need to provide learners with academic support for their smooth transition from the old curriculum to the new curriculum through a Bridge programme. The curriculum before NEP 2020 was based on a constructivist approach. Hence, competency development had not been given much importance. However, NEP

2020 recommends competency-based education and following this, competency-based teaching-learning materials, including textbooks, are currently being developed.

The idea of the bridge programme is to have a fun-filled series of games and activities that will allow the children to enjoy, interact, shed their inhibitions, speak with other students and teachers, play and engage in simple projects (why not a treasure hunt!), etc. The purpose is to develop an interactive and playful classroom environment to set the atmosphere and prepare both teachers and students for the new syllabus, new textbooks and new approach to learning.

Continuing this vision of the bridge programme, a bridge programme of six weeks has been developed for learners entering Grade 8 this year, which marks the final year of the middle stage. It is pedagogically essential that the old and new curriculum is bridged at this stage for paving the path of smooth learning in higher grades.

Teachers' Section

Introduction

Mathematics is the art and science of discovering patterns and explaining them. These patterns are all around us, in nature, in technology, and in the motion of the earth, sun, moon, and stars. There is mathematics in everything that we do and see, from shopping and cooking, to throwing a ball and playing games, to solar eclipses and climate patterns. Mathematics thus gives us the foundational concepts and capacities required to think about the world around us and the world beyond us. But most of all, when taught well, mathematics is truly enjoyable and can become a lifelong passion.

The goal of mathematics education is to bring life to these aspects of mathematics (NCF-SE, 2023, page 268). With the growing challenges with respect to artificial intelligence, machine learning, data science, climate modelling, infrastructure development, and the numerous other related scientific issues faced by India and all nations today, mathematics along with computational thinking has become ever more important. Quality education in mathematics and mathematical thinking will thus, be indispensable for India's future, and indeed for ensuring India's leadership role in these critically important and emerging fields.

The National Curriculum Framework-School Education (NCF-SE), 2023 reiterates the importance of providing varied educational opportunities not to aim only for all students to learn but more importantly, to learn how to learn, so that they may become lifelong learners and also have the ability to constantly adapt to changing times. The NCF-SE, 2023, further suggests to include those curriculum contents, which will help in developing key capacities, values, and dispositions by all students across subject areas to become good, fulfilled, and productive human beings in today's rapidly changing world. It further recommends using effective pedagogical strategies, which are more experiential, integrated, inquiry-driven, discovery oriented, discussion-based, project-based, arts-based, sports-based, and activity-based during classroom transaction. The learning outcomes as well as detailed syllabi for mathematics were developed for different grades by taking care of the Curricular Goals (CGs) and Competencies suggested by NCF-SE, 2023.

Students that have just entered Grade 8, have studied Mathematics in Grades 6 and 7, following the old curriculum. Now, they will be introduced to new textbook of Mathematics— 'Ganita Prakash'. In this textbook, the curricular content is aligned to curricular goals and competencies as given in the NCF-SE, which needs to be understood by the teachers for its better transaction. Gaps have been identified between Learning Outcomes of old curriculum and new curriculum for Mathematics. Now, it is deemed essential to bridge these gaps and equip students with basic prerequisite knowledge, so that a student entering Grade 8 can smoothly and confidently adapt to the new textbook. Teachers also need to be aware of the considerable shift in the pedagogical approach included in the new textbook and also, of the preparation of required teaching-learning material they need to prepare for the classroom transaction. The experiential learning through play-based, game-based, art-based, etc., is a common thread across subject areas. The objectives of this programme include—

1. Providing opportunity to learners to familiarise with the competency-based approach with reduced content load.
2. Creating positive attitude towards mathematics learning through challenging and engaging activities and games.
3. Preparing teachers to transact syllabus and textbook, based on a new pedagogic approach integrating experiential learning,

cultural rootedness, equity and inclusion, and also technological concerns.

Bridge Programme Weekly Plan

Time allocation for the middle stage along with an illustrative timetable is given in the NCF-SE, 2023 (Page 137). As per the time allocation, the total time allotted for Mathematics per week is 3 hours and 20 minutes. Therefore, an illustrative timetable of Mathematics for Bridge programme for 6 weeks is given below:

Week-wise Timetable (As per the Illustrative timetable given in NCF-SE, 2023)

Week	Subject	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total Weekly Time Available in Hours For Mathematics
Week 1	Maths	-	1 Period	1 Period	2 Periods	1 Period	-	3 Hrs. 20 Minutes
Week 2	Maths	-	1 Period	1 Period	2 Periods	1 Period	-	3 Hrs. 20 Minutes
Week 3	Maths	-	1 Period	1 Period	2 Periods	1 Period	-	3 Hrs. 20 Minutes
Week 4	Maths	-	1 Period	1 Period	2 Periods	1 Period	-	3 Hrs. 20 Minutes
Week 5	Maths	-	1 Period	1 Period	2 Periods	1 Period	-	3 Hrs. 20 Minutes
Week 6	Maths	-	1 Period	1 Period	2 Periods	1 Period	-	3 Hrs. 20 Minutes

This timetable is suggestive in nature and the school may adapt it in different contexts without changing the total allocated time for Mathematics.

Activity-wise Timetable

An illustrative activity-wise timetable for Mathematics based on the above timetable is given below. The details of each activity are given later in student's section.

Week	Competencies to be Addressed	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Week 1 (W1)	• Explore numbers and mean of numbers through calendar • Recognise cube numbers through game • Engaged in recreational puzzles • Observe patterns	-	W1.1	W1.2	W1.3 W1.4	W1.5	-
Week 2 (W2)	• Engaged in recreational puzzles • The properties of polygons • Able to identify square numbers through visualisation • Exploring algebraic expressions and equations through puzzles • Identify fractional parts of quantities	-	W2.1	W2.2	W2.3 W2.4	W2.5 W2.6	-
Week 3 (W3)	• Recreational puzzles • Density of Fractions • Recreational puzzles • Exploring volume vs. area • Explore patterns pictorially, numerically as tables of values	-	W3.1	W3.2	W3.3 W3.4	W3.5 W3.6	-
Week 4 (W4)	• Recreational puzzles • Able to decode the rule in number pattern through visualisation • Able to differentiate between bar graph, line graph and pictograph • Patterns in exponents • Explore patterns pictorially and numerically	-	W4.1	W4.2	W4.3 W4.4	W4.5 W4.6	-

Week 5 (W5)	Number patterns making different stories for the same number sentence	-	W5.1	W5.2	W5.3 W5.4	W5.5 W5.6	-
Week 6 (W6)	Number patterns patterns in exponents	-	W6.1 W6.2	W6.3 W6.4	W6.5 W6.6 W6.7	W6.8 W6.9	-

Pedagogy and Assessment

In the bridge programme, teachers are expected to use experiential learning activities, which will facilitate children's transition from Grade 7 to Grade 8. The learning exposure to be provided during the bridge programme in Mathematics, needs to be more activity-based. Since in the new textbook, concepts are explained through games and activities so, appropriate integration of games as well as linkage with real-life contexts needs to be ensured, while interacting with the students. Most of the activities given in this material are based on puzzles, riddles, group discussions, games, collaborative-learning approach, posing, investigating and answering questions. Teachers should engage students in meaningful discussions including questions that require explanations. Hence, care has to be taken to provide opportunity to all students to be a part of these activities so that, they can joyfully participate in the learning process and feel more confident in their abilities. The activities included in this material are suggestive in nature and teachers may use similar games/puzzles/activities in the classroom and encourage students to device their own activities.

Students need to be assessed for the understanding of concepts and mathematical skills and capacities, such as procedural fluency, computational thinking, problem solving, visualisation, optimisation, representation, and communication. Various strategies, such as observation, peer assessment, group discussion, reflective questions, simple projects, etc., could be used for assessing students and providing constructive feedback.

Linkage with New Textbooks

The Learning Outcomes (LOs) for Grades 6, 7 and 8 new textbooks were developed based on the Curricular Goals (CGs) and Competencies for middle stage Mathematics given in NCF-SE, 2023 (see the Appendix). The LOs developed for the new textbooks for Grades 6 and 7 are connected with those of Grade 8 since they are in a continuum. The students entering Grade 8 in the academic year 2025–26, who have learnt that the existing Grade 7 textbook might not be exposed to some of the LOs, which are an essential prerequisite to understand the new Grade 8 textbook. A gap analysis has been done and it was found that few LOs related with some CGs/Competencies have to be bridged. Activities based on these LOs have been designed and presented here. This bridge programme also contains different ice breaking activities, which will not only help learners to acquire basic prerequisite competencies required to understand the concepts included in Grade 8 Mathematics but also to create positive, vibrant and sustainable attitude among the students towards learning mathematics.

Students' Section

This programme is designed to support learners to actively participate and engage in learning activities of Grade 8 Mathematics confidently and to enjoy learning mathematics. You have learnt many concepts from the Grade 7 textbook. Now, you will get a textbook of Grade 8, integrating competency and experience learning based approach.

Some of the concepts you will learn in Grade 8 will require your engagement with the competencies that are given in new Grades 6 and 7 textbooks, which you could not study. This six week long bridge programme will support you in learning those concepts and acquiring the required competencies, hence facilitating a seamless transition to Grade 8.

Mathematics consists of lots of interesting activities, games, puzzles, riddles, etc. It is essential to see and engage in those activities and games and solve puzzles and riddles. This will help you to develop essential skills, which in turn will help you

in learning Mathematics as well as other subjects in future. This bridge programme will also provide you a supportive environment to build confidence and enhance your motivation in learning Mathematics.

Teachers will provide you the guidance and support to do different activities given in the material as per the timetable. They will provide individual attention and constructive feedback and you can seek the support of your teacher at any time of the learning process. You can also seek the support of your parents to undertake any activities at your home, such as game, puzzle, etc., (for example, Mathematical *Tambola*). You may request your parents to get necessary materials/ resources to conduct an activity/ game/puzzle, (for example, calendar, rubik cube, number cards, sketch pen, etc.).

Bridge Programme Content: Detailed Activity

Activities for Week 1

The introductory sessions (40 minutes each) aim to enhance the motivation level of students towards learning Mathematics by involving them in various puzzles, games and activities. Care must be given to provide students ample opportunity to think, question, discover and verify the results. This will help in creating interest and satisfaction among them. Apart from enhancing the motivation, these types of activities will help in developing mental computational capabilities and logical thinking also.

While doing these, the teacher will get an opportunity to observe the students' thinking process. They may see whether the students are able to apply the concepts learnt by them till now, the strategies they employ, while playing the games, etc. Based on these observations teachers may motivate students to improve their learning strategies. Few such activities/games/puzzles are given below:

Activity W1.1: Recreational Puzzle

Material Required: A calendar of any month, coloured sketch pens and sheet of paper.

- A calendar may be given to students in pairs. They have to observe the calendar keenly and write their observations in the notebook.
- Let the students do on their own. Teacher can suggest question but should not reveal the conclusions before taking responses of students' observations.
- Teacher may ask students to do the following:
  - Draw boxes around square numbers (number obtained when a number is multiplied to itself two times. 9 = 3 × 3 is a square number) and colour them with a single colour.
  - Draw circles around cube numbers (number obtained when a number is multiplied to itself three times. 8 = 2 × 2 × 2 is a cube number.) and colour them with a new colour.
  - Draw triangle around prime numbers.

May 2025

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

- Students may be asked to choose any 2 by 2 number square grid from the calendar they have. They should try to answer the following questions:
  - What is the sum of the numbers in the diagonals of the grid?
  - What magic do you observe?

Based on the above activity, some reflective questions may be discussed, such as:

- How do you differentiate between square number and cube numbers?
- How do you identify prime numbers?
- Why is the sum of diagonals always same for any 2 by 2 grid?

Extension of the Activity

- Teacher can extend this activity by suggesting students to take a 3 by 3 grid. They may find—
  1. The sum of diagonal numbers.
  2. The mean of all numbers. They may be asked to see what special thing they observed.
- Teacher may encourage students to explore more such patterns in the calendar.

Participation of Special Children

- Teacher may pair them with a peer buddy.
- Teacher can use braille number cards/calendars for the children with visual impairment.

Activity W1.2

Material Required: Two big dice, which can be made by using a cubical box.

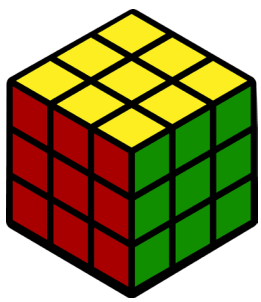
- Teacher may divide the whole class in two teams, say A and B (some innovative team names can be thought of). Every team will throw the dice. Chance may be given to every student of the team.
- Divide the blackboard into two parts. Put team names in the two parts.

Steps to Play the Game

1. One member of Team A will be called to throw the dice. He will speak loudly the number that appears on the top of the dice, to his team.
2. That team has to multiply the number by itself, 3 times.
3. This output will be written on the board under Team A.
4. Then it's the turn of Team B. One member will be called to throw the dice and tell the number loudly to their team. That team will also multiply the number by itself 3 times.
5. Both the teams will add their entries after their throw.
6. The number of throws of the dice may be decided (10 or 12 etc).
7. The team, which reaches nearest to 500 (or 1000, may be decided) in the given number of throws, will be the winner.

Based on the above activity, some reflective questions may be discussed, such as:

1. Observe the scores of each team written on the board. Try to find numbers other than seen on the board that are square/cube numbers.
2. Students may be given some number of unit cubes say, 8, 10, 25, 27, 30, 50, 64. They may be asked to make a bigger cube out of



these given number of cubes. They may be asked, for which number of cubes they could make a bigger cube and which they could not. Ask them to explain.

3. A rubik cube may be shown to students to guess how many small unit cubes have been used to make it.

Participation of Special Children

- Teacher may pair special children with a peer buddy. This will facilitate them to do this activity.
- They can also be invited to throw the dice, to multiply the number by itself to write on board.

Activity W1.3: Recreational Puzzles

Students may be asked to play this game either individually or in pairs. They may be motivated to disclose their strategy before the class.

	−	4	−		1
+		−			
2	x		+	8	18
+		+		−	
	−	3	x		-20
15		2		0	

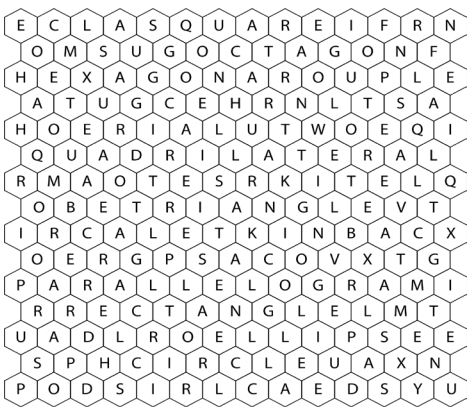
How to Play?

Fill in the missing numbers

1. The missing values are the whole numbers between 1 and 9.
2. Each number is used only once.
3. Each row is an arithmetic equation.
4. Each column is an arithmetic equation.
5. Remember that multiplication and division are performed before addition and subtraction.

Activity W1.4: Recreational Puzzle

Students may be asked to play this game either individually or in pairs.



How to Play?

1. Locate the following mathematical terms in the above grid.
2. Encircle them in the grid.
3. These could be found vertically, horizontally or diagonally.

4. Time may be allotted for doing this.
5. Marks may be decided accordingly.

Words are: Circle, Octagon, Square, Parallelogram, Star, Hexagon, Quadrilateral, Triangle, Kite and Rectangle.

Activity W1.5: Pattern Observation

In this activity, students explore, identify and generalise patterns using physical movements. They, then, connect it to number patterns.

How to Play?

Step 1: Students may be asked to perform a simple body movement sequence without explaining the pattern.

Example 1: Clap, clap, clap, clap... (continue).

They may be asked questions such as—

- What do you notice about the movement?
- Can you predict what comes next? Why?
- If I stop at the 7th movement, what should the 8th movement be?

Step 2: Change the movements to

Example 2: Clap, clap, jump, clap, clap, jump...

Possible questions could be—

- How is this different from movements in Example 1?
- Can you describe the rule?
- If first jump is at 3, second jump is at 6; then at what number do we get the third jump?

Many such different body movements can be thought of Questions followed by discussions should be done.

Step 3: Connecting to numbers

Example 3: Clap, clap clap, clap clap clap, clap clap clap, clap, ...

We may write the corresponding sequence of numbers as 1, 2, 3, 4 ...

- What sequence of numbers can we assign to Example 2?
- If we denote clap by natural numbers and jump by 0 then the sequence in Example 2 would be 1, 2, 0, 1, 2, 0, ...
- Students may be given a number sequence, such as 1, 3, 5, 7,... and may be asked to assign corresponding body movements that justify this pattern.

We may ask students to assign their own numbers and create a sequence of numbers.

Step 4: Students may think of many such movements and their corresponding number patterns.

Reflections on the Activity

Discussion may be held on questions, such as:

- How do patterns help us make predictions?
- Where do we see patterns like this in real life?

Participation of Special Children

- Instead of requiring physical movement (for example, clapping, jumping), allow students with mobility disabilities to use gestures, verbal cues, or assistive devices.
  - ➢ Provide alternative options, such as—
  - ➢ Hand tapping or finger snapping instead of clapping.
  - ➢ Nodding, blinking, or pointing instead of jumping.
  - ➢ Using small objects (counters, flashcards, or digital tools) to represent movements.
  - ➢ Pair students with physical disabilities with a peer buddy who can perform the movements on their behalf while they identify, predict, and describe the pattern.

Activities for Week 2

Activity W2.1: Let us Brainstorm

Students may be given these puzzles to solve. They may do it individually or in pairs. They may be asked to justify their answers.

A. Determine the missing value in the puzzle below.

 = 16

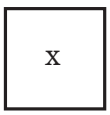
 = 13

 = 8

 = ?

B.

= $x^2 - 1$, if x is an even number



= $x^2 + 1$, if x is an odd number

a. What is the value of

–

= ?

b. What is the value of

+

= ?

Activity W2.2: A Mathematical Tambola

This game will make students explore their previous knowledge and will prepare to connect different concepts in Mathematics.

How to Play?

- Each student gets a *tambola* ticket with 15 numbers randomly selected from 1 to 90.
- Instead of directly calling out numbers, the host will give a math-based clue for each number. For example, instead of saying 2, it may be said 'An even prime number'.
- Players are required to solve the clue to mark the correct number on their ticket.
- Winning rules:
  1. Early five: first to mark any 5 numbers.
  2. Top row/middle row/bottom row: First to mark all numbers in a row.
  3. Full house: first to mark all 15 numbers.
  4. Students will mark question numbers on each strike out for later verification.

Some Sample Clues

S.No.	Clue	Number
1.	3^2	9
2.	The sum of intirior angles in a triangle	180
3.	Half of 130	65

Suggestions for the Teacher

- You can create more such clues based on basic arithmetic, geometry, prime numbers, factors, multiples, etc.
- Teacher can give questions in written or can announce as per convenience.
- Teacher may change the difficulty level of the clues as per students' comprehension level.

Activity W2.3

Students may be made to explore different polygons, identify their properties, and classify them based on sides, angles, and symmetry.

Materials Required

1. Pre-made polygon cutouts (triangles, quadrilaterals, pentagons, hexagons, etc.)
2. A worksheet with clues and challenges
3. Whiteboard and markers
4. Straws or sticks

How to Perform Activity

- Warm-up Discussion.
  1. Ask students what they know about polygons.
  2. Show different polygon shapes and discuss their sides, angle and classifications.
- Hide or display polygon cutouts around the classroom.
- Divide students into small groups.
- Give instructions to each group with clues like:
  1. Find a shape with all 3 sides.
  2. Find a shape with 5 angles.
  3. Find a 4-sided figure with a pair of parallel sides.

4. Find a 4-sided figure with a pair of parallel sides.
5. Find a 4-equal sided figure with a pair of parallel sides and 90-degree angle.
6. Find a 4-sided figure with a pair of parallel sides and 90-degree angles.

More such conditions can be thought of and discussed.

- Each group searches for the correct shape and records its properties on the worksheet provided to them.
- Each group presents one shape they found, explaining its properties.

Extension

Discuss real life examples of polygons (stop signs, tiles, windows, etc.).

Exploratory Questions Based on the Activity

Teachers may generate a discussion on questions that require explorations. Here are a few examples—

1. Is circle a polygon?
2. Can we draw a polygon with 2 straight lines?
3. Can we consider open figure as a polygon?
4. Can we consider square as a rectangle? If yes, then why?

Hands on Practice

1. Teacher may instruct students to draw a polygon using some clues, on a white board with the help of a marker.
2. Students may also be encouraged to construct polygons with the help of straws and sticks, and given clues.

Activity W2.3

The number 9 can be written as $9 = 3 \times 3$. So, it is a square number.

This activity will make the students aware about such special numbers called square numbers.

Material required: Grid sheet/graph paper/Math notebook (used in foundational stage), coloured sketch pens, square numbers cards and box.

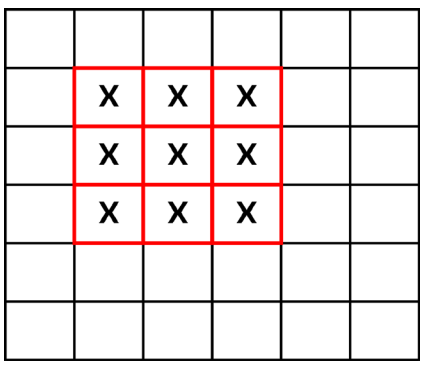
Preliminaries

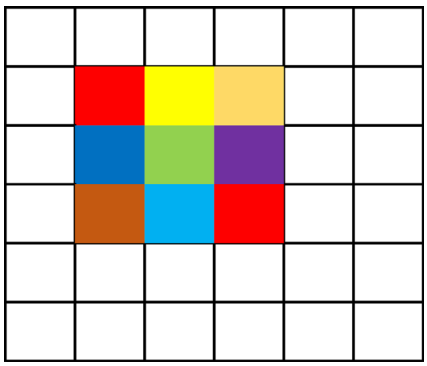
- Prepare number cards (of square of numbers from 1 to 8 and a few non-square numbers).

- The number of cards will be equal to total number of students in the class.
- There can be multiple cards with the same square number.

Procedure

- One grid sheet or graph paper or page of a Math notebook may be given to every student.
- All the students may be provided opportunity to present their work in front of the whole class.
- Put all the number cards in a box.
- One student comes and picks a number card from the box and reads the number on it loudly.
- Colour or cross the number of boxes on the sheet equal to the number written on the chosen card. For example, if the number on the number card is 9, then 9 boxes should be coloured in the grid. The following process should be adopted for doing this:
  - Fill or cross the adjacent boxes equally in horizontal and vertical manner (sample has been shown as under).
  - Fill the boxes with different colours.
- There is a possibility that students may not get equal number of filled or crossed squares horizontally and vertically for some numbers.
- Now they may observe and tell about the shape formed and write its name.





- The teacher may ask questions to the presenters. Some sample questions are as follows:
  1. How many rows are coloured? Write in your notebook.
  2. How many columns are coloured? Write in your notebook.

3. Count the number of boxes coloured in total.
4. Is there any relationship between the number of rows and columns, are coloured and the total number of boxes?
5. If yes, then what is that relationship?
6. What pattern have you observed in this relationship?
7. What is the name of shape formed by the coloured boxes?
8. What is the difference between shapes of the coloured boxes for numbers 16, 4, 25, 9 36 and of 8, 10, 15, 12, 30?

- After discussion on above questions, teacher will conclude the class by introducing square numbers relating to the concept of multiplication. For example:

  $1 \times 1 = 1$

  $2 \times 2 = 4$

  $3 \times 3 = 9$

  $4 \times 4 = 16$

  $5 \times 5 = 25$

  $6 \times 6 = 36$

  And so on.

- Teacher may discuss how the square number and the 2D square shapes are related to each other.

Extended Learning and Exploration

- Try the same process of filling colours in boxes for some other random numbers like 10, 15, 12, 20, etc. Is it possible to make the shape of square with these number of boxes?
- Students may be motivated to extend their learning by knowing the need of square numbers in mathematics.
- Discuss on how does the area of a square and the square numbers are related?

Participation of Special Children

- Special children will also be able to do this activity, if the teacher pairs them with a peer buddy.
- Some concrete objects like same size marbles or ***bindi*** can be given to the children with visual impairment so that they can count them and arrange in square shape.

Activity W2.4

Teacher may encourage students to solve puzzles to make them explore different concepts of Mathematics learnt. The NEP 2020 encourages puzzles in the Mathematics curriculum. Some puzzles are given below.

Puzzle 1

- Think of a number.
- Add 5 to it.
- Multiply the result (got in step 2) by 3.
- Now subtract 15 from above.
- Now divide the last result by the original number.
- Finally add 7 to the result.

Puzzle 2

- Think of a number between 20 to 99.
- Add the digits of the number.
- Subtract the result from original number.
- Again, add the digits of final number you get in step 3.

Puzzle 3

- Think of a number.
- Add 5.
- Double your result.
- Add 40.
- Divide by 2.
- Subtract the number that you first thought.
- Multiply by 4.

Puzzle 4

Find me: Who am I?

- I am a 2-digit number.
- The sum of my digits is 10.
- I am greater than 8 but less than 30.
- What number am I?

Puzzle 5

Find me: Who am I?

- I am a prime number.
- The sum of my digits is 8.
- I am greater than 10 but less than 50.
- What number am I?

Puzzle 6

Find me: Who am I?

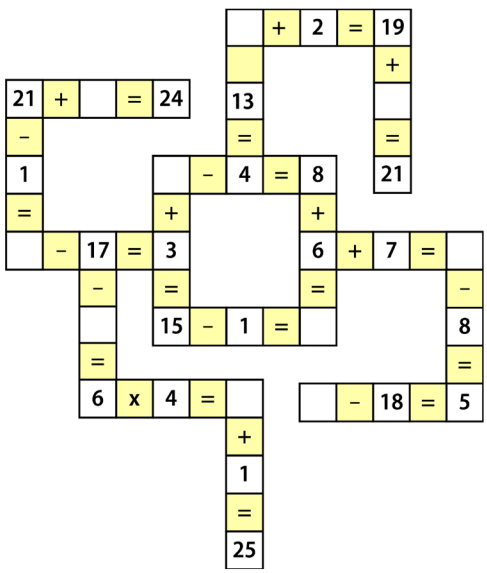
- I am a square number.
- My first digit is 2.
- The sum of my digits is 10.
- What number am I?

Reflection and Discussion

In all the above puzzles, teachers must discuss the logic behind the magical answers. Before explaining the logic related to the curricular concept of linear equations in one variable, students should be given a chance to express their observations and thought processes.

Activity W2.5

Students may be encouraged to fill in the blank spaces. The NEP 2020 encourages use of such games, which make children explore and connect different mathematical concepts.



Activity W2.6

LO: Identify fractional parts of quantities.

Fraction Pizza Party

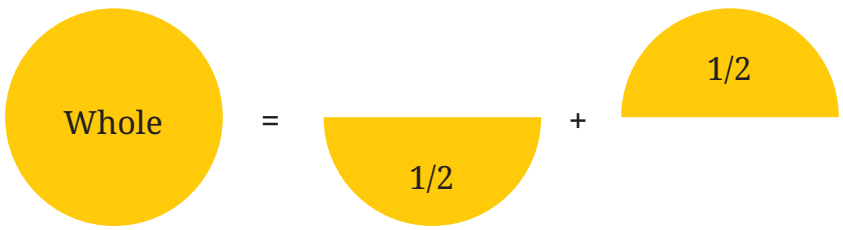
This activity will help students understand fractional quantities by creating and comparing pizza slices.

Material Required

- Large paper circles (representing pizzas)
- Coloured markers or crayons
- Scissors
- Multiple flashcards with fraction amounts (for example, 2 pieces of 1/2, 4 pieces of 1/4 and 6 pieces of 1/6)

Procedure

1. Divide students into small groups and give each group a paper pizza.
2. Call 1 student from each group and ask them to choose 1 set of fractions.
3. Ask them to cover pizza paper with the help of fractions one-by-one.
4. No gap and no overlapping are allowed.
5. Find out and note down "How many total slices are left" after putting each slice?
6. Take ½ parts and combine them to form a whole. How many such parts do you see, are required?



7. Take the 1/8th parts and combine them to form a whole.

   How many 1/8 parts would be required to make a whole? One way to find this is:

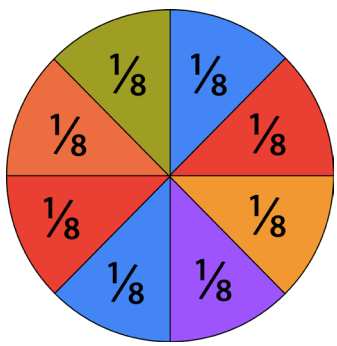
   1/8 + 1/8 = 2/8

   2/8 + 1/8 = 3/8

   3/8 + 1/8 = 4/8

   4/8 + 1/8 = 5/8, etc.

   Students may be encouraged to explore other ways, if possible.



Questions for Exploration

1. If you combine all the slices given to you, can you make a whole pizza again?
2. After placing first 1/2 piece, how many pieces do you need to complete the whole pizza? Will 1/2 + 1/2 pieces give a whole pizza?
3. After placing first 1/3 piece, how many pieces do you need to complete the whole pizza?
   - Was the remaining area covered by 2 pieces of 1/3?
   - Could 1/3 + 1/3 + 1/3 pieces complete the whole pizza?
4. After placing first 1/4 piece, how many pieces do you need to complete the whole pizza?
   - Does remaining area got covered by 3 pieces of 1/4?
   - Does 1/4 + 1/4 pieces completed the whole pizza? If not, then how many pieces are required?
   - Does it mean that 1/4 + 1/4 is equal to half or 1/2? Can we say 1/4 + 1/4 + 1/4 = 3/4?
   - Does 1/4 + 1/4 + 1/4 + 1/4 pieces complete the whole pizza?

Activities for Week 3

Activity W 3.1

Through this activity, students will get an idea about the denseness of fractions. That is, they will be able to know that they can find as many fractions as possible between any two fractions. This activity will also help to improve number sense and reasoning skills with fractions.

Material Required

- Long rolls of paper strips
- Scissors
- NCERT Mathematical kits (if present in school)
- Blank cards

Procedure

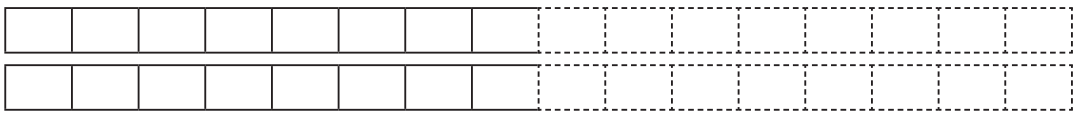
Step 1

- Write two fractions, say, 1/4 and 1/2 on the board and the students may be asked to check, if there are fractions between them.
- Discuss that denseness of fractions means that there can be as many fractions as we want between the two fractions.

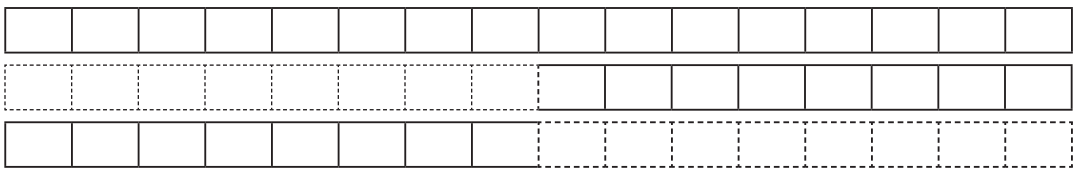
Step 2: Hands-on Exploration

- Take two copies of a paper strip.

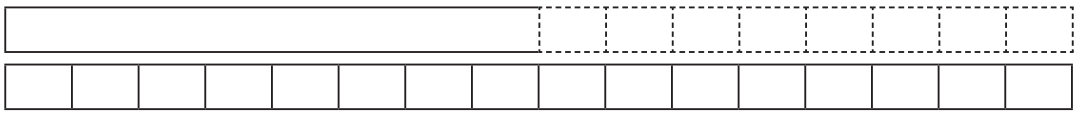
- Ask the students to fold those strips in 2 equal halves.



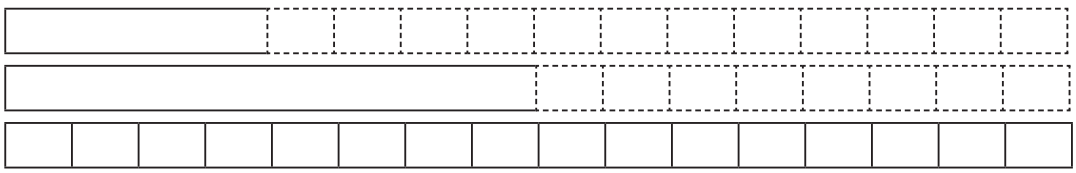
- Take one of the strips and cut it into two equal parts with the help of scissors.



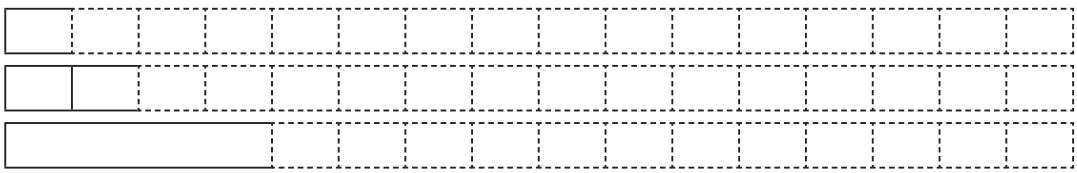
- Take one part and keep it on the other strip.

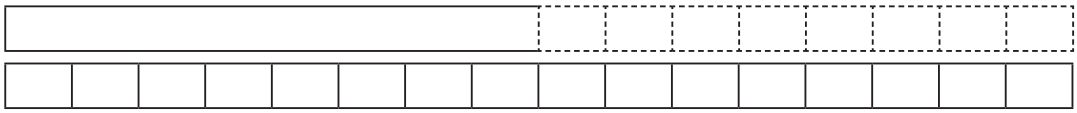


- Take the remaining half and put it on the first half.



- Continue this process until the students are unable to cut remaining part in to 2 equal parts.





Discussion to Explore

1. What does this activity explain?
2. Can we divide these strips further more? If yes, then to what extent?
3. If half of a unit is 1/2, then what will be the half of 1/2?
4. Does 1/4 lie in between 0 and 1/2?
5. How many fractions can lie between 2 fractions?
6. Ask students, if they see gaps between their fractions.
7. Challenge them: "Is there another fraction that can go between these parts of strips?"

Reflection

Emphasise that fractions are dense—there's always another one between any two fractions.

Extension

- Students may be motivated to observe and generalise the above processs to find a fraction between two fractions Fraction 1 and Fraction 2 as—

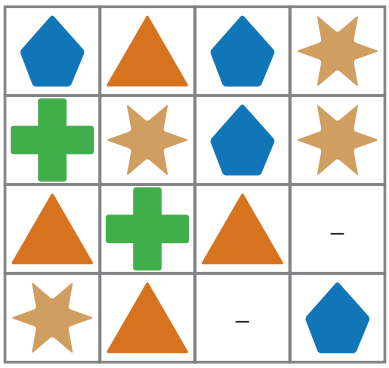
  (Fraction 1 + Fraction 2)/ 2
- Use the Math Kit for hands on practise in different ways.
- Number line can also be used for this topic.

Activity W 3.2

Students may be asked to solve the following puzzles either in groups or individually. They may explain their strategy of obtaining the result.

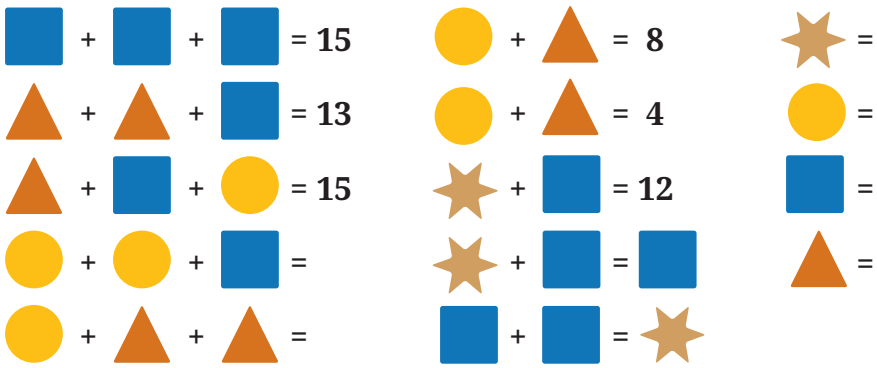
Let's Brainstorm

1. The grid below has symbols that contain a whole number value less than 10. Each symbol has its own value. The numbers you see at the end of each row and column are the sums of the figures' values for that row or column.



Can you find out the value of each symbol  ?

2. Here, you are given two representations, where symbols have been used. Each symbol represents a numeric value. Find the value of each symbol.



3. Make the following equation true by drawing/putting/writing a single line.

4. What should be added to IX, to make 'six'?

Teachers may try to find some more such puzzles that will engage students in the process of exploration.

Activity W 3.3

Students will get an opportunity to explore the difference between Volume and Area, through this activity. This will be done by comparing how much space different containers occupy and how much they can hold.

Material Required

- Two flat trays.
- Two deep containers (different shapes).
- Rice or small beans or sand.
- Small cups (to be taken as measuring cups).

(The teacher can try arranging one deep container with a base approximately the same as one of the trays.)

A flat tray

A deep container

Procedure

Step 1

- Show students the flat trays and deep containers (of different shapes).
- Ask:
  - What do you notice about these things (trays and containers)?
  - How are the trays different from the deep containers?
  - Which ones do you think will hold more rice/sand? Why?

Step 2

- Sprinkle a thin layer of rice or sand on the flat trays until the surface is fully covered. (The teacher needs to ensure that there is only one layer of the rice or sand on the trays.)
- Use measuring cups to measure how much rice or sand each tray holds.
- Ask:
  - Did the rice or sand cover the entire tray?
  - Without changing the shape the rice or sand takes on the tray, would the tray be able to 'hold' more of it? (We cannot make a heap of rice or sand.)
  - How can we measure the space covered by the rice or sand?
  - Can you think of other examples, where we use areas in daily life (for example, carpets, tiles, painting walls)?

Step 3: Measuring Capacity

- Fill the deep containers with rice or sand to the top.
- Use measuring cups to measure how much rice or sand each container holds.
- Ask:
  - Why do the deep containers hold more rice or sand than the trays?
  - What changed when we measured volume instead of area?
  - How many layers of rice or sand would we need to make the trays hold the same amount as the deep containers? Estimate.
  - How is volume different from area?

Step 4: Making Real-world Connections

Discuss examples from real life:

- Why do water bottles and storage boxes have depth?
- Would a swimming pool be useful, if it only had area but no depth?
- Do architects and builders use volume when designing rooms and buildings? How?

Reflections

- Summarise that area measures surface coverage, while volume measures the total space inside an object or a container.
- Encourage students to think about other objects, where area and volume play a role in real life.
- Let students predict, which objects in the classroom have a large area but small volume and vice versa.
- Let students predict situations, where Area is used and situations, where Volume is used.

Participation of Special Children—

- Use lightweight containers and trays that are easy to handle.
- If students have difficulty lifting or pouring, provide pre-measured cups of rice or sand so they can still participate.
- Arrange the activity on lower tables or surfaces so all students, including those using wheelchairs, can comfortably access the materials.

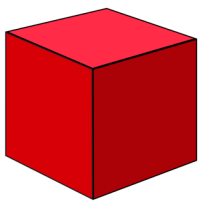
- Pair students so they can work together, allowing those with mobility challenges to observe, instruct and record findings, while their peers assist with pouring and measuring.

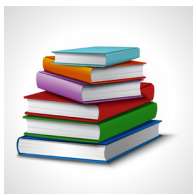
Activity W 3.4: Packing a Suitcase

In this activity, students may be made to explore the concept of volume by packing objects into a given space, helping them understand how shape, size and arrangement affect capacity.

Material Required

- A box (representing a suitcase)
- Various small objects (for example, cubes, balls, books, folded paper, toy blocks, foam, pieces)






- Paper and pencils for recording observations.

Step 1

- Show students the box (supposed to be a suitcase) and the small objects.
- Ask:
  - What do you think will happen, if we try to fit all these objects into the box?
  - Will all the objects fit? Why or why not?
  - What do we need to consider, while packing a suitcase in real life?

Step 2

- Divide the students into small groups and give each group a box and a set of objects.
- Ask them to try different ways of packing the objects inside the box.
- Encourage them to think critically by asking them:
  - Which objects fit easily and why?

- Which objects take up the most space?
- Does the order or arrangement of the objects affect how much it fits?

Step 3

- Let the students count the objects they successfully fit into the box.
- Ask them to remove the objects and estimate which object has more space and which has less.
- Introduce the idea of volume as the total space an object occupies.
- Explain how different shapes and arrangements affect and how space/volume of the box/suitcase is used.
- Ask:
  - If two objects have the same height and width but different shapes, do they take up the same amount of space?
  - If we had a bigger box, would we be able to fit double the objects? Why or why not?

Step 4

- Discuss how this applies to real-life situations, such as:
  - Packing a suitcase efficiently for travel
  - Fitting groceries into a bag or fridge
  - Storing books in a bookshelf
- Ask:
  - Why is understanding volume important in everyday life?
  - How do packers or architects use the understanding of the notion of volume to maximise space?

Reflections

- Summarise that volume is the amount of space an object takes up. Also, different shapes and arrangements can affect how things fit together in a given box.
- Encourage students to think about other real-life situations, where understanding volume is useful (for example, arranging furniture, stacking boxes, designing storage spaces).
- In each of the above steps, teachers may frame more questions that would not only lead to the concept of volume but also allow students to play with this idea joyfully.
- Students may also be allowed to frame questions and ask other groups or students.

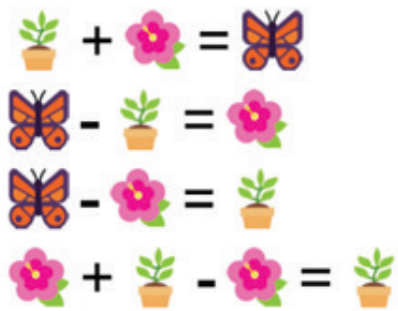
Participation of Special Children

- Use lightweight objects, like foam blocks or paper cubes that are easy to grasp.
- Ensure that materials are placed at an accessible the height for students using wheelchairs.
- Allow students to work in pairs or small groups, so tasks can be shared based on ability and comfort.
- Encourage discussions, where all students share their ideas.

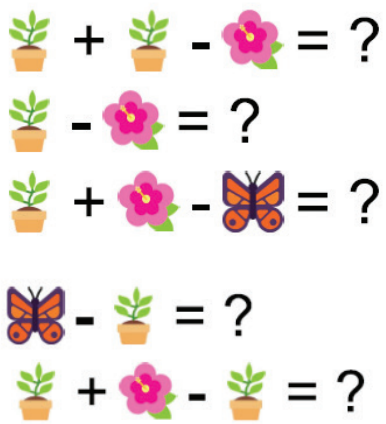
Activity W 3.5

Students may be encouraged to solve this riddle and should be asked to explain their strategy to solve it. This can give them an idea about solving linear equations.

If the following equations are true:

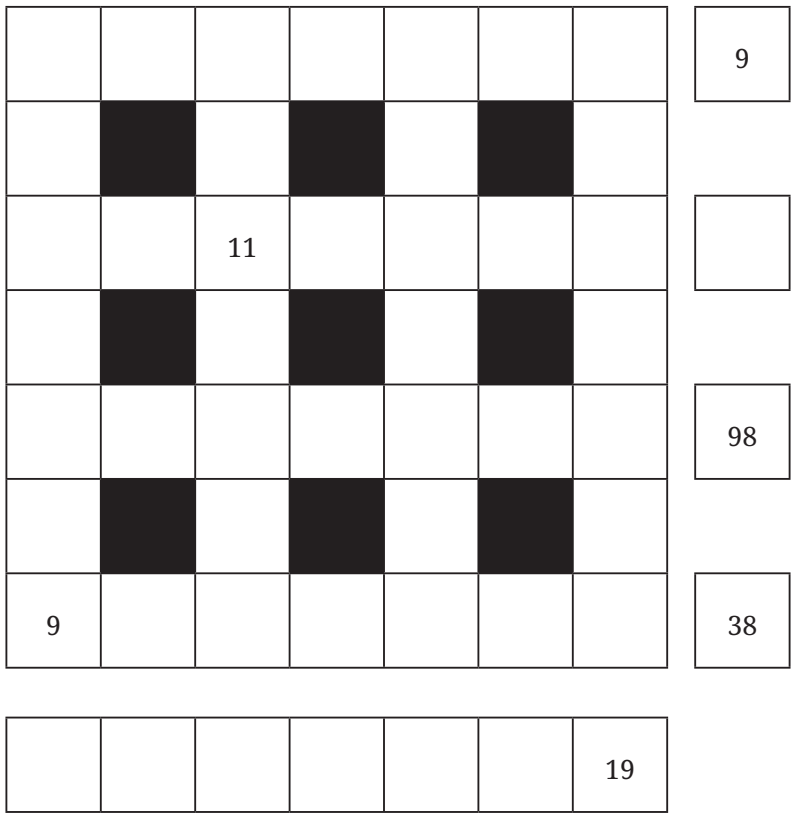


Then solve these:



Activity W 3.6

Students may be motivated to work on this puzzle. This will help them link different mathematical concepts.



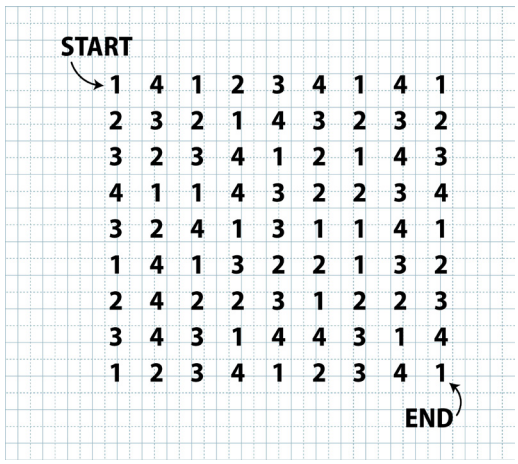
Fill in the missing numbers:

1. The missing values are the whole numbers between 1 and 16.
2. Each number is only used once.
3. Each row is a math equation.
4. Each column is a math equation.

Remember that multiplication and division are performed before addition and subtraction.

Activities for Week 4

Activity W 4.1: Teacher may ask students to play this puzzle.



How to Play?

This is a zigzag puzzle with numbers 1, 2, 3 and 4. Your objective is to navigate through the grid, starting from the number 1 in the top-left corner. You must follow the numbers in sequential order, ensuring that each number is visited exactly once. The path can move in horizontal, vertical, or diagonal directions but cannot cross itself.

Activity W 4.2

Teacher can give either printed sheets of the following number pattern to students or draw the number pattern on the blackboard.

Procedure

Observe the following number pattern:

$$1$$
$$1 + 3$$
$$1 + 3 + 5$$
$$1 + 3 + 5 + 7$$
$$1 + 3 + 5 + 7 + 9$$

1. Write next 5 rows in the same pattern.
2. Add the numbers of each row and write the result.
3. Observe these numbers and name the type of these numbers.
4. Write these numbers in other possible ways.
5. Draw the result of each row on the grid sheet, keeping in mind that 1 box on grid is equal to 1 unit square.

Reflection and Discussion

- What difference are you observing in these various square boxes on the grid sheet?
- What pattern have you observed?

- Can you tell the sum of consecutive first 10 odd numbers?
- How do you calculate the sum without writing and adding the numbers actually?
- Write the rule or formula to find the sum of n consecutive odd numbers?

Extended Learning and Exploration

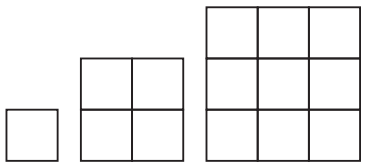
Teacher can give various number patterns like square number pattern, triangular number pattern, ***Virahanka/fibonacci*** number. Students have to discover the rule of assigned number patterns.

Activity W 4.3

Students may be asked to extend the following pictorial patterns further for two steps. Express each of these as a numerical pattern as directed.

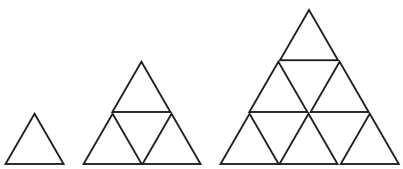
1. Stacked Squares

Count the number of small squares in each case and write it. 1, 4, ... Extend the sequence till 10 terms. Do you find any pattern?



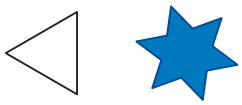
2. Stacked Triangles

Count the number of small triangles in each case and write it. Extend the sequence till 10 terms. Do you find any pattern?



3. Koch Snowflake

To get from one shape to the next shape in the Koch Snowflake sequence, one replaces each line segment '—' by a 'speedbump'_/_+. As one does this multiple times, the changes become tinier with very extremely small line segments. Extend it by three more steps.



- How many total line segments are there in each shape of the koch snowflake?
- What is the corresponding number sequence?

Activity W 4.4

Procedure

A project may be given to students to collect the data from reliable sources. Students should be divided into groups of 4–5.

1. Every group has to collect data on the following topics:
   - Temperature of your city in the month of July for the last 5 years.
   - Literacy rate of any 5 states of India in the last five years.
   - How many students of your class like ice-cream among the following: vanilla, chocolate cone, butter scotch, strawberry and kesar-pista.
   - What is the favourite game among the following: cricket, football, basketball, tennis, badminton and volleyball.
   - Collect data from the students of your class.
2. Each group has to make a table with tally marks.
3. Each group has to draw a bar graph, line graph and pictograph for the collected data.

Reflection and Discussion

Teacher will provide opportunity to every group to present their work in front of the whole class.

Here is an example:

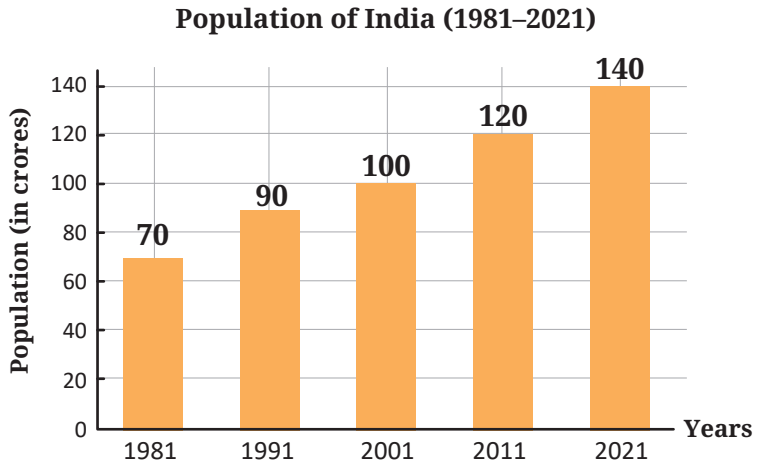
Take population of a country in different decades. Represent the data as a pictograph, bar graph and line graph.

Pictograph

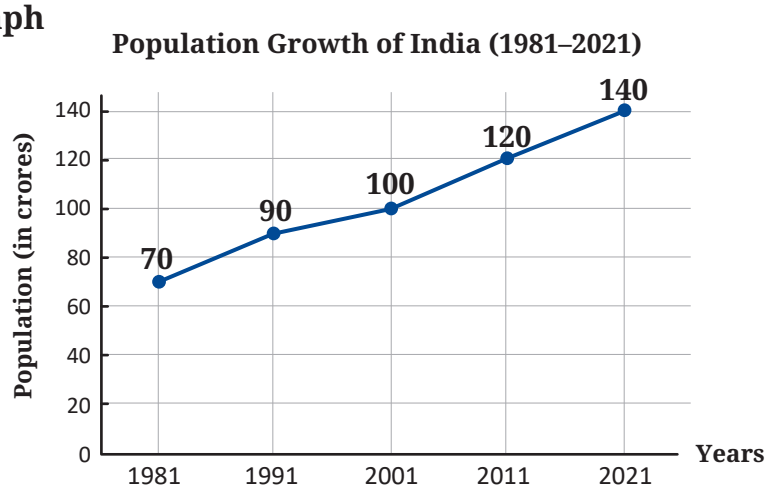
 = 20 crore people

S.No.	Year	Population	Population
1.	1981		70 core
2.	1991		90 core
3.	2001		100 core
4.	2011		120 core
5.	2021		140 core

Bar graph



Line graph



Discuss

1. What is the difference between these three graphs?
2. In which situation, line graph could not be drawn from the data collected by the students and why?

Activity W 4.5: Building Towers with Blocks

Material Required

- Different coloured blocks.
- Paper and pencil for recording results.

Explain to the students that each block will represent a number, and stacking blocks will help illustrate exponents. For example, stacking 2 blocks means 2^1 and stacking 4 blocks means 2^2 and so on.

Procedure

Ask students to create towers representing different powers of 2:

- For 2^1, they stack 2 blocks.
- For 2^2, they stack 4 blocks.
- For 2^3, they stack 8 blocks.

Reflection and Discussion

1. After stacking blocks for different exponents, students may be made to explore what 3-D shape they get. For example, 2^1 gives a cuboid, whereas 2^2 gives a cube and so on. They may see for which exponent of 2 they get a cube and for which other a cuboid. Can they get any other 3-D shape other than these two?
2. They may observe as to how the number of blocks increases as the exponent increases. Is there any pattern?

Activity W 4.6

This activity will help students to:

- Understand the concept of fractals.
- Build simple fractals like the Sierpinski Triangle or Koch Snowflake.

Materials Required: Paper, markers, ruler (optional), printouts of basic geometric shapes (triangles, squares, etc.).

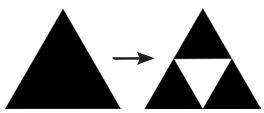
A fractal is a shape or pattern that repeats itself no matter how much you zoom into it.

Procedure

Guide students to build fractals step-by-step.

1. Draw a large equilateral triangle on your paper.

2. Find the midpoints of each side and join them. Remove the middle triangle so obtained. It will look as shown—



3. Again, join the midpoints of each of the sides of the three shaded triangles. Remove the three triangles so obtained. It will look like—

4. Ask the students to continue the process for at least two more times. Take sufficiently large paper or cardboard for this purpose.

Reflection

Ask the students to describe the final structure they obtain. Does the final one looks like a big triangle made up of smaller triangles, and if we zoom in, do we see the same pattern inside?
This is a fractal.

Extension

1. Students may try this for different shapes, such as square, rectangle, parallelogram or any other shape of their choice.
2. Students may be asked to associate numbers with each shape. Say, number of triangles obtained in each step or the number sides on outer edges in each step (3, 6, ...). They need to find a pattern.

Activities for Week 5

Activity W 5.1

Fractals are all around us in nature. They help explain the irregular, repetitive patterns in many things we see every day. Students may be made to explore how fractals can represent real-world data using patterns and algorithms.
Materials Required: Graph paper, printouts with different fractal patterns and their corresponding data (such as trees, coastlines, plant structures or any other structure of their choice).

Procedure

1. Students may be asked to get a photograph of a tree. They may observe the branching. They may use this data to create a branching fractal pattern. The data shows how each branch divides into smaller branches at a constant angle. They may use a repetitive method to create fractal.
2. This activity may be done for coastline data. The coastline is irregular and jagged, which means it's a fractal pattern. Use this data to draw an irregular coastline that gets more jagged as you zoom in.

3. Another similar activity can be done for the adjoining picture.

Extension

Data related to clouds, or mountains, or even river systems can serve as good models for the concept of fractals.

Activity W 5.2

Number sense involves giving meaning to numbers, that is, knowing about how they relate to each other and their relative magnitudes. Having a sense of number is vital for the understanding of numerical aspects of the world. Here are some ideas to develop and strengthen students' sense of numbers.

Procedure

- Ask the students to choose a two-digit number.
- Tell them to reverse the digits to get a new number.
- Add this new number to the original number.
- Ask students to check for their divisibility by a number.
- Check if every student gets a number by which the sum obtained in step 3 is divisible.
- Discuss why this happens!

Procedure

- Ask students to think of a three-digit number.
- Now, they should make a new number by putting the digits in the reverse order.
- Subtract the smaller number from the larger one.
- Ask the students to check by which number the difference so obtained is divisible. Which other multiple of this divisor will divide the difference?
- Discuss how this happens!

Procedure

- Students may be asked to think of any 3-digit number (abc).
- Now, using this number, students may be asked to form two more 3-digit numbers (cab, bca).

- Now, add the three numbers so formed.
- Students may explore the smallest number by which it will be divisible.
- Discuss how this happens!

Activity W 5.3

For this activity, students work in pairs or small groups. The students may draw a hundred square as shown below:

0	01	02	03	04	05	06	07	08	09
10	11	12	13	14	15	16	17	18	19
20	21	22	23	24	25	26	27	28	29
30	31	32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47	48	49
50	51	52	53	54	55	56	57	58	59
60	61	62	63	64	65	66	67	68	69
70	71	72	73	74	75	76	77	78	79
80	81	82	83	84	85	86	87	88	89
90	91	92	93	94	95	96	97	98	99

Procedure

- The following clues may be written on the blackboard:
  - The number is greater than 9.
  - The number is not a multiple of 10.
  - The number is a multiple of 8.
  - The number is even.
  - The number is not a multiple of 11.
  - The number is less than 175.
  - Its ones digit is larger than its tens digit.
  - Its tens digit is odd.

Part A

- Tell the students
  - How have a number in your mind that is on the hundred squares but you are not going to tell them what it is.
  - They have to ask you for any four clues out of the given eight clues.
  - With every clue they speak out, you will say just 'YES' or 'NO'.
  - Try to find the set of four clues that help them to find the number in your mind.
  - Give a chance to each group to do this.

Part B

Four of the given clues are true but they do not help in finding the number. Find those numbers.

Reflection

Consider the questions that led the students being interested and able to progress, and those you needed to clarify. Such reflection always helps you engage the students to find mathematics interesting and enjoyable. If they do not understand and do something, they are less likely to become involved.

Activity W 5.4: Making different stories for the same number sentence

Traditionally, word problems appear in textbooks or in classroom teaching at the end of a chapter. Often, little time and attention is spent on making sense of these word problems. Students often get confused with the words and the message the sentences convey. Let the students create their own stories, or word problems; narrate a mathematical sentence like 5 + 6 = 11 can help to build an understanding of the mathematical ideas and lead to greater problem solving skills. It can help the students overcome the difficulties of making sense of the context of the word problems because they will construct their own context and focus on making the story fitints mathematics. In that way, it also helps them with identifying, which mathematical representation to use.

This activity is directed towards forming such contexts using number statements.

Procedure

- Give the students a number statement say, 5 + 7 = 12.

  This statement can be represented by several mathematical relationships, such as:

  - adding 5 and 7 together make 12.
  - 5 more than 7 gives 12.
  - the total number of things is 5 + 7 = 12.
  - 7 less from something leaves 5.
- Give the students more such numerical statements and ask them to write different mathematical relationships for them.
- Now, ask the students to formulate a story or word problem for each of these relationships. Encourage them to use their imagination!

Example: For the statement: Adding 5 and 7 together make 12; it could be— In a cricket match, Kalyani and Shreya are batting together. Kalyani made 5 runs, whereas Shreya made 7. What is the total number of runs they made?

Activity W 5.5

The activity will help in developing the habit of exploring numbers.

Procedure

1. Ask the students to write a two-digit number.
2. They should reverse the digits and form a new number.
3. Subtract the smaller of these numbers from the larger one.
4. Using the result, repeat the process.
5. Students may observe when the process stops. Discuss about it.

Example: Suppose the number is 52.

So, 52 – 25 = 27 ⟶ 72 – 27 = 45 ⟶ 54 – 45 = 09 ⟶ 90 – 09 = 81 ...

Discuss

1. Is there any link with the table of 9?
2. What if the two digits are same?

Procedure

1. Ask the students to write a three-digit number.
2. Arrange the digits in ascending order and then in descending order. They will get two numbers.
3. Subtract the smaller number out of these from the larger number.
4. Again, arrange the digits of the difference obtained in ascending and descending order. Subtract smaller number from the larger one.
5. Continue this process.

Example: Suppose the number is 256.

We have 652 – 256 = 396 ⟶ 963 – 369 = 594 ⟶ 954 – 459 = 495

You get the same number repeatedly.

Different students may try for different numbers.

Discuss

1. What if, any digits are same?
2. What if, three digits are same?

Extension

1. Think of a 3-digit number in which the first and the last digits differ by at least
2. Reverse its digits and subtract the smaller number from the larger of the two.
3. Add the resulting number and its reverse.

What do you find?

Activity W 5.6

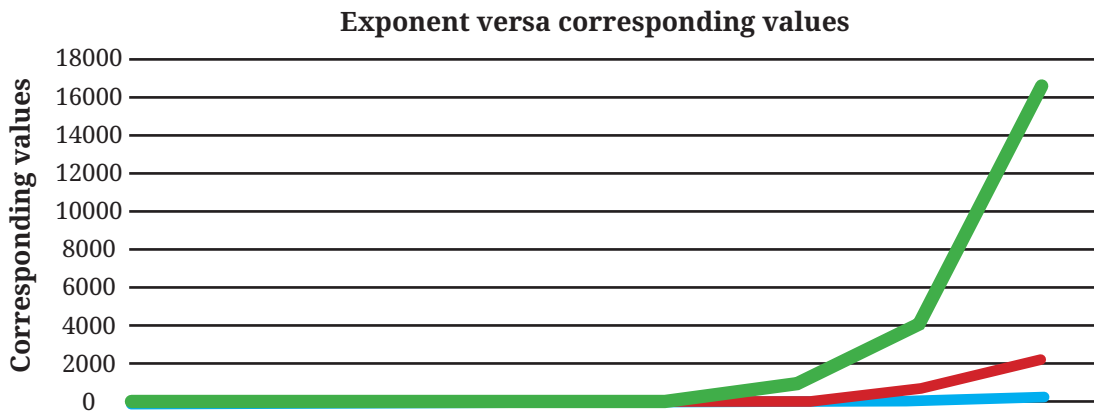
Students may be engaged in identifying and continuing patterns related to the exponents of a number. They may plot the graphs and check for themselves how much the graph rises with larger exponents.

Material Required

- Graph paper or online graphing tools.
- Rulers or measuring tools.

Procedure

- Plot the values of each exponent of numbers, such as, 2, 3, 4 on a graph paper. Plot exponents (0, 1, 2, 3, etc.) on the horizontal axis and the corresponding values 2n, 3n, 4n etc., on the vertical axis.
- Students may be asked to observe the shape of the graph. For some bases, it will be a smooth curve that grows slowly at first and then rapidly. They may observe the pattern in which the graphs grow and explain it. They may tell in which it was the steepest and why.



	Exponent 0	Exponent 1	Exponent 2	Exponent 3	Exponent 4	Exponent 5	Exponent 6	Exponent 7
Power of 2	1	2	4	8	16	32	64	128
Power of 3	1	3	9	27	81	243	729	2187
Power of 4	1	4	16	64	256	1024	4096	16384

Reflections

Following questions may be discussed:

- How do the numbers increase with each step?
- Plot graphs for exponents of numbers which are fractions or negative numbers.
- Which base grows the fastest and slowest?
- How are exponents used in real life? (for example, computing power, population growth models, interest rates, etc.)

Activities for Week 6

Activity W 6.1

Students may be encouraged to perform these activities. They may observe the patterns and explain about it.

Procedure

1. Look at this picture.

You can see that some children are standing in a line in a park.
Each one is saying a number.

2. Ask the students to tell what these numbers might mean.
3. Does it have something to do with their heights? Students should discuss and try to find out as to how it could be related to their heights.
4. The children then re-arrange themselves again and each of them says a number based on the new arrangement.

5. Students may be motivated to think and try to answer the following questions with their reasoning.

- Can the children re-arrange themselves so that the children standing at the ends say '2'?
- Can we arrange the children in a line so that all would say only 0's?
- Can two children standing next to each other say the same number?
- There are 5 children in a group, all of different heights. Can they stand such that four of them say '1' and the last one says '0'? Why or why not?
- For this group of 5 children, is the sequence 1, 1, 1, 1, 1 possible?
- Is the sequence 0, 1, 2, 1, 0 possible? Why or why not?
- How would you re-arrange the five children, so that the maximum number of children say '2'?

Extension

- Based on their weights or some other features, students may draw diagrams associating them with the numbers. They may present them to other students and ask them to guess it.

Activity W 6.2

Students may observe and discuss the reason, behind these activities.

Procedure

- Students may be asked to observe the numbers written in the table below.
- They may tell, why some numbers are coloured. Discuss.

43	79	75	63	10	29	28	34

200	577	626	345	790	694	109	198

Let us call the cells that are coloured as super cells.

- Students may be asked to create their own tables and ask the other students to reason it out. They may be allowed to use some other variations in this puzzle, as well.

Extension

- Students may create their own tables and ask their friends to colour or mark super cells in it. For example

6828	670	9435	3780	3708	7308	8000	5583	52

- Students may discuss on the following:
  - Fill the table below such that we get as many super cells as possible. Use numbers between 100 and 1000 without any repetition.

  - Can you fill a supercell table, without repeating numbers, such that there are no supercells? Why or why not?
  - Will the cell having the largest number in the table always be a supercell? Can the cell having the smallest number in the table be a supercell? Why or why not?
  - Fill a table such that the cell having the second largest number is not a supercell. Fill a table such that the cell having the second largest number is not a supercell but the second smallest number is a supercell. Is it possible?

Activity W 6.3

Engaging students in these puzzles will make them more observant about numbers.

Procedure

1. Students may be given numbers of 3 or 4 digits.
2. They may add the digits of the number to get a two-digit number.
3. They may then find other numbers which will give the same sum.

Example: Take the number 176.

1 + 7 + 6 = 14.

The other number is 545 5 + 4 + 5 = 14.

Find some more such numbers that give the sum of the digits as 14.

Extension

- There could be variations in the puzzle. For example, the sum could be a one- digit number, etc.

- Numbers of more number of digits can also be thought of.
- Students may try to find this. For the sum 14, we may ask the following—
  - What is the smallest number whose digit sum is 14?
  - What is the largest 5-digit whose digit sum is 14?
  - How big a number can you form having the digit sum of 14? Can you make an even bigger number?
  - Students may think and discuss about such different digit sums.
  - Find out the digit sums of all the numbers from 40 to 70.
  - Calculate the digit sums of 3-digit numbers, whose digits are consecutive (for example, 345). Do you see a pattern? Will this pattern continue?

Activity W 6.4

Engaging students in these puzzles will make them more observant about numbers.

Pretty Palindromic Patterns

Procedure

The numbers that can be read the same from left to right and from right to left are called palindromes or palindromic numbers. For example, 232, 444, 54645, etc.

1. Students may be asked to write all palindromes using certain number of digits.

   For example, using the digits 3, 4, 5 we can form palindromes 343, 454, 34543, 333, etc.

   Students may form as many palindromes using the given digits.
2. A game can be played, based on this.
   - The one who forms maximum number of palindromes using the given digits will be the winner.

     Or
   - The one who forms the longest palindrome will be the winner, etc.

Procedure

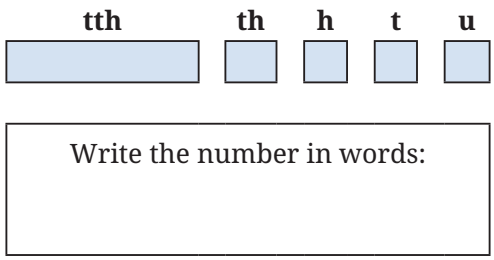
1. Students may write a 2-digit number and reverse the order of the digits. Add these two numbers.
2. They may check whether the addition is a palindrome. If not, continue the process of reversing the digits and adding them.
3. They may check, if they get a palindrome at some stage or not. For example, 36 + 63 = 99 (a palindrome!)

   39 + 93 = 132 (not a palindrome) ⟶ 132 + 231 = 363

   (a Palindrome!)
4. Students may be asked to do this for different numbers.

   Students may explore and tell, for which numbers it took only one step, few steps or large number of steps.
5. Students may explore whether reversing and adding numbers repeatedly, starting with a 2-digit number, always give a palindrome?

III. Procedure



- I am a 5-digit palindrome.
- I am an odd number.
- My ‘t’ digit is double of my ‘u’ digit.
- My ‘h’ digit is double of my ‘t’ digit.
- Who am I? _____
- Teacher/students may create more such puzzles and give others to solve.

Activity W 6.5

Students may be engaged in discussing these puzzles. This will make them observe how mathematics is spread all around them.

Procedure

1. Students may try and find out all possible times on a 12-hour clock of each of the type 4:44, 10:10, etc.
2. They may try to find some dates from the past that obey a certain pattern.

   Example: Manish has his birthday on 20/12/2012, where the digits '2', '0', '1'and '2' repeat in that order.
3. It could also be, Meghana, has her birthday on 11/02/2011, where the digits read the same from left to right and from right to left.
4. Some numbers may be given to the students. They may be allowed to use both addition and subtraction to get the required number. For example,

40,000	7,000
300	1,500
12,000	800

   - Suppose the given numbers are—
   - To form a number 39800. We can write 39,800 = 40,000 – 800 + 300 + 300.
   - Try for other numbers, such as 45000, 5900, 17500, 21400...
   - Teacher may change the set of given numbers and the required numbers. Students may try to do that.

Activity W 6.6

Students may be asked to do some simple estimates. It is a fun exercise, and they may find it amusing to know the various numbers around them. Remember, exact numbers are not required for the following questions. Students may share their methods of estimation with the class.

- Steps you would take to walk—
  - From the place you are sitting to the classroom door.
  - Across the school ground from start to the end.
  - From your classroom door to the school gate.
  - From your school to your home.

Some other places may be also thought of.

- Number of times you blink your eyes or the number of breaths you take—
  - In a minute
  - In an hour
  - In a day
- Name some objects around you that are—
  - A few thousand in number
  - More than ten thousand in number
- Try to guess within 30 seconds. Check your guess with your friends.
  - Number of words in your Maths textbook—
    a. More than 5000
    b. Less than 5000
  - Number of students in your school who travel to school by bus—
    a. More than 200
    b. Less than 200
  - Earlier, people used to walk long distances as they had no other means of transport. Suppose you walk at your normal pace. Approximately, how long would it take you to go from:
    a. Your current location to one of your favourite places nearby.
    b. Your current location to any neighbouring state's capital city.
    c. The southernmost point in India to the northernmost point in India.
  - Make some estimation questions and challenge your classmates.

Activity W 6.7

Students may be asked to solve the following puzzles. They may explain their logic of getting the solution.

1. There is only one supercell (number greater than all its neighbours) in the following grid. If you exchange two digits from one of the numbers, there will be 4 supercells. Figure out which digits to swap.

16,200	39,344	29,765
23,609	62,871	45,306
19,381	50,319	38,408

2. Students may be asked 'How many rounds does your birth year take to reach the kaprekar constant?'
3. Students may be asked 'Write one 5-digit number and two 3-digit numbers, such that their sum is 18,670.'

Activity W 6.8: Game!

Students may be asked to sit in a circle and play a game of numbers. One of the children starts by saying '1'. The second player says '2', and so on. But when it is the turn of 3, 6,9, ... (multiples of 3), the player should say 'idli' instead of the number. When it is the turn of 5, 10, ... (multiples of 5), the player should say 'vada' instead of the number.

When a number is both a multiple of 3 and a multiple of 5, the player should say 'idli-vada'! If a player makes any mistake, they are out. The game continues in rounds till only one person remains.
Teacher/Students may ask such questions for this game—

- For which numbers, should the players say 'idli' instead of saying the number?
- For which numbers, should the players say 'vada'?
- What is the first number for which the players will say, 'idli-vada'?
- At what number, is 'idli-vada' said for the 10th time?
- If the game is played for the numbers 1 to 90, find out:
  - How many times would the children say 'idli' (including the times they say 'idli-vada')?
  - How many times would the children say 'vada' (including the times they say 'idli-vada')?

- How many times would the children say 'idli-vada'?

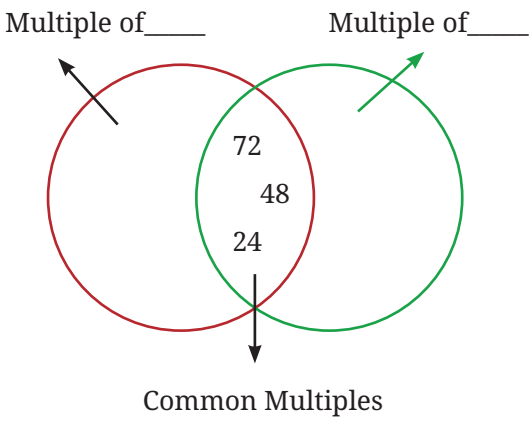
- The teacher may ask students to play the game for the following pairs of numbers—

Idli	Vada
2	5
3	7
4	6

Activity W 6.9

Teacher may give these situations to students and ask them to discuss about them.

1. In the diagram below, Anant has erased all the numbers except the common multiples. Find out what those numbers could be and fill in the missing numbers in the empty regions.



2. There are some boxes with four numbers in each box given below. Within each box, try to say how each number is special compared to the rest.

5	7	3	8	27	3	17	27
12	35	11	24	123	31	44	65

3. The figure on the left shows the puzzle. The figure on the right shows the solution of the puzzle. Think what the rules can be to solve the puzzle.

Rules

Fill the grid with prime numbers only, so that the product of each row is the number to the right of the row and the product of each column is the number below the column—

(a)

			75
			42
			102
170	30	63	

5	5	3	75
2	3	7	42
17	2	3	102
170	30	63	

(b)

			105
			20
			30
28	125	18	

			8
			105
			70
30	70	28	

(c)

			63
			27
			190
45	42	171	

			343
			660
			44
28	154	231	

CGs and Competencies for Mathematics at Middle Stage as given in NCF-SE

Curricular Goals (CGs)	Competencies
CG-1 Understands numbers and sets of numbers (whole numbers, fractions, integers, rational numbers, and real numbers), looks for patterns, and appreciates relationships between numbers	C-1.1 Develops a sense for and an ability to manipulate (e.g., read, write, form, compare, estimate, and apply operations) and name (in words) large whole numbers of up to 20 digits, and expresses them in scientific notation using exponents and powers. C-1.2 Discovers, identifies, and explores patterns in numbers and describes rules for their formation (e.g., multiples of 7, powers of 3, prime numbers), and explains relations between different patterns. C-1.3 Learns about the inclusion of zero and negative quantities as numbers, and the arithmetic operations on them, as given by Brahmagupta. C-1.4 Explores and understands sets of numbers, such as whole numbers, fractions, integers, rational numbers, and real numbers, and their properties, and visualises them on the number line. C-1.5 Explores the idea of percentage and applies it to solve problems. C-1.6 Explores and applies fractions (both as ratios and in decimal form) in daily-life situations.
CG-2 Understands the concepts of variable, constant, coefficient, expression, and (one-variable) equation, and uses these concepts to solve meaningful daily-life problems with procedural fluency	C-2.1 Understands equality between numerical expressions and learns to check arithmetical equations. C-2.2 Extends the representation of a number in the form of a variable or an algebraic expression using a variable. C-2.3 Forms algebraic expressions using variables, coefficients, and constants and manipulates them through basic operations. C-2.4 Poses and solves linear equations to find the value of an unknown, including to solve puzzles and word problems. C-2.5 Develops own methods to solve puzzles and problems using algebraic thinking.

CG-3 Understand, formulate, and apply properties and theorems regarding simple geometric shapes (2D and 3D)	C-3.1 Describes, classifies, and understands relationships among different types of two - and three-dimensional shapes using their defining properties/attributes. C-3.2 Outlines the properties of lines, angles, triangles, quadrilaterals, and polygons and applies them to solve related problems. C-3.3 Identifies attributes of three-dimensional shapes (cubes, parallelepipeds, cylinders, cones), works hands-on with material to construct these shapes, and also uses two-dimensional representations of three-dimensional objects to visualise and solve problems. C-3.4 Draws and constructs geometric shapes, such as lines, parallel lines, perpendicular lines, angles, and simple triangles, with specified properties using a compass and straightedge. C-3.5 Understands congruence and similarity as it applies to geometric shapes and identifies similar and congruent triangles.
CG-4 Develops understanding of perimeter and area for 2D shapes and uses them to solve day-to-day life problems	C-4.1 Discovers, understands, and uses formulae to determine the area of a square, triangle, parallelogram, and trapezium and develops strategies to find the areas of composite 2D shapes. C-4.2 Learns the Baudhayana-Pythagoras theorem on the lengths of the sides of a right-angled triangle, and discovers a geometric proof using areas of squares erected on the sides of the triangle, and other related geometric constructions from the Sulba-Sutras. C-4.3 Constructs various designs (using tiling) on a plane surface using different 2D shapes and appreciates their appearances in art in India and around the world. C-4.4 Develops familiarity with the notion of fractal and identifies and appreciates the appearances of fractals in nature and art in India and around the world.
CG-5 Collect, organise, represent (graphically and in tables), and interpret data/information from daily-life experiences	C-5.1 Collects, organises, and interprets the data using measures of central tendencies such as average/mean, mode, and median. C-5.2 Selects, creates, and uses appropriate graphical representations (e.g., pictographs, bar graphs, histograms, line graphs, and pie charts) of data to make interpretations.

CG-6 Develop mathematical thinking and the ability to communicate mathematical ideas logically and precisely	C-6.1 Applies both inductive and deductive logic to formulate definitions and conjectures, evaluate and produce convincing arguments/ proofs to turn these definitions and conjectures into theorems or correct statements, particularly in the areas of algebra, elementary number theory, and geometry.
CG-7 Engage with puzzles and mathematical problems and develop own creative methods and strategies to solve them	C-7.1 Demonstrates creativity in discovering one's own solutions to puzzles and other problems, and appreciates the work of others in finding their own, possibly different, solutions. C-7.2 Engages in and appreciates the artistry and aesthetics of puzzle-making and puzzle-solving.
CG-8 Develop basic skills and capacities of computational thinking, namely, decomposition, pattern recognition, data representation, generalisation, abstraction, and algorithms in order to solve problems where such techniques of computational thinking are effective	C-8.1 Approaches problems using programmatic thinking techniques such as iteration, symbolic representation, and logical operations and reformulates problems into series of ordered steps (i.e., algorithmic thinking). C-8.2 Learns systematic counting and listing, systematic reasoning about counts and iterative patterns, and multiple data representations; learns to devise and follow algorithms, with an eye towards understanding correctness, effectiveness, and efficiency of algorithms.
CG-9 Know and appreciate the development of mathematical ideas over a period of time and the contributions of past and modern mathematicians from India and across the world	C-9.1 Recognises how concepts (like counting numbers, whole numbers, negative numbers, rational numbers, zero, concepts of algebra, geometry) evolved over a period of time in different civilisations. C-9.2 Know and appreciate the contributions of specific Indian mathematicians (such as Baudhayana, Pingala, Aryabhata, Brahmagupta, Virahanka, Bhaskara, and Ramanujan).
CG-10 Know and appreciates the interaction of Mathematics with each of their other school subjects	C-10.1 Recognises interaction of Mathematics with multiple subjects across Science, Social Science, Visual Arts, Music, Vocational Education, and Sports.

विद्यया ऽमृतमश्नुते

एन सी ई आर टी
NCERT

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