Theme 1: Number System

Rational numbers as extension of integers to make the system closed for division (by non-zero numbers) was introduced in class VII. In this class children will be enabled to explore the properties of rational numbers to find inadequacy in them and to realize the need for new numbers like irrational numbers. Children should also get the feel of another very interesting and important property of rational numbers i.e. between any two rational number there lie many infinite rational numbers. Number line and representation of rational numbers on number line forms the basis for visualizing that for every rational number there is a point on the number line but its converse is not true. Number operations are also extended to exponents. This understanding leads to classify positive integers into various classes like square and cube numbers. Children should also understand and develop the ability to properly apply the division algorithm for finding the square root of numbers.

Learning Outcomes:

Children will be able to:

- describe properties of rational numbers and express them in general form;
- consolidate operations on rational numbers;
- represent rational numbers on the number line;
- understand that between any two rational numbers there lies another rational number (making children see that if we take two rational numbers then unlike for whole numbers, in this case you can keep finding more and more numbers that lie between them.);
- generalise and verify properties of rational numbers. (including identities);
- use general form of expression to describe properties of operations on rational numbers like closer, commutative, associative, existence of identity and existence of inverse;
- do word problem (higher logic, two operations, including ideas like area);
- write repeated multiplication and division using integers as exponents;
- describe and verify laws of exponents with integral powers;
- find squares, square roots, cubes, cube roots of number;
- find square and square roots;
- undertake calculating square roots using the factor and division method for numbers containing;
- no more than 4 digits and
- no more than 2 decimal places
- find cubes and cube roots;
- estimate square roots and cube roots.
- learn the process of moving nearer to the required number;
- write and understand a 2 and 3 digit number in generalized form ($100a + 10b + c$, where a, b, c can be only digit 0-9) and engage with various puzzles concerning this. (like finding the missing numerals represented by alphabets in sums involving any of the four operations.);
- construct and solve problems and puzzles;
- solve number puzzles and games;
- deduce the divisibility test rules of 2, 3, 5, 9, 10 for a two or three-digit number expressed in the general form;
- find union and intersection of sets;
- define disjoint sets;
- find complement of a set.

Number System

Key Concepts	Suggested Transactional Processes	Suggested Learning Resources
Rational Numbers ☞ Properties of rational numbers. (including identities). Using general form of expression to describe properties ☞ Representation of rational numbers on the number line ☞ Between any two rational numbers there lies another rational number ☞ Word problem **Exponents Powers** ☞ Laws of exponents with integral powers ☞ Square and Square roots using factor method and division method for numbers containing (a) no more than total 4 digits and (b) no more than 2 decimal places ☞ Cubes and cubes roots (only factor method for numbers containing at most 3 digits) **Playing with numbers** ☞ Writing and understanding a 2 and 3 digit number *in generalized form* ($100a + 10b + c$, where *a, b, c* can be only digit 0-9) and engaging with various puzzles Children to solve and create problems and puzzles. ☞ Deducing the divisibility test rules of 2, 3, 5, 9, 10 for a two or three-digit number expressed in the general form. **Sets** ☞ Union and intersection of sets ☞ Disjoint set ☞ Complement of a set	▷ Revising previous concepts learnt by children. ▷ Building on children's previous learning ▷ Involving children in writing general form of rational numbers and associating it with the rules of algebra. The operations on algebraic expressions will help in describing properties of rational numbers. ▷ Encouraging children to use the rules for comparison of integers and fractions to develop their own rules for comparison of rational numbers. ▷ Encouraging children to reach the conclusion that half of the sum of two rational numbers lies between them and thus a rational number can be obtained between any two rational numbers. Providing hints to children while reaching the conclusion that the process of finding a rational number between any two numbers never stops and thus there lies infinite many rational numbers between any two rational numbers ▷ Facilitating children to see and understand that if we take two rational numbers then unlike for whole numbers, in this case you can keep finding more and more numbers that lie between them. ▷ Facilitating children to observe patterns in square numbers and to form their rules for perfect square numbers and square roots. ▷ Facilitating children to observe patterns in perfect cube numbers and form rule for cube root numbers ▷ Encouraging children to play with numbers to find square roots and cube roots using prime factorisation ▷ Encouraging children practice the division method to find square roots of numbers. ▷ Utilising children's understanding about algebra to introduce the generalised form of 2 and 3 digit numbers and to prove divisibility test of numbers.	▷ Maths Kit

Theme 2: Ratio and Proportion

This theme, at this stage develops in children the ability to understand and appreciate another way of the application of mathematics in daily life called commercial mathematics. The percentage, unitary method, profit and loss, simple and compound interest etc. are based on ratio and proportion. Understanding of ratio and proportion and the skill of applying them in daily life is further required to be strengthened in this class. Children will be properly exposed to higher level problems on profit and loss, compound interest and direct and indirect variations. The problems on these topics should be picked up from daily life situations like banking, taxation, loan transaction etc.

Learning Outcomes:

Children will be able to:

- solve slightly advanced problems involving application on percentages, profit and loss, overhead expenses, discount and tax;
- explore the difference between simple and compound interest (compounded yearly up to 3 years or half-yearly up to 3 steps only),
- arriving at the formula for compound interest through patterns and using it for simple problems;
- solve simple and direct word problems related to direct and inverse variation, and time and work problems.

Ratio and Proportion

Key Concepts	Suggested Transactional Processes	Suggested Learning Resources
⯈ Slightly advanced problems involving applications on percentages, profit & loss, overhead expenses, Discount, tax. ⯈ Difference between simple and compound interest (compounded yearly up to 3 years or half-yearly up to 3 steps only ⯈ Direct and inverse variations – Simple and direct word problems ⯈ Time and work problems– Simple and direct word problems	⯈ Arriving at the formula for compound interest through patterns and using it for simple problems.	⯈ Maths Kit

Life Skills: Solving daily life problems

Theme 3: Algebra

In this theme the focus will be on developing skills in children to use linear equations and systems of linear equations to represent, analyse, and solve a variety of problems. They should recognize equations for proportions (y/x = m or y = mx) as special linear equations (y = mx + b) and use a linear equation to describe the association between two quantities in bivariate data (such as arm span vs. height for students in a classroom). In this class, fitting the model, and assessing its fit to the data are done informally. Interpreting the model in the context of the data requires children to express a relationship between the two quantities in question and to interpret components of the relationship in terms of the situation. They should be able to strategically choose and efficiently implement procedures to solve linear equations in one variable, understanding that when they use the properties of equality and the concept of logical equivalence, they maintain the solutions of the original equation. Children will be able to solve systems of two linear equations in two variables and relate the systems to pairs of lines in the plane; these intersect, are parallel, or are the same line. They will also understand the construction of algebraic expressions and extend the addition and subtraction to multiplication and division of expressions.

In this Class children should understand various identities and their use in solving problems related to multiplication and division (factorization) of algebraic expressions.

Learning Outcomes:

Children will be able to:

- multiply and divide algebraic expressions (integral coefficient only);
- focus on some common errors like $2 + x \neq 2x$, $7x + y \neq 7xy$ etc.;
- prove and use identities $(a \pm b)2 = a\,2\pm 2ab + b$, $a2 - b2 = (a - b)\,(a + b)$ $(a\pm b)2=a2\pm2ab+b2$;
- factorize algebraic expressions (simple cases only) as examples the following types $a(x + y)$, $(x \pm y)2$, $a2 - b2$, $(x + a).(x + b)$;
- solve linear equations in one variable in contextual problems involving multiplication and division (simple rational coefficient in the equations);
- multiply two algebraic expressions and forms algebraic identities for square of binomials;
- factorize an algebraic expression using identities;
- find solution to inequalities in one variable using properties of in equalities.

Algebra

Key Concepts	Suggested Transactional Processes	Suggested Learning Resources
▶ Algebraic Expressions ▶ Multiplication and division of algebraic expression (Coefficient should be integers) ▶ Identities $(a \pm b)^2 = a^2 \pm 2ab + b^2$, $a^2 - b^2 = (a - b)\,(a + b)$. ▶ Properties of in equalities. ▶ Factorisation (simple cases only) as examples the following types $a(x + y)$, $(x \pm y)^2$, $a^2 - b^2$, $(x + a)(x + b)$	▶ Encouraging children to undertake multiplication of algebraic expressions based upon the distributive property of multiplication over addition and subtraction of numbers. Moreover, children already have the idea that same number multiplied repeatedly can be expressed in powers and the same is true for variables. Children should be encouraged	▶ Maths Kit.

Algebra

Key Concepts	Suggested Transactional Processes	Suggested Learning Resources
➤ Solving linear equations in one variable in contextual problems involving multiplication and division (word problems) (avoid complex coefficient in the equations)	to develop their own results for algebraic identities by using the multiplication of algebraic expressions. ➤ Continuing the idea of numerical coefficient and factors of a term to evolve methods of writing an expression in terms of product of two or more expressions. This will lead to the factorisation of algebraic expressions. ➤ Drawing attention of children to and laying special emphasis on the common errors that children commit while learning algebra like $2 + x = 2x$, $7x + y = 7xy$ etc.	

Skill: establish relationship between known and unknown facts

Theme 4: Geometry

The theme in this class will focus on making the definitions more meaningful and enabling children to perceive relationships between properties and figures. Logical implications and class inclusions should be understood, but the role and significance of deduction may not be understood.

The children will be prepared to enter into the fourth level of geometrical thinking at this stage by learning informal deduction in this class. They learn to construct proofs, understand the role of axioms and definitions, and know the meaning of necessary and sufficient conditions. The children should be able to give reasons for steps in a proof. The another important way of learning about shapes and figures is through relating it with numbers i.e using the analytical geometry. Initiation of this process will be i done in this class with introduction of representing any point in a plane as ordered pair of real numbers. With this introduction child should be able to geometrically represent numerical relation between two variables Children will then construct the concept of linear graph and relationship between the variables as linear equation.

Learning Outcomes:

Children will be able to:

- explore and verify properties of quadrilaterals like sum of angles of a quadrilateral is equal to 360° (by verification);
- explore and verify properties of parallelogram (by verification) like
  (i) opposite sides of a parallelogram are equal,
  (ii) opposite angles of a parallelogram are equal,
  (iii) diagonals of a parallelogram bisect each other. [also find justification to why (iv), (v) and (vi) follow from (ii)]
  (iv) diagonals of a rectangle are equal and bisect each other
  (v) diagonals of a rhombus bisect each other at right angles.
  (vi) diagonals of a square are equal and bisect each other at right angles.
- identify and match pictures with objects [more complicated e.g. nested, joint 2-D and 3-D shapes (not more than 2)];
- draw 2-D representation of 3-D objects (continued and extended);
- count number of vertices, edges & faces & verifying Euler's relation for 3-D figures with flat faces (cubes, cuboids, tetrahedrons, prisms and pyramids);
- generalize the sum of angles of quadrilateral and use it in solving various problems related to finding angles of a quadrilateral;
- explain properties of parallelograms and tries to reason out how one property is related to other;
- represent 3-D shapes on a plan surface like paper, board, wall etc.;
- make nets of prisms and pyramids and forms the shapes from the nets;
- construct quadrilaterals using pair of compasses and straight edge given:
  - ☛ four sides and one diagonal
- three sides and two diagonals
  - ☛ three sides and two included angles
  - ☛ two adjacent sides and three angles
- construct quadrilaterals given:
  - ☛ four sides and one diagonal
  - ☛ three sides and two diagonals
  - ☛ three sides and two included angles
  - ☛ two adjacent sides and three angles.
- describe the meaning of axes (same units), Cartesian plane, plotting points for different kind of situations (perimeter vs length for squares, area as a function of side of a square, plotting of multiples of different numbers, simple interest vs number of years etc.);
- read linear graphs;
- distinguish the shapes that are symmetrical and find line of symmetry by paper folding;
- define and identify various parts of a circle.

Geometry

Key Concepts	Suggested Transactional Processes	Suggested Learning Resources
Understanding shapes: ☛ Properties of quadrilaterals – Angle Sum property ☛ Properties of parallelogram (By verification) (i) Opposite sides of a parallelogram are equal, (ii) Opposite angles of a parallelogram are equal, (iii) Diagonals of a parallelogram bisect each other. (iv) Diagonals of a rectangle are equal and bisect each other. (v) Diagonals of a rhombus bisect each other at right angles. (vi) Diagonals of a square are equal and bisect each other at right angles. **Representing 3-D in 2-D** ☛ Identify and match pictures with objects [more complicated e.g. nested, joint 2-D and 3-D shapes (not more than 2)]. ☛ Drawing 2-D representation of 3-D objects (Continued and extended) ☛ Counting vertices, edges & faces & verifying Euler's relation for 3-D figures with flat faces (cubes, cuboids, tetrahedrons, prisms and pyramids) **Construction of Quadrilaterals:** ☛ Given four sides and one diagonal ☛ Three sides and two diagonals ☛ Three sides and two included angles ☛ Two adjacent sides and three angles Idea of reflection symmetry and symmetrical shapes **Circle** ☛ Circle, centre, radius/ diameter, arc, chord, sector and segment.	Involving children in activities of measuring angles and sides of shapes like quadrilaterals and parallelograms and to identify patterns in the relationship among them. Let them make their hypothesis on the basis of the generalisation of the patterns and later on to verify their assertions. Involving children in expressing/representing a 3-D shape into 2-D from their life like drawing a box on plane surface, showing bottles on paper etc. Facilitating children making nets of various shapes like cuboids, cubes, pyramids, prisms etc. Again from nets let them make the shapes and to establish relationship among vertices, edges and surfaces. Through pattern let them reach to Euler's relation. Constructing various figures by children using compasses and a straight edge. But it is also important to involve children to argue why a particular step is required. For example, on drawing an arc using compasses we find all those points that are at the given distance from the point where the metal end of the compasses was placed.	Maths Kit Geoboard with rubber band Geometry box

Life Skill: deductive reasoning

Theme 5: Mensuration

Children should be clear about the idea of area as measure of region occupied by a shape on a surface and the formulae to find area of rectangle and square. In this class the theme will enable them to evolve the methods of finding the area of shapes like trapezium and other polygons. The idea behind the formulae of finding area of rectilinear shapes is moving from known to unknown i.e. developing the methods using the formulae they know like rectangle. Children will develop the ability to think how a trapezium and parallelogram can be converted into a rectangle of same area.

Using this understanding the methods of finding the surface area of 3-D figures is to be introduced. For this the nets of simple figures like cuboid will be useful to visualize the shapes of different surfaces of this figure. This visualization will help children in evolving formula for finding area of all surfaces. There are many figures like cuboid in children's vicinity like room with four walls, roof and floor, and cartons used for packing various items. Problems related to finding surface area and volume/capacity of such shapes are in children's daily life. Therefore, in this class children should be able to construct meaningful problems and solve them using this understanding.

Learning Outcomes:

Children will be able to:

- find area of trapezium and polygons by using square grid and also by using formulae;
- find surface area of cuboid, cube and cylinder through their nets and later on by using formulae;
- form formula to find volume of a cuboid and cylinder by observing and generalizing patterns of counting units cubes that completely fill the cuboids.
- find volume and capacity (measurement of capacity) of cuboidal and cylindrical vessels

Mensuration

Key Concepts	Suggested Transactional Processes	Suggested Learning Resources
⮞ Area of a trapezium, a polygon and semi-circle. ⮞ Surface area of a cube, cuboid, cylinder. ⮞ Idea of Total surface area and curved surface areas of various 3-D figures ⮞ Concept of volume, measurement of volume using a basic unit, volume of a cube, cuboid and cylinder ⮞ Volume and capacity (measurement of capacity)	⮞ Revising previous concepts learnt by children. ⮞ Building on children's previous learning ⮞ Encouraging children to discuss in groups about converting trapezium and parallelograms into rectangles of equal area. This will help them in formation of formulae to find these areas. ⮞ Involving children in finding the surface area of a cube and cuboid and in opening such boxes and realizing that all these surfaces are made up of rectangles and squares only. The rest of the activity will be focused on finding the total surface area (TSA) which will only be to add these areas.	⮞ Maths Kit ⮞ Daily use readymade 2D,3Dshapes

Mensuration		
Key Concepts	**Suggested Transactional Processes**	**Suggested Learning Resources**
	▶ Based on children's previous learning and understanding and the vocabulary they have related to measurement of volume and capacity through their daily life experiences involving them in activities to get a feel of filling a given space and to measure it by just counting the unit items that fill it completely. This will also help them in deciding why a cube is taken as a unit of measuring volume.	

Life Skills: Solving daily life problems

Theme 6: Data Handling

Based on children's learning about mean, median and mode in earlier classes, in this class, children will be enabled to develop the ability to apply this learning for data with large number of observations which may require to be grouped. Avoid giving irrelevant numbers as data. Let children collect data and find an appropriate average. They will also learn to interpret pie charts being commonly seen in newspapers. Once they are comfortable with interpretation they will learn to represent data as pie charts. Understanding that the probability of chance event is a number between 0 and 1 that expresses the likelihood of the event occurring is developed in this class. Through various random experiments like tossing of coin, throwing a die, occurrence of a letter say E in random selected paragraphs etc. children should infer larger numbers indicate greater likelihood. The ability to find that a probability near 0 indicates an unlikely event, a probability around $\frac{1}{2}$ indicates an event that is neither unlikely nor likely (called as equally likely event), and a probability near 1 indicates a likely event will also be focused on.

Learning Outcomes:

Children will be able to:

- arrange ungrouped data into groups and represent grouped data through bar-graphs;
- construct and interpret bar-graphs;
- interpret simple pie charts with reasonable data numbers;
- consolidate and generalise the notion of chance in events like tossing coins, dice etc. and relating it to chance in life events;
- throw a large number of identical dice/coins together and aggregating the result of the throws to get large number of individual events. observing the aggregating numbers over a large number of repeated events;
- make a hypothesis on chances of coming events on the basis of its earlier occurrences like after repeated throws of dice and coins;

Data Handling

Key Concepts	Suggested Transactional Processes	Suggested Learning Resources
- Arranging ungrouped data, it into groups, representation of grouped data through bar-graphs, constructing and interpreting bar-graphs. - Simple Pie charts with reasonable data numbers - Consolidating and generalising the notion of chance in events like tossing coins, dice etc. Relating it to chance in life events.	- Conducting activities with children related to throwing a large number of identical dice/coins together and aggregating the result of the throws to get a large number of individual events. - Involving children in making their assumption for the future events on the basis of the above data. Observing the aggregating numbers over a large number of repeated events will also help them in forecasting the chances of future events. Comparing with the data for a coin. Observing strings of throws will help children in developing notion of randomness.	- Maths Kit - Coins, dice, etc.

Life Skills: Understanding and interpreting data, drawing inferences