Learning Indicators Mathematics up to class VIII

Curricular Expectations

- Moves from number sense number patterns
- Sees relationships between numbers and look for patterns in relationships
- Gain proficiency in using newer language of mathematics like, variables, expressions, equations, identities etc
- Uses arithmetic and algebra to solve real life problems and pose meaning problems
- Discover symmetries and acquire sense of aesthetics by looking around regular shapes like triangles, circles, quadrilaterals etc.
- Comprehend the idea of space as reason enclosed with in boundaries of a shape
- Relate numbers with shapes in terms of perimeter, area and volume and uses them to solve every day life problems
- Learn to provide reasoning and convincing arguments to justify their own conclusions particularly in mathematics
- Collects, represents (graphically and in tables) and interprets data/information from her/his life experiences

CLASS VI

Conceptual Area	Pedagogical Processes	Learning Indicators
• **Numbers** • Consolidates the sense of numberness up to 5 digits in terms of its size of estimation • Gets familiar with large numbers up to 8 digits • Understands the importance of brackets and other symbols like, =, <, >. • formulates divisibility rules of 2, 3, 4, 5, 10 and uses them as and when required • Appreciates the classification of numbers as even, old, prime, co prime etc.	• Through various situations make children compare numbers up to 5 digits like cost of two houses, number of spectators present in two cricket matches etc. • Number patterns could be used to extend numbers up to 8 digits and then daily life situations involving 8 digit numbers could be discussed e.g. cost of property, • Involve children in classification of numbers on the basis of tier properties like even, odd, multiples and factors. these numbers can be used to classify numbers in to various categories • Divisibility rules can be introduced using patterns, and then different division problems could be discussed to show their use. For example, let children form multiplication tables of different numbers like 2, 3, 4, etc and then from the multiplication facts ask them to identify the pattern like multiple of 3 has sum its digits divisible by 3, multiple of 5 has either 5 or zero in its ones place etc.	Create situations around her in which she finds numbers. • Through situations like money transactions, measuring of height budget etc. child uses larger numbers and thus appreciates their use. • Child reduces fractions involving larger numbers to simplest (lowest) forms • child attempts to construct examples through which she demonstrates the add

Conceptual Area	Pedagogical Processes	Learning Indicators
• Understands the significance of HCF and LCM and finds them • By observing patterns identifies and formulates rules for whole numbers • Appreciates the need for negative numbers • Through patterns formulates rules for	• encourage children to create number patterns through which HCF and LCM can be discussed. • Different number operations could be performed by students which through discussions could help to know the different	• Given a fraction child identifies a situation for 0. • the given fraction • uses divisibility rules to find factors of a number
ordering of integers, their representation on number line, addition and subtraction of integers etc. • represents fractions and decimals pictorially and on number line • Finds sum and difference of two fractions	properties like closure, commutatively etc. • Situations could be created and discussed in which numbers are required to be represented for opposite situations, like directions, give and take situations etc. • Daily life situations and pictures could be presented to introduce fractions and decimals like representing part of a whole as number, a dot mark placed to separate rupees and paisa, meter and centimeter, kilometer and meter, liter and milliliter etc. • Encourage children to look at the pictures showing sum and difference of like fractions and to generalize. • Let children evolve that to add or subtract two unlike fractions it is required to convert them into equivalent fractions of same denominators (like fractions)	• demonstrates her ways of finding HCF and LCM of two numbers • devises her strategies to identify appropriate situations to use the concepts of HCF and LCM. • creates daily life situations where opposites are involved and represents such quantities by positive and numbers • makes her own strategies of ordering, adding and subtracting integers

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2. Algebra • Understands variables through patterns • Classifies quantities as variable and constant	• Situations may be presented before the children that would prompt them to form patterns and feel the need for a symbol in place of number. • Discussions may be held to show different mathods of comparison of quantities are helpful in different situation situations.	• child tries to identify a pattern • child tries to formulate the pattern identified by her and tries to suggest a symbol for a general term of the pattern • Child tries to construct examples that require
Ratio and Proportion • Understands how the comparison of two quantities through ratio is different from comparisons done earlier • Understands the meaning of proportion • knows how ratio and proportion are related to unitary method. • solves problems related to daily life using unitary method.	• Children may be encouraged to create examples to show the difference between comparison of quantities done through operation of subtraction and that through ratio • Examples could be discussed to show the difference between ratio and proportion and to relate them • Daily life problems related to unitary method could be discussed that lie in child's everyday life like shopping finding rate etc.	the concept of ratio. • By constructing examples child tries to know how the concept of proportion is built upon that of ratio. • While solving problems on unitary method child tries to understand unit of which quantity is to be found. Finds rate and the total amount in related context using unitary methods

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3. **Geometry** • Differentiates between different geometrical figures on the basis of their observable properties • Classifies angle into different types on the basis of their measurement • Understands the difference between different types of triangles and the basis on which they are classified. • Classifies Quadrilaterals as trapezium, parallelogram, rectangle, square, rhombus • Identifies 3-D shapes and their parts. • Identifies 2-D symmetrical objects. • Understands reflection symmetry. • Constructs angles of different measures using compasses.	• Activities can be performed in which students can be shown concrete models and pictures of different geometrical shapes. Students can be involved in activities related to identify, angles, triangles & quadrilaterals and nets. • A better way of connecting 2-D with 3-D is relating nets of various solids with their shapes. • Models and Nets of 3-D shapes can be made by students to get an idea of their edges, faces etc. • Discussion can be held after showing objects to the children • Activities can be performed using mirror and children may be made to observe the reflections. The observations can then be discussed. Folding a paper cutout of a to show the reflection symmetry in case the two halves exactly cover each other. • After discussing the drawing of 60° angle using compasses, the construction of other angles like 30°, 120° etc. can be discussed with the children. Give then a feel of dividing a circle into equal segments that correspond to angle. For example a circle can be divided into six equal parts bay the chords of length equal to radius of the circle and this actually forms $1/6^{th}$ of complete angle i.e 60^0 at the centre. • Different geometrical figures may be given to draw that involves angles of various measures, line segments etc.	• classifies angles in different groups/types • Child tries to draw different types of triangles and quadrilaterals. • Child attempts to prepare solids using their Nets. • Child observes the objects and tries to make strategies to decide about the symmetry of the object. • Child observes the reflection of objects in mirror and then tries to formulate rules about the symmetry of the object. • Child tries to see the logic behind drawing an angle of certain measure using geometrical properties. • After learning to draw an angle of certain measure child tries to device ways to draw related angles.

Conceptual Area	Pedagogical Processes	Learning Indicators
Mensuration • Understands the concept of perimeter of a shape. • Understands the concept of area of a shape.	• Different shapes can be shown to the students and through the notion of boundary, the concept of perimeter can be discussed. • Discussion can be held about boundary and region, which can lead to concept of area.	• Child tries to calculate the perimeter of different shapes given. She tries to formulate the perimeter of shapes like rectangle, square etc. • Child tries to calculate the areas of rectangle ad square by dividing them into appropriate smaller units. She tries to think of such small units.
Data Handling • Understand the use of organizing data. • Represent data through pictograph, bar graph.	• Daily life situation involving quantitative information can be discussed with students. • Discussion can be held about why data should be organised. Children can be motivated to use their own ways of organising data. • Children may be asked to explore their own ways of representing the data.	• Child tries to identify daily life situations in which the information is required to be properly arranged. • Child tries to explore different ways to organise and represent data.

CLASS VII

Conceptual Area	Pedagogical Processes	Learning Indicators
Numbers • Multiplication and division of integers • Properties of integers • Problem solving using operations on integers • Multiplication and division of fractions • Introduction to rational numbers • Operations on rational numbers • Decimal representation of rational numbers • Multiplication and division of decimal fractions • Problem solving using operations on rational numbers and decimal fractions • Exponents	• The rules for multiplication and division of whole numbers have already been studied by children. Involve children in discussion to find their ways of multiplying integers. Use of patterns in multiplying a negative integer by another integer may be a new idea for children as up till now they have learnt that multiplication is repeated addition or an operator in case of fractions. Give proper time to children to appreciate why product of two negative integers is positive. Similarly encourage children to explore and using concept of dividing a natural number by another by simply finding the number which when multiplies the divisor gives the dividend as product. So to find -4÷ -2 we have to find the number which on multiplication with -2 gives the result -4. Many children will be able to infer that the required number must be +2. Many such examples will help the child to make their own rule like +ve ÷ -ve = -ve, -ve ÷+ve= -ve and -ve÷-ve=+ve.	• Multiplies integers by using patterns and generalizes the rules to multiply a positive integer by a negative integer, a negative integer by a positive integer and two negative integers • Divides two integers by using patterns and forms rules to perform division in integers. • Multiplies fractions by using patterns/paper folding/pictures and generalizes the rules • Divides fractions by using patterns/visualization/picture and forms rules • Forms rules to add, subtract, multiply and divide rational numbers by using the operations on fractions and integers. • Represents a rational number as decimal fraction and forms rules for operations on decimal fractions • Uses exponential form and their rules to

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Numbers	• Involve children in classification of numbers on the basis of their properties like even, odd, multiples and factors. these numbers can be used to classify numbers in to various categories • Divisibility rules can be introduced using patterns, and then different division problems could be discussed to show their use. For example, let children form multiplication tables of different numbers like 2, 3, 4, etc and then from the multiplication facts ask them to identify the pattern like multiple of 3 has sum its digits divisible by 3, multiple of 5 has either 5 or zero in its ones place etc. • Utilise children's knowledge about describing multiplication of fractions as operator 'of" and explain by paper folding, shading parts of whole etc. for example $\frac{1}{3} \times \frac{1}{2}$ is one-third of one-half which can be shown as   The double shaded region is one-sixth of the	solve problems related to repeated multiplication. • Observes patterns in multiplication tables and forms divisibility rules.

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	whole which shows that $\frac{1}{3} \times \frac{1}{2} = \frac{1}{6}$. Let children do lot of such sums and observe the pattern that in all cases the product of fractions can be obtained by multiplying their numerators and their denominators Similarly $\frac{1}{2} + \frac{1}{4}$ means the number of one-fourths in one-half. Simple visualization is required to find that one-half contains two one-fourths. Let children Observe pattern and find their own ways of dividing a fraction by another fraction. • Involve children in exploring their ways of writing repeated multiplication in short form as repeated addition is represented by multiplication. With discussion let the children reach to the conclusion of writing repeated multiplication in exponent form.	
Algebra **ALGEBRAIC EXPRESSIONS** • Generate algebraic expressions • Performs operations on algebraic expressions • Simple linear equations in one variable (in contextual problems) with two operations	• Use child's context and encourage them to generate algebraic expressions by proper choice of variable/unknown and operations. • Child's daily life experiences like adding/subtracting a group of 2 notebooks and 5 pencils to/from another group of 3 notebooks and 8 pencils etc. Let children form their own rule that like terms can only be added or subtracted. • Involve children in groups of three or four to explore situations which can be expressed by	• Forms, add and subtract algebraic expressions involving one or two variables/unknowns • Expresses situations in to simple linear equations and solves them
	simple equations and solve them. Textbooks have many such examples.	

Conceptual Area	Pedagogical Processes	Learning Indicators
Ratio and Proportion • Ratio and proportion and Unitary method continued • Understanding percentage as a fraction with denominator 100 • Percentage and conversion of fractions and decimals into percentage and vice-versa. • Application to profit and loss (single transaction only) • Application to simple interest (time period in complete years).	• Children know about many ways of comparing quantity. Utilise their experiences to conclude that ratio is another way of comparing quantities. Percentages and their applications are also in child's daily life experiences which can be used to form various formulae and solving problems using them.	• Describes ratios as percentage and forms formulae for profit/loss and simple interest using unitary method
Geometry **Understanding shapes:** • Pairs of angles (linear, supplementary, complementary, adjacent, vertically opposite) • Properties of parallel lines with transversal (alternate, corresponding, interior, exterior angles) **Properties of triangles:** • Angle sum property • Exterior angle property • Pythagoras Theorem (Verification only) **Symmetry** ○ Recalling reflection symmetry ○ Idea of rotational symmetry, observations of rotational symmetry of 2-D objects. (90_0, 120_0, 180_0) **Representing 3-D in 2-D**: ○ Identification and counting of vertices, edges, faces, nets (for cubes cuboids, and cylinders,	• Diagrams and use of upper primary mathematics kit (developed by NCERT) help children in visualizing the relationship between various pairs of angles when `a transversal cuts two lines (parallel and non parallel)., angles of triangle and relationship among its sides. • Involve children in experimentation with measurement of sides of right angled triangles and recognition of pattern to hypothesize the Pythagorian relation. • Conduct activities with children given in textbooks (paper folding and observing diagrams) and encourage children to visualize symmetry and criterion for rotational symmetry of various shapes. • Children working in groups with traced	• Identifies pairs of angles like linear, supplementary, complementary, adjacent and vertically opposite and finds the one when other is given • Hypothesize the relationship between pairs of angles out of eight angles formed by a transversal with parallel lines. • Verifies angle sum and other properties of triangles and uses these properties to find unknown elements of a triangle. • Appreciates the rotational symmetry of various shapes and figures • Reads simple maps and forms her own maps like home to school, map of her village, house etc. • Establishes congruence criterion for triangles

Conceptual Area	Pedagogical Processes	Learning Indicators
cones). ○ Mapping the space around approximately through visual estimation. **Congruence** ○ Congruence through superposition ○ Extend congruence to simple geometrical shapes e.g. triangles, circles. ○ Criteria of congruence **Construction** ○ Construction of a line parallel to a given line from a point outside it ○ Construction of simple triangles..	copies of various shapes and superimposing one above the other help them in establishing congruence criterion.	and circles. • Constructs simple triangles when three out of six elements are given(like three sides, two sides and included angle, a side and two angles etc.)
Mensuration • Revision of perimeter and Idea of Circumference of Circle **Area** • Concept of measurement using a basic unit area of a square, rectangle, triangle, parallelogram and circle	• Involve children in activities targeted to measurement of region enclosed by closed figures on a plan surface and encourage them to come to the conclusion that a unit is required. • Conduct activities related to measuring units squares within a figure drawn on a square grid and to compare various regions.	• Measures approximate area of simple regular and irregular closed shapes by using unit square grid sheet • Forms formulae to find area of the region enclosed in a rectangle and a square as a better way of counting the number of units squares that fill them completely.
Data handling • Collection and organisation of data – choosing the data to collect for a hypothesis testing. • Mean, median and mode of ungrouped data – understanding what they represent. • Constructing bar graphs • Feel of probability using data.	• Utilize child's daily life experiences and contextual problems to test hypothesis by collection and organization of data. Situations like finding a representative value to data help in understanding the idea of finding mean, median and mode of ungrouped data. Staring with small sets of numbers will be easier to visualize and represent it by bar graphs. • Involve children in drawing inferences for future events from the existing data	• Finds various representative values for simple data from her daily life. • Represents data by simple bar graphs and interprets them.

CLASS VIII

Conceptual Area	Pedagogical Processes	Learning Indicators
Number System **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 **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.	• Involve children in writing general form of rational numbers and to associate it with rules of algebra. The operations on algebraic expressions will help in describing properties of rational numbers. • Let children use the rules for comparison of integers and fractions to develop their own rules for comparison of rational numbers. • Encourage children to conclude that the half of the sum of two rational numbers lies between them and thus a rational number can be obtained between any two rational numbers. Provide hints to the children to reach to 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 • 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. • Make children observe patterns in square numbers and to form their rules for perfect square numbers and square roots. • Likewise let children observe patterns in perfect cube numbers and form rule for cube root numbers • Allow children to play with numbers to find	• Describes properties of rational numbers and expresses them in general form • Performs operations on rational numbers • Reach to the conclusion that between any two rational numbers there lies infinite many rational numbers. • Finds square, square root, cube and cube root of numbers using different methods • Provide logic and valid reasoning for divisibility tests of 2, 3, 5, 9 and 10

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	square roots and cube roots using prime factorisation • Let children practice the division method to find square roots of numbers. • Utilising child's understanding about algebra introduce the generalised form of 2 and 3 digit numbers and to prove divisibility test of numbers.	
Algebra **Algebraic Expressions** • Multiplication and division of algebraic expression (Coefficient should be integers) • Identities $(a \pm b)^2 = a^2 \pm 2ab + b^2$, $a^2 - b^2 = (a - b)(a + b)$ • Factorisation (simple cases only) as examples the following types $a(x + y)$, $(x \pm y)^2$, $a^2 - b^2$, $(x + a)(x + b)$ • Solving linear equations in one variable in contextual problems involving multiplication and division (word problems) (avoid complex coefficient in the equations)	• The 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. Let children 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. • Give special emphasis to the common errors that children commit while learning algebra like $2 + x = 2x$, $7x + y = 7xy$ *etc.*	• Multiplies two algebraic expressions and forms algebraic identities for square of binomials • Factorizes an algebraic expression using identities • Describes simple contextual situations into linear equations and solves them using different methods

Conceptual Area	Pedagogical Processes	Learning Indicators
Ratio and Proportion • 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 & work problems– Simple and direct word problems	), Arriving at the formula for compound interest through patterns and using it for simple problems.	
Geometry **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.	Involve 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. Involve 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.	• Generalizes sum of angles of quadrilateral and uses it in solving various problems related to finding angles of a quadrilateral • Explains properties of parallelograms and tries to reason out how one property is related to other • Represents 3-D shapes on a plan surface like paper, board, wall etc. • Makes nets of prisms and pyramids and forms the shapes from the nets.

Conceptual Area	Pedagogical Processes	Learning Indicators
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)	Let children make 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	• Identifies relationship among number of edges, vertices and surfaces in various 3-D shapes and generalizes it. • Constructs quadrilaterals using compasses and straight edge given • Four sides and one diagonal
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	Children enjoy constructing various figures by 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.	• Three sides and two diagonals • Three sides and two included angles • Two adjacent sides and three angles

Conceptual Area	Pedagogical Processes	Learning Indicators
Mensuration • Area of a trapezium and a polygon. • Surface area of a cube, cuboid, cylinder. • Concept of volume, measurement of volume using a basic unit, volume of a cube, cuboid and cylinder • Volume and capacity (measurement of capacity)	• Children already know the method of finding area of a rectangle. Let children discuss in groups to convert trapezium and parallelograms into rectangles of equal area. This will help them in formation of formulae to find these areas. • In finding surface areas of cube and cuboid involve children in opening such boxes and realize that all these surfaces are made up of rectangles and squares only. The rest of the job of finding total surface area will only be to add these areas. • Children already have vocabulary related to measurement of volume and capacity through their daily life experiences. Involve 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 hel them in deciding why a cube is taken as a unit of measuring volume.	• Finds area of trapezium and polygons by using square grid and also by using formulae • Forms formula to find volume of a cuboid by observing and generalizing patterns of counting units cubes that completely fill the cuboids • Finds surface area of cuboid and cube through their nets and later on by using formulae.

Conceptual Area	Pedagogical Processes	Learning Indicators
Data handling • 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.	Conduct activities related to throwing a large number of identical dice/coins together and aggregating the result of the throws to get large number of individual events. Involve 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 also help 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	Makes hypothesis on chances of coming events on the basis of its earlier occurrences like after repeated throws of dice and coins.

Introduction to graphs
• 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.)
• Reading off from the graphs
  o Reading of linear graphs
  o Reading of distance vs time Graph
	Involve children in representing the rectangular arrangement of children in a class by using numbers and encourage them to come to the conclusion of using two axes and a unit. By this way they will appreciate that each child can be identified by a pair of numbers.
	
	Making such drawings will help in categorizing the set of points as in a line of on a curve or randomly placed
		Draws and reads points plotted on Cartesian plane