Learning Outcomes in Mathematics-Elementary Stage

Introduction

Various educational surveys and achievement data over the years show that learning achievements of children in various subjects-especially Mathematics- are not up to the expected levels despite all the efforts made by states in this direction. It is a fact that many a time, teachers complete the syllabus as per the textbook but they do not have a clear idea about the kind of learning they expect from children in various subjects including Mathematics.

'Curricular expectations' define what a child should know, be able to do and dispositions that should be acquired over a period of time. Learning outcomes derived from curricular expectations and syllabus may help all the stakeholders in understanding the goals to be achieved. The learning outcomes are generally treated as assessment standards or benchmarks for assessment.

Highlighting the end product of the learning process normally leads to achieving it through rote memorisation without understanding. However the highlighting of the end product in mathematics learning lays emphasis on remembering the facts and using algorithms without understanding. Further it develops a handicap in children about use/applications of mathematical ideas in daily life. Integration of the environmental component with mathematics has been taken up. The teachers are excepted to provide learning opportuntities while transacting different concepts of maths to help children explore and connect with their immediate surroundings, (self, family, school etc). The suggested pedagogical processes include examples for the same.

Learning is a continuous process. The learning outcomes are impacted by the learning /pedagogical processes used to develop competencies. The learners are expected to realise and use mathematics as an important tool that they can talk about, use and explore as well as understand its structure. Therefore, this document tries to list the learning outcomes in Mathematics for Classes I to VIII along with some suggested pedagogical processes which may be undertaken to achieve the outcomes. These pedagogical processes are not exhaustive. They are suggestive in nature, and may vary according to the learner's context. An innovative and creative teacher may be able to achieve the learning outcomes through these and many more different pedagogical processes.

Curricular Expectations:

- Develop a connection between daily life contexts and that of mathematical thinking.

- Understand shapes and articulate their observable properties as similarities and differences among them.
- Develop own methods of performing operations on numbers in daily life (addition, subtraction, multiplication and division).
- Develop language and symbolic notations with standard algorithms of performing number operations.
- Estimate outcome of operations on two or more numbers and use it in daily life activities.
- Learn to represent the part of a whole as a fraction and order simple fractions.
- Collect , represent and interpret simple data from her/his contexts and use it in everyday life.
- Identify and extend simple patterns in shapes and numbers.

Class I (Mathematics)

Suggested Pedagogical Processes	Learning Outcomes
The learner may be provided opportunities in pairs/groups/ individually and encouraged to: ➢ observe different contexts and situations from the immediate environment such as the things that are inside/outside the classroom. They may be encouraged to use the spatial vocabulary/ concepts like top- bottom, on- under, inside- outside, above-below, near- far, before- after , thin – thick, big- small etc. ➢ identify and draw the things which are near-far, tall-short, thick-thin, etc. ➢ handle concrete materials or models and classify them. For example, objects which are round in shape like *chapati*,ball, etc and which are not round such as pencil box. ➢ count objects like, students may take out objects up to 9 from a given collection of objects such as picking any 8 leaves /4 beads/6 ice-cream sticks etc, from the given box. ➢ take out objects up to 20 from a given collection of objects. ➢ use words like more than, less than or equal through the strategy	**The learner:** • **works with numbers 1 to 20** • classifies objects into groups based on some physical attributes like shape, size and other observable properties including rolling and sliding. • recites number names and counts objects up to 20, concretely, pictorially and symbolically. • counts objects using numbers 1 to 9. • compares numbers up to 20. For example tells whether number of girls or number of boys is more in the class. • **applies addition and subtraction of numbers 1 to 20 in daily life** • constructs addition facts up to 9 by using concrete objects. For example to find 3+3 counts 3 steps forward from 3 onwards and concludes that 3+3=6. • subtracts numbers using 1 to 9. For example the child takes out 3 objects from a collection of 9 objects and counts the

Suggested Pedagogical Processes	Learning Outcomes
of one to one correspondence in objects in two groups. ➢ explore different strategies to add numbers up to 9 like counting on forward and using already known addition facts. ➢ evolve different strategies to subtract numbers up to 9 like recounting after taking out objects from a given collection. ➢ use different strategies like aggregation, counting forward, using addition facts, etc. to extend addition up to 20 (sum not exceeding 20) ➢ develop different strategies of taking away through objects/ pictures. ➢ count in groups of tens and ones for numbers more than 20. Like, 38 has 3 groups/bundles of ten each and 8 loose (ones). ➢ sort objects based on similarities and differences through their sense of touch and observation. ➢ verbalise the properties of shapes/criterion used by them in sorting/ classifying solids/ shapes ➢ use concrete play money for making amounts up to Rs 20. ➢ finds short lengths in their immediate environment. using non uniform ➢ units like finger, hand span, length of a forearm, footsteps, etc. ➢ conduct classroom discussions on observation of pattern and allow them to describe in their own language. Let children find what will come next and justify the answer.	remaining to conclude 9-3=6 • Solves day to day problems related to addition & substraction of numbers up to 9. • **recognizes numbers up to 99 and writes numerals**. • **describes the physical features of various solids/shapes in her own language. For example- a ball rolls, a box slides etc.** • **estimates and measures short lengths using non uniform units like a finger, hand span, length of a forearm, footsteps, etc.** • **observes, extends and creates patterns of shapes and numbers. For example arrangement of shapes/ objects/ numbers, etc. like**  • (i) • 1,2,3,4,5,……. • 1,3,5,…… • 2,4,6,…… • 1,2,3,1,2,..., 1,…3,……..

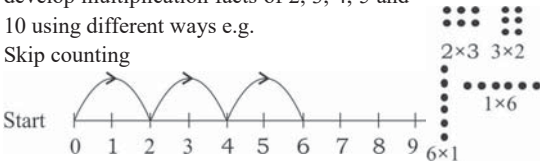
Suggested Pedagogical Processes	Learning Outcomes
➢ observe and collect information from the visuals, contexts/ situations such as number of items.	• **collects, records (using pictures/ numerals) and interprets simple information by looking at visuals. (For example in a picture of a garden the child looks at different flowers and draws inference that flowers of a certain colour are more).** • **Develops concept of zero.**

Class II (Mathematics)

Suggested Pedagogical Processes	Learning Outcomes
The learner may be provided opportunities in pairs/groups/ individually and encouraged to: ➢ identify number naming & number writing patterns, read and write numbers up to 99. ➢ apply the understanding of place value of numbers while grouping & recognising them. ➢ add 2 digit numbers up to 99 by using addition facts up to 9. ➢ develop and use alternate strategies for addition and subtraction of numbers ➢ explore situations in which addition and subtraction of numbers is required. For example combining two groups, enlarging a group by adding more objects. ➢ develop their own contextual situations/questions based on subtraction and addition. ➢ create situation/ context in which a number has to be repeatedly	**The learner**: • **works with two digit numbers** - reads and writes numerals for numbers up to 99. - uses place value in writing and comparing two digit numbers. - forms the greatest and smallest two digit numbers (with and without repetition of given digits). - solves simple daily life problems/situations based on addition of two digit numbers. - solves daily life situations based on subtraction of two digit numbers. - represents an amount up to Rs. 100 using 3-4 notes and coins (of same/ different denominations). • **describes basic 3D and 2D shapes with their observable chracteristics** - identifies basic 3D-shapes such as cuboid, cylinder, cone and

Suggested Pedagogical Processes	Learning Outcomes
added. ➢ trace different faces of 3D objects on paper and naming their corresponding 2D Shapes. ➢ classify shapes based on their physical attributes through cut out/ paper folds of different shapes. ➢ use observations/ sense of touch to describe the shapes and their physical attributes. ➢ add up to numerical value of Rs. 100, by using concrete play money of different denominations ➢ measure different lengths/ distances by using uniform but non standard unit. ➢ discuss and share the experiences of children while they observe different balances for weighing objects. ➢ construct their own balance (simple) and weigh and compare the weights of different things around them. ➢ compare the capacity of two or more containers. ➢ discuss about the special day/ particular day of a week when children share time and house related work with their family members. ➢ verbalise the unit of repeat in a pattern and make ideas about their extension ➢ extend patterns created by using shapes, thumb print, leaf print and numbers, etc. ➢ collect information from people around, record it and draw some inference from it.	sphere by their names. - traces 2D outlines of 3D objects. - identifies 2D shapes (rectangle, square, triangle, circle) by their names. • **distinguishes between straight and curved lines.** • **draws/ represents straight lines in various orientations (vertical, horizontal, slant).** • estimates and measures length/distances and capacities of containers using uniform non-standard units like a rod/pencil, cup/spoon/bucket etc. • compares objects as heavier/lighter than using simple balance. • identifies the days of the week and months of the year • sequences the events occurring according to their duration in terms of hours/days, for example ,does a child remain in school for longer period than at home ? • draws inference based on the data collected such as 'the number of vehicles used in Samir's house is more than that in Angeline's'. • Identifies the values of currency notes up to 100/coins and performs addition and subtraction operations.

Class III (Mathematics)

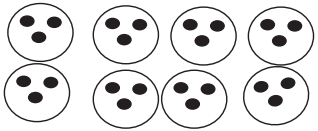
Suggested Pedagogical Processes	Learning Outcomes
The learner may be provided opportunities in pairs/groups/ individually and encouraged to: ➢ count large number of objects from their surroundings by making groups of 100,10 and ones. ➢ write a number (up to 999) and the other group reads it. ➢ apply place values for writing greatest/ smallest numbers with three digits. (Digits may or may not repeat.) ➢ arrange concrete objects and draw different multiplication facts/ combinations of a given number, For example 6 mangoes can be arranged as ➢ develop multiplication facts of 2, 3, 4, 5 and 10 using different ways e.g. Skip counting  and by using repeated addition ➢ experience equal sharing and grouping and connecting them mathematically in their own context. For example, sharing of equal number of sweets among children.	**The learner:** • **works with three digit numbers** - reads and writes numbers up to 999 using place value. - compares numbers up to 999 for their value based on their place value. - solves simple daily life problems using addition and subtraction of three digit numbers with and without regrouping, sums not exceeding 999 - constructs and uses the multiplication facts (tables) of 2, 3, 4, 5 and 10 in daily life situations. - analyses and applies an appropriate number operation in the situation/ context. - explains the meaning of division facts by equal grouping/sharing and finds it by repeated subtraction. For example 12÷3 as number of groups of 3 to make 12 and finds it as 4 by repeatedly subtracting 3 from 12 - adds and subtracts small amounts of money with or without regrouping. - makes rate charts and simple bills • **acquires understanding about 2D shapes** - identifies and makes 2D-shapes by paper folding , paper cutting on the dot grid, using straight lines etc. - describes 2D shapes by the number of sides, corners and diagonals. For example ,the shape of the book cover has 4 sides, 4 corners and two

Suggested Pedagogical Processes	Learning Outcomes
➢ observe various 3D shapes available in the surroundings and discussions may be held for identification of similarities and differences with respect to their corresponding 2D. Shapes like triangle, square, circle cut outs of cardboard. ➢ make 2D shapes through paper folding/paper cutting activities. ➢ describe the properties of 2D shapes in their own words/languages like number of corners, shape of edges, etc. ➢ discuss their observation regarding various shapes they observe in their surroundings – on the floor, on the footpath, etc., to draw conclusion that all shape do not tile. ➢ conduct role play of seller and buyer in selling/buying situation where lots of addition and subtraction of amounts using play money may be done. ➢ measure the length of objects in their surroundings by using scale/ tape. Students may be encouraged to estimate the length first and then verify it by actual measurement. ➢ use simple balance to compare and find weight of common objects in terms of non-standard units likes small stones, packets of objects, etc. ➢ measure capacities of different containers and describe their experiences of doing so, e.g. finding how many jugs can fill a basket or how many glasses can be filled with one jug of water. ➢ use of vocabulary about time and calendar through discussions/ story telling	diagonals - fills a given region leaving no gaps using a tile of a given shape. • **estimates and measures length and distance using standard units like centimetres or metres** & identifies relationships. • **weighs objects using standard units - grams & kilograms using simple balance .** • **compares the capacity of different** containers in terms of non standard units. • **adds & subtracts measures involving grams & kilograms in life situations.** • identifies a particular day and date on a calendar. • reads the time correctly to the hour using a clock/watch. • extends patterns in simple shapes and numbers . • **acquires understanding about data handling.** • records data using tally marks, represents pictorially and draws conclusions

Suggested Pedagogical Processes	Learning Outcomes
➢ attempt to read a clock and calendar. ➢ observe patterns both geometrical and numerical and discuss them. (Presentation by the group may be done in front of the whole class) ➢ collect and record data in their own way and use pictograph to represent it. For example flowers of different colours in the school garden or the number of boys and girls present in a class. ➢ to interpret pictographs from magazines and newspapers which can be displayed in the classroom.	

Class IV (Mathematics)

Suggested Pedagogical Processes	Learning Outcomes
The learner may be provided opportunities in pairs/groups/ individually and encouraged to: ➢ explore and write multiplication facts through various ways like skip counting, extending patterns, etc. For example, for developing multiplication table of 3, children could use either skip counting or repetitive addition or pattern as shown below: 1 2 **3** 4 5 **6** 7 8 **9** 10 11 **12** - - -	**The learner:** ➢ **applies operations of numbers in daily life** ➢ multiplies 2 and 3 digit numbers ➢ divides a number by another number using different methods like: ➢ pictorially (by drawing dots) ➢ equal grouping ➢ repeated subtraction ➢ by using inter-relationship between division and multiplication ➢ creates and solves simple real life situations/ problems including money, length, mass and capacity by using the four operations. • **works with fractions**

Suggested Pedagogical Processes	Learning Outcomes
- - | - | - - | - | ➢ expand the two digit number and multiply. For example, 23 multiplied by 6 could be solved as follows: $23\times6 = (20+3)\times6 = 20\times6+3\times6$ $= 120+18 = 138$ ➢ solve and create daily life problems using multiplication like, if a pen costs Rs. 35 what will be the cost of 7 pens? ➢ discuss and evolve standard algorithm for multiplication. ➢ make groups for division, e.g. 24÷3 means  ➢ i.e. to find how many groups of 3 can be there in 24 or how many 3's make 24. ➢ create contextual questions based on mathematical statements. For example the statement 25 – 10 =15 may trigger different questions from different students. A student may create. "I had 25 apples. Ten were eaten. How many apples are still left?" ➢ create contextual problem through group activity such as dividing the class in two groups where one group and the	• identifies half, one-fourth, three-fourths in a given picture(by paper folding) and also in a collection of objects. • represents the fractions as half, one-fourth and three-fourths by using symbols $\frac{1}{2}, \frac{1}{4}, \frac{3}{4}$ respectively. • shows the equivalence of $\frac{1}{2}$ and $\frac{2}{4}$ and other fractions. • **acquires understanding about shapes around her/him** • identifies the centre, radius and diameter of the circle. • finds out shapes that can be used for tiling. • draws cube/ cuboids using the given nets. • shows through paper folding/ paper cutting, ink blots, etc. the concept of symmetry by reflection. • draws top view, front view and side view of simple objects. • explores the area and perimeter of simple geometrical shapes (triangle, rectangle, square) in terms of given shape as a unit like the number of books that can completely fill the top of a table. • converts metre into centimetre and vice-versa. • estimates the length of an object/distance between two locations, weight of various objects, volume of liquid, etc., and verifies them by actual measurement. • solves problem involving daily life situations related to length, distance, weight, volume and time involving four basic arithmetic operations. • reads clock time in hour and minutes and expresses the time in a.m. and p.m.

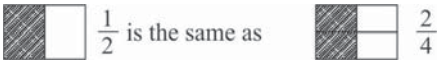
Suggested Pedagogical Processes	Learning Outcomes
other solves by using different operations and vice- versa. ➢ to discuss and co-relate fractional numbers like half, one fourth, three fourths. ➢ represent the fractional numbers through activities related to pictures/paper folding . For example – shade half the picture  Shaded part of which of the following pictures do not represent one fourth (1/4)  ➢ draw circles with various lengths of radius, compasses and explores various design with the shape. ➢ discuss observation on tiling (of different shapes) which they see in their homes/ on footpaths / floors of various buildings. ➢ make their own tiles and verify whether the tiles they created tessellate or not. ➢ look at various objects in the classroom from different viewpoints and make a deep drawing of the view. For example: a glass may look like this from the front. Questions like, 'But	• relates 24 hr clock with respect to 12 hr clock. • calculates time intervals/ duration of familiar daily life events by using forward or backward counting/ addition and subtraction. • identifies the pattern in multiplication and division (up to multiple of 9). • observes, identifies and extends geometrical patterns based on symmetry. • represents the collected information in tables and bar graphs and draws inferences from these.

Suggested Pedagogical Processes	Learning Outcomes
how it would look like from the top?' Or 'how it would look like from below?' may be raised. ➢ convert rupees into *paisa*: For example how may 50 *paisa* coins you will get in exchange of 20 rupees. ➢ make bills so that the students while making bills will use the four operations of addition/ subtraction/ multiplication/ division. ➢ first estimate the length of an object/ distance and then verify them by actually measuring them. For example, estimating the length of their bed or distance between the school gate and the classroom and verifying it by measuring them. ➢ make a balance and weigh things with standard weights. In case standard weights are not available, packages with standard weights may be used like packets of ½ Kg *dal*, 200 gm pack of salt, 100 gm pack of biscuits. ➢ innovate use of weights like using two 250 gm packets instead of 500gm packet (or by using stones of equivalent weights, etc.) ➢ make their own measuring vessel to measure capacities of other vessel. For example – a bottle may have capacity for 200 ml and can be used as a measurement unit to know the amount of water in a jug or in a container. ➢ observe and study the calendar and come up with number of weeks in a month/ in a year. Let children explore the pattern in number of days in each month and how days are associated with dates in a month, etc. ➢ utilise their experiences inside/outside the class having exposure to telling time/ reading clock in hours and minutes allowing peer	

Suggested Pedagogical Processes	Learning Outcomes
learning. ➢ discover the time lapsed in an event by counting forward or using subtraction/ addition are created. ➢ explore patterns/ designs in their environment (using shapes and numbers) and can be encouraged to make such patterns and extend them. ➢ collect information and draw meaningful results in their daily life. Using these experiences, the children may be involved in activities focusing on data handling. ➢ read data/bar graphs, etc., from newspapers/magazines and interpret them.	

Class V (Mathematics)

Suggested Pedagogical Processes	Learning Outcomes
The learner may be provided opportunities in pairs/groups/ individually and encouraged to: ➢ discuss on contexts/ situations in which a need arises to go beyond the number 1000 so that extension of number system occurs naturally. For example number of grams in 10 Kg, number of metres in 20 Km, etc. ➢ represents numbers beyond 1000 (up to 100000) using place value system, like extend learning of numbers beyond 9 thousand, how to write number one more than 9999.	**The learner:** **works with large numbers** • reads and writes numbers bigger than 1000 being used in her/his surroundings. • performs four basic arithmetic operations on numbers beyond 1000 by understanding of place value of numbers • divides a given number by another number using standard algorithms. • estimates sum, difference, product and quotient of numbers and

Suggested Pedagogical Processes	Learning Outcomes
➢ operate (addition and subtractions) large numbers using standard algorithm. This may be identified as extension of algorithm for one more place. ➢ use variety of ways to divide numbers like equal distribution and inverse process of multiplication ➢ develop the idea of multiples of a number through its multiplication facts, skip counting on a number line and number grid. ➢ develop concept of factors through division of numbers and multiples. ➢ estimate the result through approximations and then verifies it. ➢ discuss and use contexts/ situations from daily life in activities to develop understanding about fractional part of the group like, how many bananas are there in half a dozen bananas? ➢ compares fractions through various ways like paper folding, shading of diagram etc. ➢ develop the idea of equivalence of fractions through various activities. For example ➢ By paper folding and shading:  $\frac{1}{2}$ is the same as $\frac{2}{4}$ ➢ understand the idea of decimal fractions $\left(\frac{1}{10}th\ and \frac{1}{100}th\right)$	verifies the same using different strategies like using standard algorithms or breaking a number and then using operation.(For example, to divide 9450 by 25, divide 9000 by 25, 400 by 25, and finally 50 by 25 and gets the answer by adding all these quotients). **acquires understanding about fractions** • finds the number corresponding to part of a collection. • identifies and forms equivalent fractions of a given fraction. • expresses a given fraction $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{5}$ in decimal notation and vice-versa. For example in using units of length and money- half of Rs. 10 is Rs.5 • converts fractions into decimals and vice versa. **explores idea of angles and shapes** • classifies angles into right angle, acute angle, obtuse angle and represents the same by drawing and tracing. • identifies 2D shapes from the immediate environment that have rotation and reflection symmetry like alphabet and shapes. • makes cube, cylinder and cone using nets designed for this purpose. • relates different commonly used larger and smaller units of length, weight and volume and converts larger units to smaller units and vice versa. • estimates the volume of a solid body in known units like volume of a bucket is about 20 times that of a mug. • applies the four fundamental arithmetic operations in solving problems involving money, length, mass, capacity and time

Suggested Pedagogical Processes	Learning Outcomes
➢ develop earlier understanding of angles and to describe it. ➢ observe angles in their surroundings and compare their measures. For example, whether the angle is smaller, bigger or equal to a corner of a book which is a right angle; further, classify the angles. ➢ introduce protractor as a tool for measuring angles and use it to measure and draw angles. ➢ explore symmetry by using paper folding/ paper cutting ➢ explore shapes so that they can find out that some shapes look the same only after one complete rotation/ part of a rotation ➢ plan their shopping–to make estimates of money (in different denominations) and the balance money one would get. ➢ conducts role play of shopkeepers/ buyers in which students create bills. ➢ measure length of different objects using a tape/ metre scale. ➢ appreciates the need of converting bigger units to smaller units. ➢ discuss experiences on units of capacity printed on water bottle, soft drink pack, etc. ➢ fill a given space by using different solid shapes, cubes, cuboids, prisms, spheres, etc. and encourage students to decide which solid shape is more appropriate. ➢ Measure volume by counting the number of unit cubes that can fill a given space ➢ explore patterns in numbers while doing various operations	intervals • identifies the pattern in triangular number and square number. • collects data related to various daily life situations, represents it in tabular form and as bar graphs and interprets it.

Suggested Pedagogical Processes	Learning Outcomes
and to generalise them like patterns in square numbers.  ➢ Triangular number like as shown below also forms a pattern  ➢ collect information and display it in a pictorial form. For example, heights of students from their class and represent it pictorially. ➢ collect and discuss various diagrams/ bar charts from the newspapers/ magazines may be in the class.	