Dealing with the Complexity of Numbers and Geometry

Numbers speak their own language. It is a language of relating symbols to quantity, of expressing daily life experiences to do with adding or subtracting these quantities in different ways. It is a language that can be expressed through patterns and properties that numbers display when they are in different combinations and relationships with each other. For example, as numbers arranged in a definite order, or as whole numbers, fractions, odd numbers, square numbers and so on. And all this can happen in the built environment.

Come enter this intricate and exciting world of numbers with the design ideas situated in the built environment that help to build understanding of numbers!

16 Measures Around Us
17 Vertical Scales and Horizontal Scales
18 Highlighting Angles in Buildings
19 Door Angle Protractor
20 Floor Number Lines on Tiles and Panels
21 Fraction Aids
22 Magic Squares on Floor and Walls
23 Tangram Tiles
24 Brick and Tile Patterns on Floor and Walls
Introduction

What are measures around us? Many of us keep struggling with estimates of lengths, distances, weights and volumes throughout our life. Can we give children measures for things around them in a variety of concrete ways? Why not allow them to play and work with some real measures around us?

The built space can provide several concrete examples of standard and non-standard measurements of lengths, distances, weights, and capacities. These may be standard units of floor tile lengths or repeated motifs in a border pattern or regular distances marked on stepping stones.

Children can be helped to develop a measurement sense by having scales placed horizontally or vertically on walls, floors, desks and doors. Weights of furniture and common objects in the classroom can be labelled.

The capacity of water tanks, buckets and waste paper bins can be written on them in ways that children can understand easily.

Teaching-Learning Activities

Activity 1: Measurement of Length with Non-Standard Tools

Classes I, II

a) The teacher should measure and compare his hand span with a repeated print or motif or tile. Then compare this measurement with the child hand span.

b) Ask the children to measure the length and width of their books, copies or pencil box with the help of their pencils or eraser. Now have a discussion. Why is the measurement less or more? Give children time to think and answer. Vocabulary such as long short, longer shorter, longest shortest, approximately, equal, thin, thick will be used in the discussions.
Teacher’s Role

- Use the vocabulary associated with the various types of measurements in context of a lesson.
- Help children develop a sense of measurement by giving many opportunities to children to explore their environment and make measurements.
- Arrange for all materials that are to be measured.
- Help children develop the skill of estimation of distances, weights and capacities.

Objectives

1. To expose children to non-standard units of measurements.
2. To make measurements of length, weight and capacity familiar to children.
3. To develop a feeling for quantification of measurements in metre (m), centimetre (cm), kilogram (kg), gram (g), litre (l), and millilitre (ml).

Suggested Activities

1. Measurement of Length with Non-Standard Tools
3. Estimation of Weights
4. Measuring and Weighing Exercises

Activity 2: Measurement of Capacity with Non-Standard Tools

Classes I, II, III, IV

Do similar exercises as in activity for measuring lengths. Ask the children if milk is carried in vegetable bags or a bucket? Let children count the number of mugs that will fill a bucket. Give them a small bottle and let them see how many bottles will fill a mug. Talk about how liquids are measured.

For Class III and IV, introduce standard measurements such as litre cups or a bottle of 1 litre water. Use this one litre bottle to fill up a bucket to find the capacity of the bucket.
Activity 3: Estimation of Weights

For weights first estimate the weight of copy or a pencil box or a chair. Then weigh these objects. Do many exercises in estimation like this. If there is a large weighing scale in a nearby shop or flour mill, it will be fun to weigh and then label the weights of objects around the room such as chairs, stools, tyres and tables. Lift the table and tyres to get an idea of their weight.

Activity 4: Measuring and Weighing Exercises

Give many exercises with the horizontal and vertical scales, with the weighing scales and for measuring the capacity of bottles in the shop. The measurement exercises must be done for a range of objects with lengths of different sizes i.e. objects which are so small that they can be measured in 'mm' only, yet others in 'cm' and some which are long enough to exceed 1 meter length so that the correct units and their importance is established concretely in a child's mind.

These exercises must be done from time to time throughout the year. It takes time to develop these concepts. Three or four lessons are never enough. You can take string and cut it into many different lengths. Then estimate the length and measure it. Similarly give many exercises in estimation of capacity and weight.
Example

<table>
<thead>
<tr>
<th>Sample number</th>
<th>Estimated length</th>
<th>Measured length</th>
<th>Difference (or percentage error for Class VI, VII, VIII)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20 cm</td>
<td>23 cm</td>
<td>3 cm</td>
</tr>
<tr>
<td>2</td>
<td>5 cm</td>
<td>4 cm</td>
<td>1 cm</td>
</tr>
<tr>
<td>3</td>
<td>50 cm</td>
<td>60 cm</td>
<td>10 cm</td>
</tr>
<tr>
<td>4</td>
<td>75 cm</td>
<td>69 cm</td>
<td>6 cm</td>
</tr>
</tbody>
</table>

**Space for Notes**
17 Vertical Scales and Horizontal Scales

Introduction

Measurement is an integral part of math, science and even language curriculum. Even though vertical and horizontal scales are both used for measurement, their applications are different. Children are often not clear about these applications.

By providing these scales in the physical environment, children will have many opportunities to measure and develop an understanding of estimation and measurement.

There is another scale with a writing surface beside the long jump bed, in the sports area.

Suggested Activities

1. Measuring Accurately
2. Recording Measurements
3. Relationship between Non-Standard and Standard Measurements
4. Estimating Lengths - I
5. Estimating Lengths - II
6. Understanding Averages
7. Comparing Scales
8. Measurement Quiz
9. Record Keeping

Teaching-Learning Activities

Activity 1: Measuring Accurately

Classes III, IV, V

The teacher will take the tallest and the shortest child in the class. Teach children how to measure properly by standing straight without chappals or shoes and measuring accurately. Record height with the name of children on the writing surface. After 4 or 5 days, the teacher should be satisfied that children can measure height accurately. Let children practice by themselves throughout the year.
**Teacher’s Role**

The teacher will give exercises on these scales on a regular or daily basis. All math activities in the text need to be practiced throughout the year. In each class, children are at many different levels. You will have to make various exercises that recognize this. The teacher will focus on the use of correct vocabulary associated with measurement. Very often children just associate with the numeric value of a measurement and not the correct unit. Some children need very simple and basic exercises. Others will need greater challenges.

The teacher must encourage thinking and discussion.

**Objectives**

1. To learn concepts of measurement of length and height.
2. To learn concepts of long and short, taller and shorter, tallest, shortest, approximate-exact, centimetre and metre.
3. To understand the concept that living things grow to a certain height or width or weight.
4. To compare length between two or more things.
5. To develop the skill of estimation.
6. To encourage children to talk about measurements.
7. To help children learn to record data.
8. To help children learn to analyze data.
9. To use appropriate mathematical vocabulary in context of exercises being done in math text or in class.
10. To develop logical thinking and reasoning power.

**Activity 2: Recording Measurements**

**Classes III, IV, V**

A chart can be prepared with the names of all children in alphabetical order. Everyday two children can make height measurements and record them, without guidance of teacher. Children will learn to co-operate and work independently.
Activity 3: Relationship between Non-Standard and Standard Measurements

Classes II, III, IV, V

Children will use their hand-span to measure items around them such as a window pane or the circumference of a tree or the height of a table. Children will then use the scales to measure the length, width or circumference. They will record these items in their notebook.

<table>
<thead>
<tr>
<th>Item</th>
<th>Height (assuming 1 hand span to be of 15cms)</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>table</td>
<td>1 hand spans = 15 cm x 1</td>
<td>8 hand spans = 15 cm x 8</td>
</tr>
<tr>
<td>window pane</td>
<td>3 hand spans = 15 cm x 3</td>
<td>2 hand spans = 15 cm x 2</td>
</tr>
<tr>
<td>notebook</td>
<td>1½ span = 15 cm x 1½</td>
<td>1 handspan = 15 cm x 1</td>
</tr>
</tbody>
</table>

Activity 4: Estimating Lengths - I

Class III, IV, V

Children will estimate length of objects. They will then measure the objects on the horizontal and vertical scale and record the measurements.

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimated length</th>
<th>Measured length</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pencil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blackboard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Branch of Tree</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Book</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Activity 5: Estimating Lengths-II

Classes VI, VII, VIII

The previous activity can be made challenging for some students. Use the chart below.

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimated length</th>
<th>Measured length</th>
<th>Difference</th>
<th>Percentage error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pencil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubber</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Door</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Window Grill</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pillar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Activity 6: Understanding Averages

Classes V, VI, VII

a) Measure the height of two children. Find their average height.

b) Measure the height of four children. Find their average height.
c) Measure the height of 10 children. Find their average height.
d) Find the average length of 5 pencils.

Note: Once the concept of averages is understood, give other problems. Children can find out average consumption of milk or average earnings of a daily wage earner. If marks are given for exams in Class VI and VII, average marks can also be recorded.

Activity 7: Comparing Scales

Classes III, IV, V

Ask children to compare their small 15 centimetre scale with the vertical and horizontal scales. How many scales make one metre? Two metres?

Ask three children to measure the same table or stool or pencil. Do they all get the same answer?

Activity 8: Measurement Quiz

Classes II, III, IV, V

Children can learn to prepare quizzes. The teacher should help for a while, then let children make their own questions and ask other children. Ask, how did they arrive at an answer? Did they use the same process?

a) Guess the height of the bottle?
b) Guess the height of the tree?
c) Guess the length of the eraser?
4. List three items in the class that measure less than 20 centimetres.
d) List three items in the class that measure more than one metre.

Activity 9: Record Keeping

Classes IV, V, VI, VII, VIII

a) Each child can keep a monthly record of their long-jump. At the end of each month, a chart of all children will need to be made on the writing surface in the veranda to record 1st, 2nd, 3rd and so on.
b) Four times a year, children can record their height.

Space for Notes
Highlighting Angles In Buildings

Introduction

Angles are everywhere around us. Look for them in your buildings and the environment. The three-dimensional space in the built environment offers a vast range of angles. These design ideas will sensitize and provide a variety of experiences of angles for younger children.

For older children, the angles in the built environment become a classroom tool for understanding angles in an enjoyable manner.

Suggested Activities

1. Understanding 90° Angles
2. Recognition of Angles
3. Finding Angles More and Less than 90°

Teaching-Learning Activities

Activity 1: Understanding 90° Angles
Classes III, IV

Teacher will show 90° angle formations at the four corners of the classroom. The terminology of ‘right angle’ must be used in a casual manner. Ask the children to identify 90° angles in objects around them such as books, pencil box, table and chairs.

Activity 2: Recognition of Angles
Classes IV, V

Bring children’s attention to the angles in the built-in spaces such as walls, steps of the staircase, opening and closing of almirah and classroom doors, roofs, corners, etc. Ask children to identify the angles. The teacher should write the name of the angles on the chalk board.

A range of angles in the built-spaces in and around the schools may be highlighted.
Teacher’s Role

Teachers must bring the attention of children to various shapes in and around the school. Vocabulary related to shapes and angles must also be used when you are examining the shapes and angles. Examples of vocabulary are: straight lines, curved lines, perpendicular, right angle, inclined, circular, triangular and so on. Let children explore various angles in subjects and spaces around.

Objectives

1. To understand that an angle is formed when two straight lines meet or intersect.
2. To identify angles of 90°, smaller than 90°, and greater than 90° without measuring them.
3. To read and write angles properly.

Activity 3: Finding Angles More and Less than 90°

Class IV, V, VI

Ask children to find angles more and less than 90° in the beams in the roof, in the window grills, in the fans and so on.

Space for Notes
**Introduction**

The inherent movement of a door shutter goes through a series of angles. This can be enhanced through markings on the floor, as shown. This helps children experience angles in a familiar element like a door. It is suitable for classes III to VI.

**Suggested Activities**

1. Review Naturally Occurring Angles
2. Use of the Door
3. Practical Exercises on the Chalk Board
4. Estimation of Angles

**Teaching-Learning Activities**

**Activity 1: Review Naturally Occurring Angles**

**Classes III, IV**

a) Children may be asked to identify various angle formations in the classroom in order to familiarize them with the concept of angles i.e. an angle occurs when two lines meet or intersect.

b) Children can be asked to bend their knees and arms and make many angles or told to fold their note-books to see angles they make.

**Activity 2: Use of the Door**

**Classes III, IV, V**

a) Use the door for practical demonstrations: find $0^\circ$, $15^\circ$, $30^\circ$, $45^\circ$, $30^\circ$, $15^\circ$, $0^\circ$ and so on. Does the angle change when the size of the door is different?

b) Use the angles on a window grill to measure angles.

c) Slowly move the door starting from $0^\circ$. Let children guess or estimate the angles as the door is moved. Do this regularly. Also ask them to name the angles as you move-obtuse angle, etc.

d) Now draw angles on the board and label them. (Move from concrete examples to abstract examples).

Door angle protractors must be engraved on floor and not just painted, for longevity.
Teacher’s Role

Before showing the angles in the door, many activities must happen that are mentioned in “Naturally occurring Angles in Buildings”. After reviewing these activities, use the movement of the door to demonstrate angles.

Objectives

1. To familiarize with angles around us before formal teaching.
2. To understand angles.
3. To encourage children to estimate angles.
4. To use mathematical vocabulary in the context of real experiences with angles e.g. straight line, right angle, perpendicular, alignment, in phase, out of phase.

e) Now use the textbook (and the protractor on the window), to teach angles but always refer back to the door and angles in the room, on ramps, in window grills and so on.

Activity 3: Practical Exercises on the Chalk Board

Classes IV, V, VI

After children have had plenty of experiences with concrete angles, they can now be shown examples on the chalk board. Then children should be asked to draw angles on the writing surfaces. The teacher can also draw angles on the board and have groups of children measure and record the angles.

Activity 4: Estimation of Angles

Class IV, V, VI

a) Slowly move the door starting from 0°. Let the children guess or estimate the angles as the door is moved. Do this regularly.
b) Use a book and move it from 0° to 180°. Let children estimate the angles.
c) Now draw many angles on the writing surfaces. Children must be asked to estimate the degree of angle and then measure to check the accuracy of their estimation.
Introduction

Children learn about numbers at an early age. Numbers are all around us: one nose, two eyes, five fingers.

The shift in dealing with numbers using actual objects, to using number symbols or doing mental number work can be difficult for children. Often we see children who can name a symbol such as 14, but they cannot give you 14 objects. This is because schools and parents often forget to teach numbers using objects. Numbers are not to be taught as a "song" by counting 1,2,3,4,5,6,7........Instead use the stairs steps, number line or other objects that can be touched.

Your school may have number lines on the veranda, on the path or on the wall and perhaps in the classroom.

If there are number lines in the classroom, you may want to paint them. If they are out of children's reach it can be used as reference material.

Teaching-Learning Activities

Activity 1: Number Recognition

Classes I, II

a) Children can fill in numbers on plain number lines.

b) The teacher should neatly write numbers 0 to 10 on the floor tiles and panels with chalk. Each child will hop on one foot and call out the number name. Other children should watch and can tell how many were right and which one was wrong.
Teacher’s Role

- Play with children on number lines and give ideas for play.
- Teach some games to the children.
- Encourage children to make up their own games.

Objectives

1. To promote physical development of children as they run, jump and hop on the tiles or stones.
2. To promote making of rules and obeying rules through discussion and negotiation.
3. To learn to recognize numbers and alphabets.
4. To learn to add and subtract playfully.
5. To recognize numbers.
6. To understand zero.
7. To recognize geometrical shapes.

Suggested Activities

1. Number Recognition
2. Understanding Zero
3. Number Patterns
4. Naming Geometrical Shapes

c) The numbers can be increased as children learn to count higher numbers.
Let children write down the numbers that they choose.
d) Clean the chalk numbers off the number line on the ground. With chalk, fill-in numbers in a random manner such as 8, 3, 17, 12. The children have to get stones and put the same number of stones on the number.
Activity 2: Understanding Zero

Classes I, II, III

Children will mark a home base as Zero. From Zero the number line will be written 1,2,3,4,5........

Children will then hop as far as they can without putting the other foot down. As soon as the other foot goes down, they are ‘out’. Zero is ‘nothing’.

In this way they will come to understand that counting actually starts from zero.

Activity 3: Number Patterns

Classes II, III

Children can write the tables and identify number patterns in ascending or descending number as shown:

Even with simple numbers, a range of patterns can be seen by children.

Space for Notes
Activity 4: Naming Geometrical Shapes

Classes IV, V

If your school has geometrical shapes shown in the picture, children can take a chalk and write the name of these shapes. They can also mark on the lines of symmetry of these shapes.
21 Fraction Aids

Introduction

"Fractions in the wall, fractions in the grill,
Fractions to look at, fractions to fill.....
They're hiding on the floor and in tile patterns too
So many types of fractions, simply waiting for you!"

For some reason, faulty teaching practices have made children afraid of fractions. Teachers struggle for ways to make fractions simple. Fractions must first be taught for a long time in a very concrete way. The BaLA Window Grills, Wall Tile Fractions, Floor Tiles and Disc on ground, will help children to understand that fractions are always a part of a “whole” object.

Suggested Activities

1. Concept of Whole
2. Oral Addition and Subtraction of Fractions
3. Parts are Smaller than the Whole
4. Newspaper Fractions
5. Window Grill Fractions
6. Vocabulary of Fractions
7. Fraction Disc on the Ground
8. Fractions in a Wall Clock

Teaching-Learning Activities

Activity 1: Concept of Whole

Classes III, IV, V

To introduce the concept of a whole and its equal parts, teachers may show children the window grills, wall tiles, floor tiles and disc on the ground on different occasions. She may ask; what is whole? While moving her finger around it. Similarly parts could be identified. Teachers must ask the children if the whole is bigger or the
Teacher's Role

The teacher needs to take a very active and formal role while teaching fractions. He must devise many different ways of helping children to understand fractions. For at least three or four years fractions can be taught in a concrete way. In classes III to VI, teach in a concrete manner and at the same time, show what the written symbols are.

Objectives

1. To understand the concept of "whole". Each "whole" is to be looked at separately.
2. To understand that "parts" have to belong to the same "whole".
3. To understand the pattern of ascending order while adding equal parts as in the case of whole numbers.
4. To understand the pattern of descending order while subtracting equal parts from the "whole".
5. To understand the relationships of fractions to real life.
6. To understand and use mathematical vocabulary associated with fractions.
7. To understand larger and smaller fractions.
8. To understand equivalent fractions.

parts are bigger. Slowly the concept about fractions as *part* of a "whole" will develop. Also compare all the *parts* of the same "whole". Children can be asked to count the whole, which is always *one* and its parts which will always be *less* than *one*. E.g. one apple when cut in two parts, then the count of part will always be more than one, but the size of parts will always be smaller than whole.
Activity 2: Oral Addition and Subtraction of Fractions

Classes IV, V, VI, VII, VIII

After seeing the fractions on the window grills, wall tiles, floor tiles and disc, ask the children to add and subtract fractions orally. For example, $\frac{1}{2} + \frac{1}{2} = 1$. Also $1 - \frac{1}{3} = \frac{2}{3}$ and so on. Then ask questions from real life such as, “If you have one burfi and want to share it equally with 3 children what would you do?” Children need to show it on the tiles or grills. ($\frac{1}{3} + \frac{1}{3} + \frac{1}{3} = 1$ burfi). Or ask children if a bowl of poha is divided equally among 5 children how many equal portions would one child get? How many portions would 2 children get? How many portions would there be if there were 4 children? Remember you must always move from simple to complex. Children need years of practice with small fractions before they move to large numbers.

Activity 3: Parts are Smaller than the Whole

Classes III, IV, V

It is advisable to work on the floor tiles as one can easily shade them with chalk or write over them. The teacher may start with the floor tiles of circular and square shape. The teacher should talk about equal sharing of a chapati and a burfi. Ask the children to divide the chapati shape tile in two equal parts with a chalk. Point out that two equal parts have been created out of one whole. The concept of $\frac{1}{2} + \frac{1}{2} = 1$ has been introduced and demonstrated both verbally and in figures. It is to be emphasized through many physical demonstrations that each part is smaller than the whole. Often children believe that $\frac{1}{16}$ is bigger than $\frac{1}{8}$ because 16 is bigger than 8. Continue to give physical experiences to show that when all parts are put together, they become one whole.

Activity 4: Newspaper Fractions

Classes IV, V, VI, VII, VIII

Ask the children to cut a piece of newspaper to the size of the tile on top row of wall tiles.

Some children can measure the length and width. This paper can be cut in half and placed over the same tile i.e. top position. Younger children can express their observations orally while older children may express in writing.

Mark out 3 equal portions on the paper. Shade one portion. Ask “How many portions are shaded?” The teacher must write $\frac{1}{3}$ on the board. Shade one more portion and again ask “How many portions are shaded?” Write $\frac{2}{3}$ on the board. When all the portions are shaded, write $\frac{3}{3}$ on the board. This then becomes $\frac{3}{3} = 1$. This concept is difficult for children unless they have had many physical experiences of fractions.
Activity 5: Window Grill Fractions
Classes VI, VII, VIII

Ask students to observe the window grills.

Ask students to write $1 + \frac{1}{2} = 1\frac{1}{2}$. Now add $\frac{1}{4} + \frac{1}{2} = \frac{3}{4}$.

The children are not required to find the Lowest Common Multiple (LCM) for this addition exercise. Instead they should physically do it. If need be, they may cut a strip of paper matching the marked grill portion. The chalkboard below the window could also be used to depict applications of various mathematical operations with ‘wholes’ and fractions.

Activity 6: Vocabulary of Fractions
Classes III, IV, V, VI

Constantly use mathematical vocabulary associated with fractions. For example:

"I’m coming in a quarter of an hour"
“Share this package of biscuits among 3 children.”
“This cloth will make 4 shirts – divide it into four equal pieces.”

Activity 7: Fraction Disc on the Ground
Classes IV, V, VI, VII

With the fraction disc on the ground show how equivalent fractions can be reduced to their simplest forms. E.g. ask children to point out $\frac{1}{12}$. Then they should point out $\frac{3}{12}$. Ask them: Can this be simplified? A child may realize that it is $\frac{1}{4}$ of the disc. Then write $\frac{3}{12} = \frac{1}{4}$. Go back to $\frac{2}{12}$ and ask if it can be written in any other way. Yes, it can also be called $\frac{1}{6}$. Practice this activity regularly.

Activity 8: Fractions in a Wall Clock
Classes IV, V, VI, VII, VIII

Look at a clock and see how many fractions it is divided into. Is this a day or $\frac{1}{2}$ a day? If so, then how can a whole day be represented in fractions? We say “The time is a quarter to eight” or “It is half past six”. How can you explain this?

How many minutes are there in an hour? How can you show 4 minutes in a fraction? How can you show 47 minutes in a fraction? How can you show 64 minutes in a fraction?
**Introduction**

Magic fascinates children. There are immense possibilities of magic with numbers. Once children start playing with numbers, their outlook towards math becomes positive. This leads to love for math. Using and making magic squares is one such way.

**Objectives**

1. To inculcate curiosity and creativity among children.
2. To develop strategies and logical thinking among children.
3. To work with positive and negative numbers.
4. To develop computation skills.
5. To see beauty in number and geometric patterns.
6. To persevere with math problems.
7. To develop attitudes of co-operation and sharing.
8. To understand mathematical vocabulary such as horizontal line, vertical line, rows, columns, diagonal and sum.

**Teaching-Learning Activities**

**Activity 1: 3 x 3 Magic Squares**

**Classes II, III, IV, V**

With chalk, the teacher should highlight a 3 x 3 square containing nine squares on the Grid Board adjacent to the chalkboard. He writes the numbers in each square as shown.

Children are asked to add up all the three numbers in each row, column and diagonals.

Amazing!! Every addition adds up to 15.
Teacher’s Role

- To provide number games for different ages and stages of children.
- To kindle an interest in math for number games.
- To encourage children to make their own games.
- To provide opportunities for sharing of math games and riddles for others.

Suggested Activities

1. 3 x 3 Magic Squares
2. Having Fun with Addition and Subtraction
3. Magic Patterns
4. 4 x 4 Magic Squares
5. Finding the Magical Sum
6. 3 x 3 Magic Square with Positive and Negative Numbers

Activity 2: Having Fun with Addition and Subtraction
Classes II, III, IV, V

A 3 x 3 block square can be highlighted with chalk on the Grid board as in Activity 1.

Children are asked to fill in the blanks. They are told that each row, column and diagonal must add up to 15.

The teacher will write the numbers as shown.

Blank magic square grids of different sizes (3 x 3, 4 x 4, etc.) to be made near the magic square guides.

Effectively using BaLA in Elementary Schools - A Teacher’s Manual
Activity 3: Magic Patterns

Classes III, IV, V

In a $3 \times 3$ matrix having 9 squares, ask children to use three numbers in such a manner that no number comes twice in any row and column. What happens when each row and column are added?

A similar activity can also be done with 3 alphabets.

Activity 4: 4 x 4 Magic Squares

Classes III, IV, V, VI

Fill in the following numbers on a Grid Board as you did for Activity 1 and 2. Now do the similar activities that were done in Activity 1 and 2.

Space for Notes
Activity 5: Finding the Magic Sum
Classes IV, V, VI, VII

How is the Magic Number worked out? In a 3 x 3 magic square there will be 9 numbers from 1 to 9. You can add them mechanically or by observing the pattern.

This is equal to 45. There are three rows and three columns, so the total of each will be 45 divided by 3, that is 15. So our Magic Number for a 3 x 3 square is 15. Now that we know the formula, children can now be asked to work out Magic Numbers for 4 x 4, 5 x 5 squares and so on.

Activity 6: 3 x 3 Magic Square with Positive and Negative Numbers
Classes VI, VII, VIII

Try to add each row, column and diagonal and see what you get!

\[
\begin{array}{ccc}
0 & 1 & -4 \\
-5 & -1 & 3 \\
2 & -3 & -2 \\
\end{array}
\quad \begin{array}{ccc}
1 & -10 & 0 \\
-4 & -3 & -2 \\
-6 & 4 & -7 \\
\end{array}
\quad \begin{array}{ccc}
0 & -1 & -3 \\
3 & -5 & -2 \\
-7 & 2 & 1 \\
\end{array}
\]

Magic sum = -3 \quad Magic sum = -9 \quad Magic sum = -4

Sample guide such as above can be used for children to identify visual patterns in the magic sum.
23 Tangram Tiles

Introduction
Tangram tiles are based on the geometric puzzle of seven pieces. It is a thousand year old puzzle from China. A square is cut into seven geometrical pieces. These seven pieces can be arranged in thousands of ways to create human figures, animals, geometrical shapes, alphabets, and so on. The essential condition is that all seven pieces must be used.

Your school may have Tangram Tiles on the floor or on the wall. You can have children trace the master tile and cut the square into 7 pieces. Or children can make their own cardboard square 15 cm x 15 cm and then cut the pieces.

Tangrams are simply another type of pattern. It is important to observe patterns used both in the natural world and the world made by us.

Suggested Activities
1. Tangram Puzzle
2. Tangram Day
3. Making Tangram Shapes
4. Making Difficult Tangram Shapes

Teaching-Learning Activities

Activity 1: Tangram Puzzle
Classes II, III, IV, V
Ask each child to make their own tangram with card sheet, thermocol, or rubber.
When it is made, take it apart, scatter the pieces and have the child put it back into a square.
Teacher’s Role

Following pages have examples of many patterns that can be made. Remember that all 7 pieces must be used to make a pattern. If you look at the patterns given, you will see patterns that have white lines in-between. This makes it easy to see which pieces are needed to make the pattern. Start with these patterns. Then ask children in higher classes to look at the patterns that do not have lines. They should make these patterns. Children can also make their own patterns. The teacher has to show the possibilities by giving children copies of patterns. You can also search the internet for more patterns. The teacher simply needs to encourage children to go ahead and experiment with shapes using the tangrams. It is also important to look at and praise children’s efforts.

If you notice that children have not made tangrams for a month, a small reminder will be in order. You can also suggest special projects saying “This week we will make tangram birds”. Next week you may want to make tangram animals.

Objectives

1. To promote understanding of geometrical shapes.
2. To think creatively.
3. To sharpen the power of observation and creativity.
4. To share and work together.
5. To learn to follow directions from the instructions / illustrations.

Activity 2: Tangram Day

Class III, IV, V, VI, VII, VIII

Special events can happen. Perhaps once a year, you can have a Tangram Day, where children make and display Tangrams.

Tangrams can be a part of a drawing or collage.
Activity 3: Making Tangram Shapes
Classes II, III, IV, V, VI
Ask children to make various shapes. Give the patterns with the ‘white lines’ and ask children to duplicate the patterns.
This forces children to observe the pattern very closely.

Tangram Alphabets and Numbers

Tangram People

Tangram Birds

Tangram Animals

Tangram Motifs

Tangram Boats

Solutions/patterns with white lines

Space for Notes
Activity 4: Making Difficult Tangram Shapes
Classes IV, V, VI, VII, VIII
Give the Tangram patterns that do not have white lines between them.
Ask children to make the patterns.
This is very challenging.

Tangram Alphabets and Numbers

Tangram People

Tangram Birds

Tangram Animals

Tangram Shapes

Tangram Boats
Introduction

What can children learn from brick and tile patterns on the floors and walls? There is mathematics all around us. It is often seen as an abstract subject but there are many concrete examples in our environment to help children become conscious of mathematical patterns from an early age.

We can see many beautiful brick patterns and jaali's around us in old buildings, temples and mosques. As repairs happen in your school, you could have the mason's replicate patterns that they have made or seen elsewhere. Maybe your school can have a museum of brick patterns on the wall or on the floor.

Suggested Activities

1. Making Brick Patterns
2. Drawing and Exhibiting Brick Patterns
3. Collection and Weight of Bricks
4. Estimation Using Bricks
5. Discussion: What is Beauty in Buildings?
6. Environmental Issues
7. Social Issues

Teaching-Learning Activities

Activity 1: Making Brick Patterns

Classes IV, V, VI

a) Real bricks are often lying around. They can be obtained or borrowed and children can lay these bricks against a wall and replicate brick patterns.

b) Miniature bricks can also be made out of clay or wood.

c) Children can design their own patterns.

These are common flooring tile patterns. If we assign numbers to the unique shapes, along the rows A, B, a range of number patterns will be visible, as shown.
Simple Brick and Tile Patterns

Complex Brick and Tile Patterns

**Teacher’s Role**

The teacher needs to be observant when repairs happen in school, or a new classroom is built. Are there any learning aids that can be incorporated into the building, the floor or the pathways? If your area is rich in stone or bamboo, you can find patterns in that too.

The teacher can design a part of his math curriculum around brick patterns. The class IV NCERT Math text book has a wealth of activities that can be used.

**Objectives**

1. To develop and enhance visual perception
2. To learn to observe closely and look for patterns in the world around
3. To develop fine motor co-ordination while copying patterns into grid / dot boards
4. To develop skills for visualizing and identifying the logical or mathematical basis for patterns and understanding the relationship of geometrical shapes
5. To look for patterns and writing a number sequence for them
6. When this number sequence has been written can it be used as a pattern for vocal music or drumbeats or with a flute?
7. To relate mathematics to the real world outside the text

**Activity 2: Drawing and Exhibiting Brick Patterns**

**Classes IV, V, VI, VII, VIII**

a) Children can take graph paper and draw brick patterns that are seen in their house or community. Be sure to mention where the pattern was found.

b) Children can put an exhibition of these patterns on a pin up board.
Activity 3: Collection and Weight of Bricks

Classes III, IV, V

Make a collection of different kinds of bricks found in your community.

a) What is the weight of bricks?

b) Ask a driver who carries bricks in his truck how many bricks a truck will carry.

c) What will be the weight of a load of bricks?

Activity 4: Estimation Using Bricks

Classes V, VI, VII, VIII

Count the bricks in a portion of the wall. Then estimate how many bricks have been used to make the wall.

Activity 5: Discussion: What is Beauty in Buildings?

Classes V, VI, VII, VIII

Have a discussion. What makes a building beautiful? Does a lot of money have to be spent to make a building beautiful? How can we make our school beautiful?

Who maintains the school building? Does maintenance have anything to do with beauty? Is there beauty in very simple buildings?

Activity 6: Environmental Issues

Classes V, VI, VII, VIII

All our needs for food, clothing and shelter come from our natural resources.

a) What are the natural resources used when a house is built?
b) How are these resources different than resources used to build a house one hundred years ago? Ask your grandparents and neighbours.

c) When resources are sourced from distant places does this place a burden on our environment? How?

Activity 7: Social Issues

Classes VI, VII, VIII

How have the artisans who build the building learned their trade? How much are they paid? Do they have bank accounts and savings? What happens on a rainy day? Approximately how many working days do they get in a year? How many people do they have to support?

Space for Notes