*Experimental Edition, for Limited Circulation only*

**CURRICULAR MATERIAL**
**FOR**
**DIPLOMA IN ELEMENTARY EDUCATION (D.El.Ed) COURSE**
**IN DIETs OF**
**ARUNACHAL PRADESH**

**Course Code: 05**

# PEDAGOGY
# OF
# MATHEMATICS AT PRIMARY LEVEL

**STATE COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING**
**GOVT. OF ARUNACHAL PRADESH**
**GOHPUR TINALI, VIDYA VIHAR, ITANAGAR**

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**The curricular material has been developed keeping in view the learning needs of the D.El.Ed Course trainees as per the current PSTE curriculum. While developing the material authentic textual/reference materials from various sources have been referred. As far as possible the content of the materials have been presented in an objective manner. The ideas and opinions as presented in the content of the materials are entirely of the developer of the material.**

# FOREWORD

The Diploma in Elementary Education (D.El.Ed.) curriculum for 2 year PSTE course of the DIETs in Arunachal Pradesh was revised and updated as an exercise deemed necessary in the context of National Curriculum framework-2005 and enforcement of Right to Education (RTE) Act-2009. The curriculum was revised on the basis of recommendations of the National Council for Teacher Education, National Curriculum Framework for Teacher Education (NCFTE) and the guidelines of Bordia Committee Report entitled "Implementation of RTE, Act and Resultant Revamp of SSA" (2010). Since 2013-14 the revised D.El.Ed Curriculum is being implemented in all the eleven DIETs of the state. However, in view of change in the structure and content of the revised curriculum, there has arisen a pressing need for content specific and contextualized curricular materials which could be handy for both teacher educators and student teachers of the DIETs in the state. Further Justice Verma Commission Report on Teacher Education-2012, constituted by the Hon'ble Supreme Court of India observed," our prospective teachers are educated through substandard readymade materials available in the form of 'guides' which are conceptually confusing and regressive in perspectives". Hence, the commission strongly recommended for development of learner friendly curricular materials for different types of teacher education courses.

The D.El.Ed curricular material has been developed in workshop situation with participation of Resource Persons from Department of Education, Rajiv Gandhi University, Itanagar and faculty members of SCERT and DIETs of the state.

I am immensely grateful to the Joint Director, SCERT, Mr. Gania Leij for his guidance, Professor Jaydev Sahu, Dept. Of Education, Rajiv Gandhi University, Itanagar for his academic support, members of SCERT Academic Team, Assistant Directors, Shri G.C.Baral, Sri S.Pradhan and Sri V.R.Sharma for supervision and finalisation of curricular materials. I am specifically thankful to the author on **Pedagogy of Mathematics at Primary Level Course Code-05, Sri V.K.Karan, Sr. Lecturer, DIET, Changlang** for his efforts in writing the texts of the course materials as per the need of the syllabus.

Lastly, it is hoped that the curricular materials will be highly useful as reference materials for the teacher educators and student teachers of the DIETs of the Arunachal Pradesh.

Moto Nyori, Joint Director SCERT, Itanagar

# ACKNOWLEDGEMENT

I acknowledge the invaluable suggestions of the participating colleagues of the 1-day consultative meeting on Development of Curricular Materials and 3-day workshop for Finalisation of Draft Curricular Materials held in the SCERT, Itanagar on 29th June 2015 and 26th to28th October'15 respectively.

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**V.K.Karan**

# INTRODUCTION

Primary mathematics education is one of the important parts of education in which the child is exposed to a formal learning experiences that are fundamental for further learning mathematics at next stage.

The National Curriculum Framework (NCF), 2005, recommended that children's life at school must be linked to their life outside the school. For that teacher needs to develop his/her understanding of mathematics with new initiative so that learning takes place among children and they will able to use it in their practical life situations.

The aim of pedagogy of mathematics at primary level is to sensitize the prospective teacher to transact mathematical content at primary level linking to children's immediate environment and their past experiences. Keeping in view the curricular material for pedagogy of mathematics at primary level has been presented content/ sub contents unit wise to the student-teachers and discusses how best teaching point can be made interesting by adopting constructivist and activity oriented approach. Besides, this would update them on various issues like status and new directions in teaching mathematics, Basic of Evaluations, Evaluation of student learning, cornerstones of mathematics teaching, teaching of specific contents relating to Numerals, Fractions, Measure, Geometrical shapes and representations.

The curricular material is of its first kind since the inception of 2 years DDPE/D El. Ed Course in (2003-05) session to cater the need of student-teachers of 11 DIETs of our state.

The problem that they face was inadequacy of curricular material in accordance with the course content in mathematics. They were totally dependent on classroom teaching and the information received during the course of interaction.

Therefore, the Department of Elementary Education, Govt. of Arunachal Pradesh felt need and decided to develop such material in the interest of prospective teachers and the responsibility came to us through the SCERT, Itanagar. We took help of contextual and reference materials in developing the material and tried to give the best.

The materials suggested for most of the activities are easily obtainable and available. However, in the event of no availability of any specific material in a given situation, alternate materials can be used.

It is hoped that student-teachers of DIETs would find the material useful in construction of knowledge and understanding of the contents.

This curricular material is exclusively for the use of only student-teachers of DIETs of Arunachal Pradesh. It is not for sale and marketing.

Any comment and suggestions is most welcome for further improvement.

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## UNIT-I

## Mathematics in School Curriculum:

Mathematics is an important subject in school curriculum. It is more closely related tour daily life as compared to other subjects. Except of our mother tongue there is no other subject which is more closely related to our daily life as mathematics. Plato advocated the inclusion of mathematics in the school education because mathematical reasoning disciplines the mind. The Indian Education Commission (1964-66) emphasised the importance of mathematics in school curriculum in view of the importance of quantification and the advent of automation and cybernetics in the scientific and industrial revolution.

### 1.1. Need and importance of mathematics at Primary Level.

Mathematics has played a pre-dominant role not only in advancement of civilization in general but also in the development of physical sciences and has now far wider application in other branches as well. Mathematics has been an inseparable part of school curriculum ever since the beginning of formal education and it continues to be so. The mathematics curriculum has undergone various changes from time to time in accordance with the changing needs of society. Realising the need of the social necessities Kothari Commission (1964-66that ) recommended that Mathematics should be taught as a compulsory subject of general education up to class X.

In this era of science and technology, a strong base of mathematics is considered to be an absolute necessity for all. Its knowledge in various forms from elementary to advance level is required in every walk of life, whether it is in home, business, industry, government, NGO, computer or decision making. It has been recognised all over the world that every citizen needs to be equipped with certain basic mathematical knowledge and skills. Therefore, mathematics has been become a part of universal education and has been made a compulsory subject of study from class I to X.

It is impossible to think an activity without the use of mathematics, whether it is any un-skilled work like digging of earth, loading and unloading of goods, grazing of animals, labourer working in factory or any skilled work like measurement, mechanical work, calculation etc. It is often only by the use of measurement function of mathematics that one is able to describe physical objects and events. No economic activity can be performed without mathematics. Mathematics is, therefore necessarily required to be learnt by all.

Mathematics not only helps in day- to- day situations but also develops logical reasoning, abstract thinking and imagination. It enriches life and provides new dimensions to thinking. NPE 1986 mentioned that mathematics should be visualised as the vehicle to train a child to think, reason, analyze and to articulate logically. Apart from being a specific subject, it should be treated as a concomitant to any subject involving analysis and reasoning. The National Curriculum framework (NCF) 2005 mentions that the goal of mathematics education in schools is the mathematization of child's thinking. Clarity of thought and pursuing assumptions to logical conclusions is central to the mathematical enterprise.

## 1.2.Objectivities of teaching mathematics at Primary Level:

**Activity: 1**
**Q. Think over the situation of a farmer. In which ways he uses mathematical knowledge in his day-to- day activities.**

The objectives imply the changes that we try to bring about in the children. It is a statement of what students should be able to do at the end of the learning period that they could not do before hand. According to NCERT's Evaluation and Examination issue "An objective is a point or end in view of something towards which action is directed, a planned change sought through any activity what we set out to do."

There are following objectives of teaching Mathematics at Primary Level.

(i) Ability to perform computation with speed and accuracy.
(ii) Ability to translate a verbal statement (a) in mathematical form using appropriate symbols and (b) diagrammatically.
(iii) Ability to make reasonably good approximations and estimate measurements.
(iv) Ability to apply mathematical concepts and skills to solve simple problems day-to-day life.
(v) Ability to think logically and
(vi) Ability to recognise order and pattern.

## 1.3.Instractional objectives at primary level in Mathematics.

Instructional objectives are narrow and psychological in nature. They may be achieved in a certain period in the classroom. These are related with the expected change in the behaviour of the students. So, they are called behavioural objectives. They give directions to the teacher in designing her instruction, guide the examiner in selecting suitable evaluation techniques and help the students in knowing what is expected of them after completing the period of learning**.**

- **Knowledge objective:** The pupil acquires knowledge of terms, concepts, symbols, definitions, principles, processes and facts.
- **Understanding objective:** The pupil develops understanding of terms, facts, symbols, concepts, definitions, principles and processes.
- **Application objective:** The pupil applies his/her knowledge and understanding of mathematics to unfamiliar or new situation.
- **Skill objective:** The pupil is able to draw various geometrical figures. He develops skill in reading table and graph etc. He develops skill in computation.

## 1.4. Influence of socio-cultural background on mathematical knowledge:

In our society, people of different culture, religion, region, language and cast live together. They carryout different type of activities for different purposes such as construction of houses, worship places, celebration of festivals and marriage ceremony, decoration, games and sports, drawing, painting, farming, marketing, cooking foods etc. They use mathematical concepts in these

activities like geometrical shapes, numbers, patterns and designs, symmetries etc. The children live in such societies. They observe the environment around them and interact with the people. Some times without knowing the mathematical concept they use many geometrical shapes and designs like empty containers, wheel, bamboo design, Rangloli Chakra, Swastik etc. It helps them construct mathematical knowledge. Study of individual's behaviour without a study of world in which he/she lives in, is incomplete. For this, one has to know about the civilization as well as cultural heritage of the concerned society. Mathematics is associated with the cultural heritage of each country. Our country has a mathematical heritage which we proud of. The numerals, decimal system of numeration and zero etc. Which the whole world is using today are the gift of ancient Indian mathematicians. The glorious name of some famous mathematicians are Sridhara, Bhaskara Charya, Varah Mihira, Arayabhatta, Brahmagupta and Ramanujam. Pupils need to be inspired by the works of these great mathematicians. Many mathematical inputs are available in the historical buildings and forts in our country. These are learning resources for our children. As we know the constructivist paradigms based on the assumption that knowledge is subjective and learners construct knowledge in the social and cultural environment in which they are embedded.

## UNIT-2

## Methods of Teaching Mathematics:

Method deals with "How to impart mathematical knowledge?" "How can I enable children learn mathematics? What is the best method? These are some questions for which every teacher has to find a solution."

The word 'method' has been derived from Latin word which means "Mode" or "way." It means method of delivering knowledge and transmitting mathematical skills by a teacher to his pupils and their comprehension and application by them in the process of learning mathematics.

According to Brondy, "Method refers to the formal structure of the sequence of acts commonly denoted by instruction. The word/term method covers both strategies and techniques of teaching and involves the choice of what is to be taught."

A teacher has different methods and techniques available for use in teaching mathematics. The selection of a suitable method depends upon the objectives of the lesson, needs of the learner and the nature of the content.

### 2.1. Inductive – Deductive method:

- **Inductive Method:** Inductive method is based on induction. Induction is a process of proving a universal truth by showing that if it is true for a particular case and is further true for a reasonably adequate number of cases, it is true for all such cases. By this method, thus, formula or generalisation is established through a convincing process of reasoning and solving problems. In this method we proceed from concrete to abstract, particular to general and from example to general rule or formula.

**Steps in Inductive Method**

i. Presentation of specific examples.
ii. Observation.
iii. Generalization
iv. Testing and verification.

| | |
|---|---|
| **Example:** 1(odd) + 3(odd) = 4 (even) | 1 + 5 = 6 (even) |
| 3(odd) + 5(odd) = 8 (even) | 3 + 9 = 12 (even) |
| 5(odd) + 7(odd) = 12(even) | 17 + 19 =36 (even) |

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In each case, the sum of two odd numbers is an even number. Then we conclude that sum of any two odd numbers is an even number.

**Merits of Inductive Method:**

- It helps understanding
- It is a logical method and develops critical thinking
- It encourages active participation of the students in learning.
- It provides ample opportunities for exploration and observation
- It sustains the students interest as they proceed from known to unknown
- It enhances self confidence

**Demerits of inductive Method:**

- This is a very slow process, so gaining knowledge by this method costs more time and labour
- Its application is limited to very few topics in mathematics where actual observation of the particular instances is possible
- It is not suitable for higher classes because higher order mathematical principles cannot be generalised through the observation of concrete cases

- **Deductive Method**: Deductive method is the opposite of inductive method. It is based on deductive reasoning. Deductive reasoning is the process of drawing logical references from established facts or fundamental assumptions. In this method we proceed from general to particular, abstract to concrete and from formula to examples. We begin with the formula or rule or generalization and apply it to a particular case.

Example: If length and breadth of a rectangle is 6m and 4m respectively, then find out the area of rectangle.
Here , students are told the formula for finding area of rectangle and then the values of length and breadth are put in the formula.
Area of rectangle = (length X breadth) sq. Unit
= ( 6m X 4m)
= 24 sq. Metre.

Merits of Deductive Method:

- It saves time and labour of the teacher and student
- It enhances speed, skill and efficiency in solving problems
- By deductive method creaming power of students increases.
- It is adequate especially at the revision and application stage
- It is the complement of inductive method
- This method is short as well as practical

Demerits of Deductive Method:

- It does not suit the child because it does not make him an active participant in the process of learning
- It encourage rote memory

- It is not suitable for beginners
- It is not suitable for the development of thinking, reasoning and discovery
- It is not in accordance with psychological principles
- It is useful for higher classes

**2.2. Play-way Method:** Play- way method is based on the principle- learning while playing. At first, the educationist Frobel recognised the importance of play in education and he tried to make it play centred. He suggested that all the knowledge should be provided to the pupils by play – way method because play is a natural instinct of the children. Children have interest in play by birth. While playing pupils recognise their own needs, they help in planning activity; accept guidance and set up their own goals. In this method children participate joyfully and due to their mutual cooperation, maximum amount of learning lakes place. It helps in developing desirable attitudes and skills. It gives confidence to learners and ultimately motivates them towards mathematics learning with interest. So, it is a psychological method and is suitable for primary classes. It leads to all round development of child**.**
Example: Describe an activity for counting by game.

Merits of Play way Method:

- Play way method is a psychological method of teaching
- It leads to the all round development of students
- The knowledge gained through this method is stable
- It develops sportsman spirit in students
- It is based on the principle of "learning by doing"
- It is suitable for primary classes

Demerits of Play way Method:

- It takes much more time because of play way activities and time for teaching remains less. Sometimes it becomes problem to complete the syllabus in time.
- Through play way method, students stay away from objectives. Generally, students become so busy in games as they make it their aim.

**2.3. Project Method:** Project method is considered to originated from America and product of John Dewey's philosophy of Pragmatism. A project is defined as a problematic act carries to completion in its natural setting. A problematic situation arises, there is a felt need to solve the problem. All the pupils under the guidance of the teacher set about trying to find a solution of the problem. In the course of this process the pupils learn things. They will be able to remember what they have learnt because of actively participated in the solution of the

problem. This method provides a real situation in which activities are conducted purposefully to reach a solution. The solution provides knowledge to the child. It provides opportunity to a child to be an active learner. It leads to an activity based learning programme. Dr. Kilpatrick, an American educationist, developed and applied practically for teaching.

- **Steps of Project Method:**

  i. Providing a situation.
  ii. Selecting and purposing of the project.
  iii. Planning the project
  iv. Evaluating the project
  v. Recording of the project

**Example:** Some suggested projects in mathematics.

- Laying out a school garden
- Visiting a local industry
- Celebration of a festival

**Merits of Project Method:**

- It suits the learner as it is based on psychological laws of learning
- It provides scope for independent work and individual development
- The children remain active throughout the execution of the project
- It develops the value of dignity of labour because children perform physical as well as mental work.
- It provides for individual differences as the students can select the activity and work at their own pace
- It encourages practical application of the subject, making the subject functional and meaningful to the learner
- It provides opportunities for children to acquire a lot of skills- observation, reference, interpretation and so on.
- It develops cooperative feeling and group-interaction.
- The child realizes his responsibilities and duties.

**Demerits of Project Method:**

- It takes more time and is not possible to fit into the regular time table.
- The knowledge is not acquired in a sequential and systematic manner.
- It is an expensive method because it requires various resources.
- Text books and instructional materials are hardly available.
- For the success of this method the teacher should be resourceful and knowledgeable.
- Teaching is disorganised.

**2.4. Problem Solving Method:** Problem Solving Method, as the name indicates, begins with the statement of a problem that challenges the students to find a solution. This method aims at presenting the knowledge to be learnt in the form of a problem. Problems are presented in front of students in natural or simpler form.

There are progressive changes in the society and mathematics is a subject of problem. In this scenario, a child has to face a number of problems in day-to-day life. If children are taught mathematics by this method, they are expected to acquire the ability of solving daily life problems. This method is suitable for primary stage too.

- **Steps in Problem Solving Method:**

i. Identifying the problem
ii. Planning the process to solve the problem
iii. Executing the planned process
iv. Evaluating the solution

**Example:**

**Problem:-** Select three/four three digit whole numbers(both odd an even) between 100 and 999. Reverse the digit of each number and find the difference between the 'reversed' number and the original number. Can you draw the generalisation?

**Problem solution:-** The problem solving involves three main steps.

- Investigation of particular cases.
- Finding a pattern.
- Generalising.

i. Investigation of particular cases.

Let the three digit number be 365 (odd number). Reversing digits gives number 563.
The difference is (563 – 365) = 198 = 2 x 99 or 22 x 9.

If the three digit number be 246 (even number), reverse number will be 642.
The difference is (642 – 246) = 396 = 44 x 9 or, 4 x 99.

ii. Finding patterns.

Odd numbers

a. 365, (563 – 365) = 198 =2 x 99
b. 135, (531 – 135) = 396 =4 x 99
c. 357, (753 – 357) = 966 = 4 x 99
d. 159, (951 – 159) = 792 =8 x 99

Even numbers

e. 246, (642 – 246) = 396 = 44 x 9
f. 468, (864 – 468) = 396 = 44 x 9
g. 268, (862 – 268) = 594 = 66 x 9

iii. Generalising.

- Difference formed from numbers and their reverse is divisible by 99 and 9
- The difference is an even number in all cases.

**Activity:-**

| Discuss in a group situation on merits and demerits of problem solving method. |
|---|

| Activity: Describe a play-way activity for giving the concept of addition. |
|---|

| Activity: Select a project and discuss on different aspects of mathematics learning. |
|---|

**UNIT-3**

# Pedagogical Content knowledge

## 3.1. Numbers:

- **Number concept**: The idea of number is abstracted from the idea of 'collection' by putting question 'How many?' For example, a collection {†† } represents the number two. When the idea of number is to be communicated, there must be a name to represent this idea, Thus, the 'number' refers to an idea or concept where as 'numeral' is the symbol used to express the idea or concept. 2 is not a number but merely a symbol used to represent the concept of twoness. For example, each of the symbol '4', four, IV, 3+1, 2 x 2, 6-2, 8 ÷2 is a name for the same number i.e. numerals for the number 4. Similarly, numerals for the number five are: 5, V, 1+4, 6-1, 10÷2 etc.
- **Counting:** The basic idea behind counting is that objects of a well defined collection are matched one –two one with an ordered set of number names. Efficient application of this idea in real situations has a few requisites-matching objects of a common property, sorting and classifying objects and ordering the relevant collection in the same way.

  **Activity:**
  Purpose: To reinforce the process of counting.
  Materials Required: A boxful of small pebbles.
  Procedure: Give each child a handful pebbles, ask the children to count pebbles and tell how many pebbles each one has got. If any child does not count correctly, let him /her count again. After the children complete one round of counting, take back the pebbles and give different set of pebbles to each child for a fresh round of counting activity.

- **Natural Number**: It is believed that most of the earlier collections are taken from nature or the surroundings of ancient man such as herd of cattle, a bunch of arrows, a cluster of trees etc. For keeping their records they gave the name to these number ideas as natural numbers.
  So counting numbers are called natural numbers.

  The set of natural numbers are expressed as
  N= {1, 2, 3, 4, 5, 6, 7, 8, 9 .....}

  - The smallest number is 1 and there is no largest natural number.

- **Concept of Zero:** The children know numbers and so it is better for them to experience zero by using concrete materials.

  **Activity:** Suppose we have to kept three leaves on the table. One child is allowed to take away one leaf. Again another child is asked to take away one of them. One leaf remains there. Now the third child is asked to take away one leaf i.e. remaining leaf. Zero leaf remains. Finally the fourth child is said to take the left leaf. He immediately

replies that Sir/Madam, there is no leaf left over. This will show that zero of something is nothing i.e. absence of something.

Thus zero is not nothing, but it represents nothing. To represent the idea of zero, we use symbol '0'.

- Whole Number: We include '0' in the set of whole numbers. So whole numbers are:
  W = { 0, 1, 2, 3, 4 .....}

| |
|---|
| The smallest whole number is 0 and there is no largest whole number. |

- **Place value:** We need only ten numerals or digits 0,1,2,3,4,.....9 to write a number, science the magnitude of each digit depends on its position. Therefore, the system of assigning numerals to numbers is a base ten system, the Hindu Arabic system, using positional (or place) value. There is a numeral for itch number from one to nine. But when we go to beyond nine i.e. ten(taking one object along with nine objects), there is no single numeral to represent it. Hence, a place is created to the left of the place where numerals used to be written representing numbers from one to nine. This newly created place is known as ten's place. The symbol 1 in this place represents the number ten. The place where the numeral representing the numbers from one to nine used to be written is assigned the name unit's place. These places will be used for writing numbers up to ninety nine.
  One hundred = 10 tens.

  The capacity of each place is to carry up to the numeral 9 only. Hence, we feel the necessity of a 3rd place to the left of the ten's place and so on.

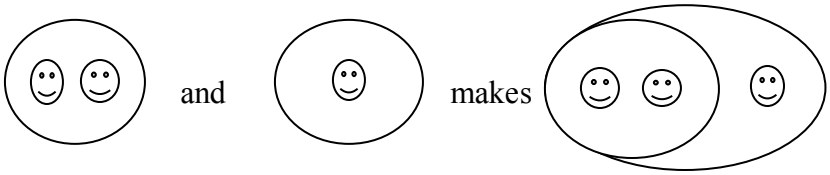
| | | Thousand's place | Hundred's place | Ten's place | Unit's place |
|---|---|---|---|---|---|
| | | | | | |

  The weightage of the places goes on increasing in order as unit's place, ten's place, hundred's place and so on.

- **Fundamental operation on whole numbers:** Addition, Subtraction, Multiplication are division are the fundamental/basic operations associated with whole numbers. We can say that there are four fundamental operations.

  **a. Addition:** The concept of addition is putting (combining ) collections of things together and recounting.

**Example:**




2 + 1 = 3

Or, we can write as 2 ← addend

Symbol → + 1 ← addend
(plus sign)

For addition 3 ← sum

Addition is counting for ward

**b. Subtraction:** There are three aspects of concept of subtraction as the process of

- Taking away:
  Example:


2 1 1

i.e., 2-1 = 1

2 ← minuend
symbol - 1 ← subtracted
(minus sign)

1 ← Difference

- Comparison: Yana has 4 pencils. Lanthai has 2 pencils. How many more pencils does Yana have than Lanthai? i.e. 4-2 =2

- Complementary addition: Yana has 4 oranges. Lanthai has 2 oranges. How many more must Lanthai take to have the same number of oranges as Yana?

  i.e., 2 +2 = 4

| | |
|---|---|
| → | Subtraction is counting backward. |
| → | Inverse operation of addition |

**c. Multiplication:** The conception of multiplication can be related to the arrangement of things in an array.

**Example:** Somia has arranged 12 glasses as show in figure (1).

See how the glasses are arranged
12 = 4 x 3 so there are 4 rows
with 3 glasses each.

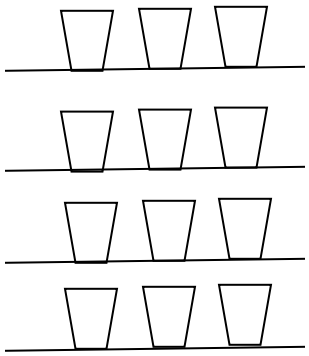


Fig (1)

Now she arranged 12 glasses in different ways.

12 = 2 x 6

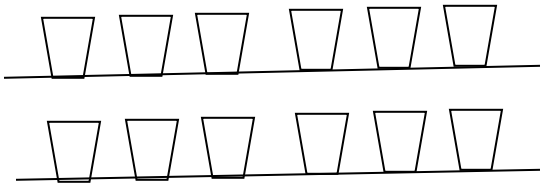


Fig (2)

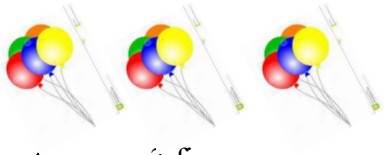
Hence, there are 2 rows with 6 glasses. So, multiplication is arrangement of things.

- Multiplication is taken as repeated addition.

Example:

1 bunches has 5 balloons

Q. bunches have 5+5+5= 15 balloons



We put question. How many 5s? We except answer 3 fives.
So, 5+5+5 = 3 x 5 = 15

We say 'three fives are fifteen'. So multiplication is repeated addition of the same number. 3 is called the 'multiplier', 5 is the 'multiplicand' and 15 is the product**.**

**d. Division:** The concept of 'Division' should be introduced through concrete experience of 'equal grouping', 'equal sharing', 'ratio' and inverse of multiplication.

- **Equal Grouping:** Situation in which we need to find the number of portions of a given size which can be obtained from a given quantity.

**Example :** There are 25 children in a class. We want to make a group of 5 children. How many groups do we have in all?
25 ÷5 =5
i.e.5 groups.

- **Equal Sharing:** Situations in which we need to find out how much each portion contains when a given quantity is shared out in to a number of equal portion.

**Example:** Nabam has Rs.60. He wanted to divide among his 3 sons. He asked his eldest son to all how much money will each will get.
60 ÷3 =Rs.20.

- **Inverse of multiplication**: Division is taken as reverse process of multiplication.

  **Example:** 3 x 5 = 15 = › 15 ÷3=5 and 15÷5=3

  Thus to answer 12 ÷4=? Answer is given as 4 x ? =12
  12 ÷4=3, . ˙ . 4 x 3=12
  We say 12 is divisible by 4.

| Each multiplication fact gives two division facts. |
|---|

- **Division:** It is the process of repeated subtraction.

  **Example:**

  28 ÷7 = ?

  28
  \- 7 one 7 is taken
  ---
  21
  \- 7 one 7 is taken
  ---
  14
  \- 7 one 7 is taken
  ---
  7
  \- 7 one 7 is taken
  ---
  0

  Q. How many times 7 has been subtracted from 28?

  Answer: 4 times.

  So, Quotient = 4
  Dividend = 28
  Divisor = 7
  Remainder = 0

**Example:** Now 22 ÷ 7 = ?

22
- 7 one 7 is taken

15
- 7 one 7 is taken

8
- 7 one 7 is taken

1

Q. How many times 7 has been taken (subtracted) from 22 ?
Ans. 3

Q. What left?
Ans. 1

So, Quotient = 3
Dividend = 22
Divisor = 7
Remainder = 1

| Dividend = Divisor X Quotient + Remainder |
|---|

- **Factors:** The concept of factors may be given by dividing a number by another number.

Q. How many natural numbers are there which divide 4 exactly?
Ans. 1,2,4
Q. How many natural numbers are there which divide 15 exactly?
Ans. 1,3,5,15.

We find that 1,2,4 and 1,3,5,15 are natural numbers which divide 4 and 15 respectively in exact way.
So, 1,2,4 are factors of 4 and 1,3,5,15 are factors of 15.
Hence, if a number 'X' is divisible by 'Y' exactly, then 'Y' is said to be factors of 'X'.

| ⇨ A factor of a number is an exact divisor of that number.<br>⇨ 1 is the factor of every number.<br>⇨ Every number is a factor of itself. |
|---|

- **Multiples:** Left as take an example of multiplications.

Q. □ x 1 = 3
Q. □ x 2 = 6
Q. □ x 3 = 9
Q. □ x 4 = 12
Q. □ x 5 = 15

---
---

The numbers 3,6,9,12,15 .....are obtained by multiplying 3 by 1,2,3,4,5 ..... So, 3,6,9,12,15.....are called multiples of 3.

Hence, multiple of a number is obtained by multiplying the number successively by1,2,3,4.....
Let us take a multiplication fact 3 x 4 = 12
It means 12 is a multiple of 3 and 4 both.
i.e. 12 is a common multiple of 3 and 4.

- **Highest Common Factor(HCF):**
  The Highest Common Factor of two or more numbers is the highest of their common factors. Highest common factor is also known as greatest common divisor.

  **Steps of HCF**

  i. Find factors of given numbers
  ii. Find common factors
  iii. Find the highest common factor.

  Example: Find the HCF of 12 and 18
  Solution: Factors of 12 are: 1,2,3,4,6,12
  Factors of 18 are: 1,2,3,6,9,18
  Common factors of 12 and 18 are; 1,2,3,6
  Highest of common factor is: 6

  Methods for Finding HCF of two or more numbers
  i. Method of Factorization
  ii. Continued division method.

  Example: Find the HCF of 16 and 24
  Solution: 16 = 2x2x2x2
  24 = 2x2x2x3
  The common factors are 2,2, and 2
  ∴ HCF = 2x2x2 = 8
  We can also find the HCF of 16 and 24 by using continued divison as under:

```
16 )  24  ( 1
   -  16
   ---------
      08) 16( 2
        - 16
   ---------
      00 (last remainder)
```

  The last divisor 8 is the HCF for which the last remainder is 0.

- **Lowest Common Multiple(LCM):**
  The Lowest Common Multiple of two or more number is the lowest (or smallest or least) of their common multiples.
  Example: Find the LCM of 3 and 4
  Solution: Multiples of 3 are; 3,6,9,12,15,18,21, 24,27,30,33,36.....
  Multiples of 4 are: 4,8,12,16,24,28,32,36.....
  Common multiples are: 12,24,36.....
  Lowest common multiple is 12

Methods of finding LCM of two or more numbers:

i.Prime factorisation method.
ii. Common Division Method.

Example: Find the LCM of 24 and 40

Solution: Here $24 = 2x2x2x3 = 2^3 x3^1$ and $40 = 2x2x2x5 = 2^3 x5^1$

There are three primes 2,3 and 5 and their highest powers are 3,1 and 1 respectively.

$\therefore$ LCM $= 2^3x3x5 = 120$

LCM can also be found by common division method.

Example: Find the LCM of 6,12,20

| | |
|---|---|
| 2 | 6,12,20 |
| 2 | 3,6,10 |
| 3 | 3,3,5 |
| 5 | 1,1,5 |
| | 1,1,1 |

So, LCM = 2x2x3x5 = 60

Relation between LCM and HCF

The product of the HCF and the LCM of two numbers a and b is equal to their product a x b

Ie. HCF x LCM = Product of the numbers = a x b

So, $HCF = \frac{a \times b}{LCM}$

$HCF = \frac{a \times b}{HCF}$

Example: the HCF of 24 and 40 is 8 and the LCM of 24 and 40 is 120

$\therefore$ HCF x LCM = 8 x120 = 960

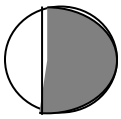
Also, 24 x 40 = 960

$\therefore$ HCF x LCM = Product of the numbers.

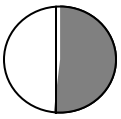
- The HCF of given numbers is smaller than or equal to the smallest number.
- The LCM of given number is greater than or equal to the largest of the numbers.

3.2. **Fractional number:**

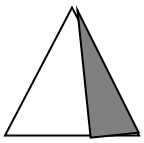
- Concept of fractional through paper folding: The concept of fraction is developed on the basis of parts of a unit/ whole,
- **Concept of one half ( ½).** At first , the children are given opportunity to observe the following figures in which they will see two unequal/equal parts of a whole. They will be able to identify two equal parts of a unit/whole.



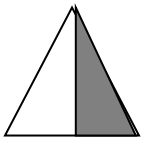
Two unequal parts



Two equal parts



Two unequal parts



Two equal parts

**Activity:** We take rectangular sheet of paper. We give one fold by matching two opposite edges so that two parts will cover each other well. Now we unfold it. It is observed that the paper is divided into two equal parts shown by a dotted line and we get one half other whole.

Half half

(½) (½)

one half ( ½)

-------- 2 halves

$^{2}/_{2(\text{whole})}$

Q. Describe another activity for one half

- Concept of one fourth($^{1}/4$): A rectangular sheet of paper is folded as shown in the figure to give the idea of one forth.

One forth one forth

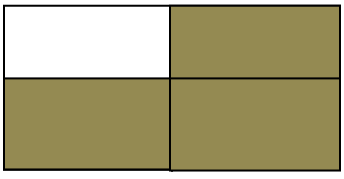
One forth

(¼)

- Concept of two fourths, three fourths and four fourths: from the above two folding of the rectangular sheet of paper the concepts of two fourth three fourth and four fourth are given:

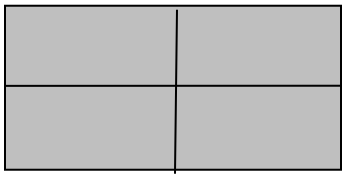
Shades parts show two fourths `

($^{2}/4$)



Shaded parts show three fourths

($^{3}/4$)

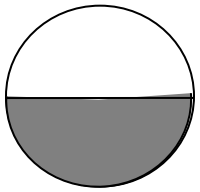


Shaded parts show four fourth (a whole)

($^{4}/4$) or 1

| Activity: Describe an activity to show one third ($^{1}/3$) , two thirds ($^{2}/3$) three thirds($^{3}/3$) or a whole through paper folding. |
|---|

The word 'fraction' has been derived from a Latin word which means to break. A fraction is a part of whole. It may be a part of a thing or a collection of things. The use of fraction is done to express different parts of whole. If we divide a thing or a collection of things in to two equal parts then each part is represented by ½. Similarly if it is divided into four equal parts then each part is read as ¼. In the same way we can say about $^1/3$, $^1/5$, $^1/6$ etc.
A fractional number is Witten by separating two numerals, one over the other, with a line '____'. The numeral which is written above the line is called 'numerator' and one written below the line is known as 'denominator'.
Suppose we divide a circle into two equal parts as given below;

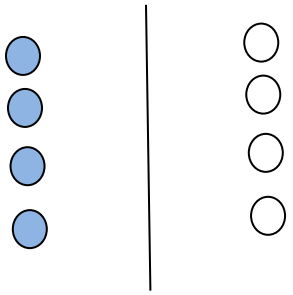


½

The shaded portion is represented by fraction ½ which means the whole circle is divided in two equal parts and one of the parts, taken. So, in a fraction, the denominator tells that the number of parts into which the whole has been divided and the numerator tells how many parts has been taken.
Therefore, if a fraction is represented by $\frac{p}{q}$ then we mean

p ⟶ Numerator ⟶ Number of parts taken
q ⟶ Denominator ⟶ Number of equal parts made

**Activity**: Represent the following collection of beads by a fraction:



- **Kind of fractional number:**

  **Unit fraction:** A fraction whose numerator is 1, is called unit fraction:

  **Example**: ½, $^1/3$, $^1/4$, $^1/5$

  **Proper fraction**: Fractions in which numerators are smaller than denominators, are called proper fractions

  **Example:** ½, $^2/3$, ¾, $^3/5$, $^5/7$, $^3/8$.....

**Improper fraction**: Fractions in which numerators are greator than or equal to the denominators, are called improper fractions,

**Example**: $^{1}/1$, $^{2}/2$, $^{3}/2$, $^{5}/2$, $^{7}/3$,$^{8}/5$.....

- **Mixed fraction**: When an improper fraction is expressed as the combination of whole number and a proper fraction. It is called mixed fraction.
  An improper fraction is converted into mixed fraction by division method.
  **Example:** Convert the improper fraction $^{3}/2$ into mixed fraction.

**Solution:**

$$\begin{array}{r} 1 \\ 2\overline{)\ 3} \\ -\ 2 \\ \hline 1 \end{array}$$

Here, Quotient= whole number i.e. whole No = 1.
Remainder = 1

$\therefore$ $^{3}/2 = 1\ ½$ = Quotient, $\frac{\text{Remainder}}{\text{Divisor}}$

- **Like friction:** What do you observe in the following fractions?

  $^{1}/2$, $^{3}/2$, $^{5}/2$, $^{7}/2$, $^{9}/2$.$^{11}/2$

  We find that denominators of all the above frictions are same. So, they are called like fractions.

  | Fractions with the same denominators are called like fractions. |
  |---|

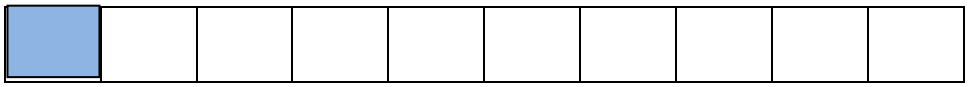
- **Unlike frictions**: Look at the following fractions.

  ½, $^{1}/3$, $^{2}/5$,$^{3}/7$,$^{4}/11$

  What do you notice here? The denominators of above fractions are different. So, they are unlike fractions.

  | Frictions with different denominators are known as unlike fractions. |
  |---|

**3.3. Decimal Numbers**: Observe the rectangular bar. Represent the shaded portion by a fraction.

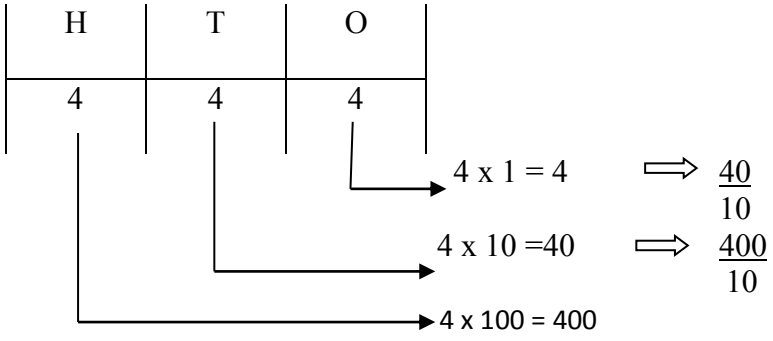


It is represent as a fraction $\frac{1}{10}$ ie one tenth

Q. Harku has 3 apples. He is to distribute equally among his ten friends. What part of the apple will each friend get?

Solution: Each friend will get $\frac{3}{10}$ part of apple ie 3 tenths.

Now observe the number 444.
444 is written according to the place value chart. We get the value of all 4s.




In the above explanation, it is clear that the value of each digit increases ten times as it moves one place to the left. In the reverse order, the value decreases ten times as digit moves to the right ie the value becomes one tenth. If we continue moving the digits to the right after the one's place, the value of the next one would not be a whole number but $\frac{1}{10}$ th of a whole.

Similarly moving further the next one would be ten times less i.e. $\frac{1}{10 \times 10} = \frac{1}{100}$ th of a whole.

In this way we get a place value chart and representation of number 4444.444 as

| Th | H | T | O | Tenths | Hundred ths | Thousand ths |
|---|---|---|---|---|---|---|
| 4 | 4 | 4 | 4 | $\frac{4}{10}$ | $\frac{4}{100}$ | $\frac{4}{1000}$ |

So, we can say it is extension of decimal system of friction. Decimal is represented by a small point (.). A decimal number has two parts- whole number part and decimal part. The two parts are separated by decimal point (.)

- Conversion of decimal number into fraction: Decimal number can be converted into fraction by using place value chart.
  Example: Convert 0.2 into fraction.
  Solution : 0.2 is reflected in the place value chart.

| Ones | Tenths |
|---|---|
| 0 | 2 |

Ie, $0.2 = 0 + \frac{2}{10} = \frac{2}{10}$

- Conversion of fraction into decimal; Let us consider an example

$$\frac{11}{5} = \frac{11 \times 2}{5 \times 2} = \frac{22}{10} = \frac{20+2}{10} = \frac{20}{10} + \frac{2}{10} = 2 + \frac{2}{10} = 2.2$$

Again we take another example:

Q. $= \frac{3 \times 20}{5 \times 20} = \frac{60}{100} = 0 + \frac{60}{100} = 0.60$

Thus, from the above examples we can conclude that fraction can be converted into decimals by making their denominators as 10, 100,1000 etc. And placing decimal point after one's place.

### 3.4. Four fundamental operations on fractional numbers addition and subtraction of fractional numbers:

For performing operation of addition and subtraction on fractional numbers, we convert them into equivalent fractions with the same denominator and then proceed.

**Example**: Add; $\frac{1}{2} + \frac{1}{5}$

**Solution:** LCM of 2 and 5 = 2 x 5 = 10

$\frac{1}{2} = \frac{1}{2} \times \frac{5}{5} = \frac{5}{10}$

$\frac{1}{5} = \frac{1}{5} \times \frac{2}{2} = \frac{2}{10}$

Now, $\frac{1}{2} + \frac{1}{5} = \frac{5}{10} + \frac{2}{10} + \frac{5+2}{10} = \frac{7}{10}$

**Example**: $\frac{1}{2} - \frac{1}{5} = \frac{5}{10} - \frac{2}{10} = \frac{5-2}{10} = \frac{3}{10}$

**Example**: $\frac{2}{3} - \frac{1}{12} = \frac{2 \times 4}{Q. \times 4} - \frac{1}{12}$ $\therefore$ LCM of 3 and 12 = 12

$= \frac{8}{12} - \frac{1}{12}$

$= \frac{8-1}{12}$

$= \frac{7}{12}$

$\therefore$ $\frac{2}{3} - \frac{1}{12} = \frac{7}{12}$

- **Multiplication of frictional numbers**:

**Example:** Find $^{2}/3 \times {}^{1}/4$

$$2/3 \times 1/4 = \frac{2 \times 1}{\text{Q. } \times 4} = {}^{2}/12 \text{ or } {}^{1}/6$$

**Example:** Simplify: $2\ 3/4 \times 1\ {}^{2}/5$

$$\text{Solution : } 2\ 3/4 \times 1\ {}^{2}/5 = {}^{11}/4 \times {}^{7}/5 = \frac{11 \times 7}{4 \times 5} = \frac{77}{20} = 3\ {}^{17}/20$$

| Product of two or more fractions $= \frac{\text{Product of numerators}}{\text{Product of denominators}}$ |
|---|

- **Division of frictional numbers:**
To divide a whole number by a fraction, multiply that whole number by the reciprocal of that fraction.

Example: $3 \div \frac{2}{5} = ?$

$$3 \div \frac{2}{5} = 3 \times \frac{5}{2} \quad (\text{reciprocal of } {}^{2}/5 = {}^{5}/2)$$

$$= \frac{3 \times 5}{2} = \frac{15}{2} = 7\ 1/2 \quad \text{Thus } 3 \div {}^{2}/5 = \frac{15}{2} \text{ or } 7\ 1/2$$

**Example:** Divide ½ by $^{1}/3$

**Solution:** $1/2 \div {}^{1}/3 = 1/2 \times {}^{3}/1$ (reciprocal of $^{1}/3 = {}^{3}/1$)

$$= \frac{1 \times 3}{\text{Q. } \times 1}$$

$$= {}^{3}/2 \text{ or } 1\ 1/2$$

Hence, $1/2 \div {}^{1}/3 = {}^{3}/2$ or $1\ 1/2$

- **Operations on decimal numbers**:
**Addition and Subtraction of decimal numbers**: We should take care of proper arrangement of digits. While dealing with the whole numbers, we should place digits according to their place ie ones below ones, tens below tens etc. Similarly tenths are placed below tenths, hundredths below hundredths and so on. The carrying and barrowing processes has to be performed in the same manner as we do in the case of whole numbers.

**Example:** Add: 24.35 and 35.52
Solution: 24.35
+ 35.52
59.87

**Example:** 3.7 + 5.32 = 3.70
+ 5.32
→ 9.02

**Example:** 32 .7 – 3.2 = 32.7
- 3.2
29.5

**Multiplication of Decimal numbers:** For multiplication of decimal numbers, we will used the process of multiplication of fractional numbers. First we convert them into fractions then we proceed.

**Example**: $0.2 \times 0.3 = \frac{2}{10} \times \frac{3}{10} = \frac{2x3}{10} = \frac{6}{10} = 0.6$

- **Division of Decimal numbers:**

**(i).Division of a decimal number by a whole number**.

Let us find $6.4 \div 2$

$6.4 \div 2 = \frac{64}{10} \times \frac{1}{2} = \frac{64 \times 1}{10 \times 2} = \frac{1}{10} \times \frac{64}{2} = \frac{1}{10} \times 32 = \frac{32}{10} = 3.2$

Or

2 ) 6.4 ( 3.2
- 6
0 4
-4
0

We perform the operation division as in the case dividing whole number (ignoring decimal point)

ii. **Division of decimal number by another decimal number:**

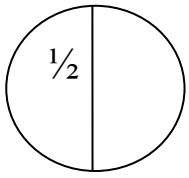
Let us find $\frac{25.5}{0.5}$ i.e. $25.5 \div 0.5$

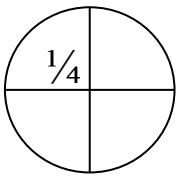
We have $25.5 \div 0.5 = \frac{255}{10} \div \frac{5}{10} = \frac{255}{10} \times \frac{10}{5} = \frac{255 \times 10}{10 \times 5} = 51$

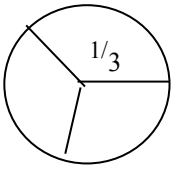
From above we conclude that decimals are converted into fraction and the we use the process of multiplication of frictions.

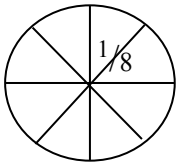
### 3.5. Use of friction dice and cubic rods:

Fraction disc consists of a square board with circular cut outs for showing different fractional numbers ½,1/3,1/4,1/8



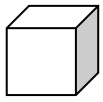



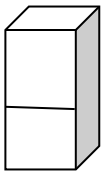

Friction disc serves as a very powerful aid for making the concept of fractions clear. These are used to understand the operation of addition and subtraction of frictions.

**Activity:** One of the children is asked to look for two equal pieces which cover the entire circular region. Now the teacher will tell that these two pieces are same circles representing half. By combing the pieces we get the complete circle i.e. ½ + ½ = 1 (whole).

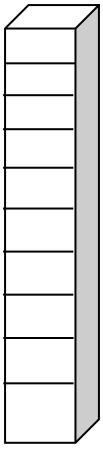
**Cubic rods**: Cubic rods are of different sizes- rod having one cube, 2 cubes, 3cubes,.....10 cubes.



1 cube rod

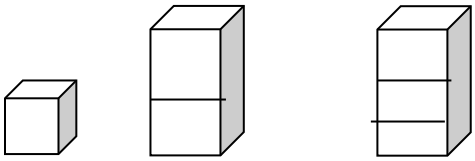


2 cube rod



10 cube rod

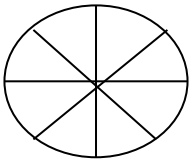
Cubic rods are used for counting , making pattern, addition etc



1 + 2 = 3

Check your progress

1. Can you suggest an activity to help a child get the concept of $^{1}/_{5}$?
2. What fraction is represented by the shaded portion?



3. Express as a decimal : $\frac{13}{10}$

# UNIT:4

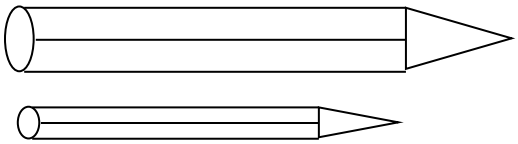
## Teaching of Measures

Measurement plays a significant in role in our everyday life. We carry out different activities related to length, distance, comparing things, weight, capacity, more area, time and temperature etc. To meet our need. The importance of measurement has been felt strongly from the beginning. The man used his body parts, stones, the sun and moon to measure lengths, weights time and predict seasons respectively. These units were not accurate. Gradually we felt to need to improve them. Child need to be made aware of which attribute of an object is being measured. Thus teaching of measures is very important to develop conceptual understanding of children regarding different aspects of measurement. Further they will be able to use necessary skills of measuring.

4.1. **Different unit of measurement**:

- **Length:** Children should have the concept of long, short, longer, shorter, same length, tall, taller, same height, near, far, nearer, farther, nearest, farthest, tallest etc. These are important prerequisite concepts. If they have no such concepts then remedial measure should be taken. Suitable examples should be selected from children's environment for explaining the above concepts.

**Activity:** Q. Find which pencil is shorter.



**Non standard units have an idea about length measurement.**
Some activities should be conducted with the active participant of children.

**Example**: Children should be asked to measure the length of an edge of a desk with the help of span.

**Example:** They are asked to estimate the length of the class room from one corner to another corner by using their pace.

Now the teacher asks children that whether you are getting the same length in examples. Certainly they will say no. He will make the point clear stating that the lengths of span and pace differ from child to child. Therefore we are getting different lengths of edge of a desk and length of the class room. Therefore we need a standard unit of measurement of length so that it will not depend on the person who is measuring it. Hand, foot, span, pace one non standard units of measurement. Thus standard unit of length is accepted by everybody worldwide.

**Standard units of measurement:**

First of all idea of centimetre will be introduced in the class by using 15cm scale. For this we need a small piece of thread. This will be put on the scale. The activity is repeated by taking threads of different size. After acquainted with centimetre, the metre scale will be introduced by using a measuring tape. They will find that

100cm =1 metre.

Centimetre, metre are standard units of measurement 'length'.

**The S.I unit of length is 'metre'.**

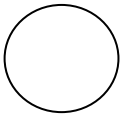
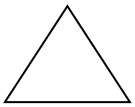
**Activity**: Measure the distance between the T.V and your bed using a measuring tape.

- **Area**: the students are provided life related situations to acquire the concept of area and its measurement.

  **Activity:** 1. Teacher asked pupils to observe the classrooms in the school. There are small and big classrooms. Small rooms accommodate less number of children while big rooms accommodate more. How does it happen? We are actually comparing their sizes i.e. Comparing the floor of the rooms. The floor of a room represents rectangular or square region.

  **Activity**: 2. Children are asked to take sheets of paper and spread them on the table top so that they will cover completely. How many sheets cover the table top? Suppose 6 sheets. Ask them to feel that the area of the table top is 6 sheets of the paper. Here, paper of sheet is unit and 6 is the area. Similar activity can be done by using post card. Children may observe and conclude that when the unit is large, the area is a smaller number and vice –vesa. The sheet of paper or the post card are informal units.

  **Activity**: 3. Teacher may ask students to draw different shapes of closed figure in their note books and shade the portion of the paper enclosed by the figures.

  In other words the area of a plane figure is the amount of surface enclosed by the closed figure or magnitude of a plane region enclosed by a simple closed figure.

  **Standard unit of area:** A square centimetre is the area of the region formed by a square of side 1cm. It is written as cm or sq. Cm. Other units of measuring area are sq. Metre, Square km, Acre, hectare etc.

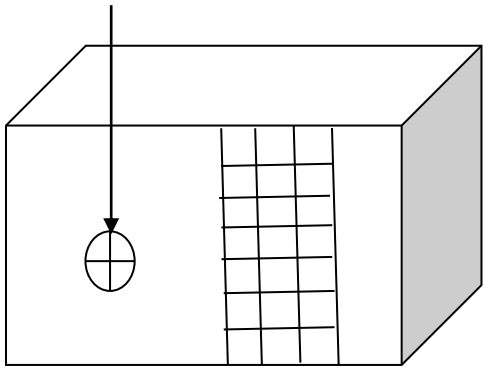
- **Volume:** Volume is a measure of space occupied by closed 3 dimensional objects such as brick, box, book, almirah, stone etc. Is their volume. Volume means amount of space occupied by these objects.

  **Activity**: To give the idea of occupied volume to the children collect stones, bricks, wooden blocksetc. Take a plastic bucket and keep water in it. Tie each of the objects with a thread. Now immerse them in water one by one. See whether level of the water rises equally always. Discuss with children on the following questions.

  - Why different levels are obtained?
  - When the water level is the highest?
  - Why this happens?
  - What is the relationship between the water level and the size of the object immersed?

  Once children get the idea of occupied volume they should be able to compare the volume of two objects. Comparison of the volume of two irregular objects can be done through the following activity.

  **Example:** Take two stones whose volumes are to be compared and rectangular glass vessel. Fill its ¾ th portion with water. Paste a graph paper strip vertically along its sides as shown below.



Now read the water level with the help of graph paper strip by counting the number of squares on it. Tie the stones with a thread. Immerse these stones into water one by one. Note down the changes in water level. Discuss with children on the following questions.

- When did water rise more?
- Why?
- Which stone occupies more space?
- Which has more volume? Etc.

The above activity may help children understand

- Every object, regular or irregular has sine.
- Bigger object occupy more space.
- Bigger objects cause more water to rise.
- An object bigger in size has more volume.

The capacity of a container is the volume of liquid, salt or sand it can hold. Teacher may discuss on the capacity of a container by providing day to day life situations such as bucket, cooker, bottle etc.

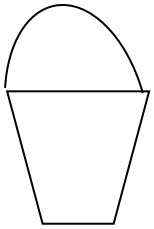
The standard unit for measuring volume may be introduced. Small unit cubes of measurement 1cm x 1cm x 1cm may be used for the purpose. It is written as 1cubic cm or 1cm 3. Other standard units of measuring volume are cubic metre ($m^3$) , cubic feet (cft) litre etc.

- **Weight**: A child first experiences weight or heaviness when he puts some effort to pull, push or lift an object. Children should be provided experiences through activities which help them realise that we need to decide which object is heavier and which one is lighter. The concept of heavy and light, thick and thin solids, more heavy, less weights of different objects should be explained by taking examples from daily life situations.
  **Example:** The teacher gives two objects pencil and book to a child. He asks him to hold them on his palms. Let the child observe and answer which object is heavier? Book or pencil. In this way he will be able to compare objects and acquire the concept of heavy, light, heavier and lighter.

Now children are given opportunities for ordering objects. In this connection three or more objects of varying weight are given and ask them to arrange in order of weight by direct handling. The teacher will introduce the terms heaviest and lightest.

Flask

Tiffin box



Bucket with water

Children observe how different quantities of things are used in everyday life for cooking food. For example rice, pulse, atta, vegetable, oil etc. They find specific amounts of these things are needed to cook them. When the teacher discusses with children on this, they can be made known how things used very in quantity which depend on how heavy they are one spoonful of salt is less in quantity than two spoonfuls on salt. Quantity of rice in a bowl depends on the size of the bowl. Through this process they will realise the need to determine the quantity of the object. Children will intuitively understand the attribute mass (generally we call it weight) and the process of measurement of mass using the concept of capacity. At elementary stage we should not give emphasis on the difference between mass and weight.

Children should be shown a two pan beam balance to weigh objects using stone and beads. They will have an idea of non standard units after using it. Some stones will be heavier so that quantity of mass kept in a balance is noticed by the children. More quantity and less quantity are obtained by placing heavy stones and light stones respectively.

The pan containing heavier object will be lower. When the beam balances we say that the two objects are of same weight. Lighter bodies are lesser in weight than heavier bodies.

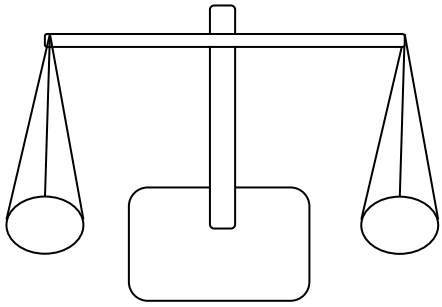


Fig. Two pan beam balance

It will be easier for children to understand the term mass/weight after having these experiences.

| Mass: The amount of matter in any substance is call the mass of kilogram. |
|---|

Standard units of measurement of weights are milligram, gram, kilogram etc. Kilogram(kg) is the Standard International (S.I) unit for measuring weight/mass.

- **Time:** Most of children have a rough idea about time. For example, when a child gets up in the morning and find other family members are still in the bed. He says, oh! I got up early. He use the world 'early' which is related to time. Children use several time-related worlds to compare the time taken for different activities such as a child says that I am waiting for a long time on the bus stand to catch the bus.

Foe developing understanding of time, the teacher should organise activities or discussion to make children learn words: Yesterday, today, tomorrow, day, night, morning, afternoon, evening, last night, soon, later, on, before, after, when and so on. As children learn to use these types of words in their daily interaction they begin to acquire sense of time.

The first practical use of time for children is to get acquainted with sequence of daily routine like cleaning, bathing, breakfast, going to school, play, homework etc. That they follow. An activity is suggested for children.

| **Activity:** Arrange in a sequence of the following events: breakfast, Getting up, cleaning, lunch, bathing, going to school, playing , going to bed, home work watching TV. |
|---|

Children need to be made aware that we can keep track of how long it takes to do something. Now they should have a concept of interval of time. For this purpose we can make a simple time measuring device like a pendulum.

**Activity**: We take a pebble. It is tied to the end of a string. It is suspended freely from the other end as shown in the figure below.

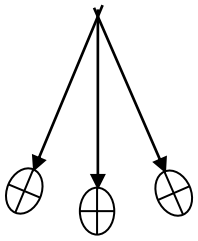


Fig.

The pendulum can be used to keep track of duration of activities as suggested.

i.Count the number of times the pendulum swings till you comb your hair.
ii. Find who took longer to comb the hair.
iii.Count the swings it takes you to draw a house.

'Instant' of time means the time at which an event occurs. We use time in this senses when we took at our watch to find of the day.
'Duration' is the time passes between two events. For example, the time between the bus starting from a place and reaching another place. So there are two events associated with duration (or time-interval), one the beginning and the other the ending. This shows that to find the time – interval, one should be aware of the order in which the events occur. Therefore, the idea of the order of 'events' is a pre-requisite for understanding this concept. To understand 'duration' a child also understands the meaning of the words 'now 'later, sometime etc.

A calendar is an effective tool for teaching children that there is an orderly way to mark the passage of time. Each year we progress through a cycle of days, weeks and months as seasons change. Birthdays and holdings come year after year.

**Measurement of time**: We have to reach school, bus station, railway station, office etc. We need a device called clock or watch for measuring time. Time is measured in seconds, minutes and hours. At Primary Stage we are not discussing about second. There are two hands which move on the dial of the clock. The short hand is called the hour hand which moves slow and shows the hours. The long hand is called the minute hand which moves fast and shows the minutes. The dial has 12 equal divisions marked as 1,2,3,4.....12 as shown in the figure. There are 5 equal divisions between two successive numbers. Thus there are 60 small divisions in all. Each big divisions represents an hour and each small division represents minute.

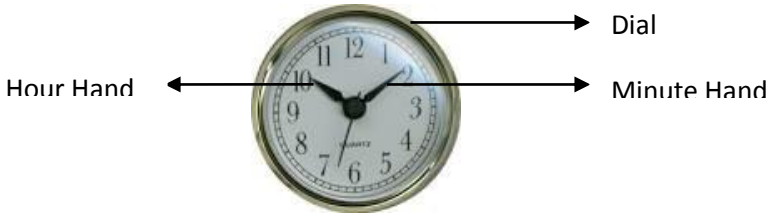



Fig. CLOCK

When the minute hand makes one round of dial, the hour hand moves one place say from 3 to 4 ie. One hour = 60 minutes. In this way it takes a full round of the dial in 12 hours. So, the hour

hand takes two rounds of the dial in a whole day. The minute hand takes five minutes to move one number to another say from 12 to 1. It takes one round of dial in 12 x 5 = 60 minutes=1 hour.

**Activity:** The teacher may present the following figure and ask pupils to read time in the morning.

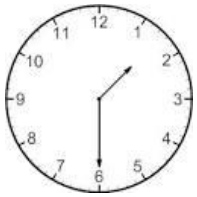


Fig.

Fig.

Minute hand is on '6' and hour hand is in between 1 and 2

Minutes = 6 x 5 = 30

So time =1 hours and 30 minutes.

Now day ⟶ night = 24 hours ie. One day =24 hours

Midnight 12 hours ⟶ Midday 12 hours ⟶ Midnight = 24 hours.

↓ ↓ ↓

0:00 hour Ante meredium (am) 12:00 noon Past meredium (pm) 0:00 hour

↓ ↓ ↓

12 0' clock night 12 0' clock day 12 0' clock night

↓ ↓

12:00 (noon) 12:00 (mid night)

Hence, in the above figures the time in 12 hour clock time is read as 3:30 am and in 24 hour clock time as 03:30 hours or 3:30 hours.

Similarly in the afternoon 4 hours 45 minutes is written as 4:45 pm in 12 hour clock time and 16:45 hours in 24 hour clock time.

Here is an exercise for you.

**Exercise**: Suggest a group activity of class V which improves ability to convert form ' standard' time to 24 hour time and vice versa.

Standard unit of time are second, minute, hour S.I unit of time is second.

- **Temperature:** The teacher should initiate the topic with the discussion on children's day –to-day experiences related to the temperature. They touch the glass filled with hot milk, horlicks, water etc. In their homes. They feel the heat. By touching ice they feel the cold.

**Activity:** A simple activity may be done in and around the classroom. One of the iron chairs is kept in the classroom and the other in the hand Sun outside the classroom. Students are allowed to get experiences of sitting in chairs. Now they are asked to tell their feeling. They will inform the class that they feel the cold while sitting in the chair inside classroom and hot while sitting in the chair kept in the Sun. Then the teacher conveys to students that the temperature is the degree of hotness or coldness.

**Example:** Suppose a child Rohan has gone to meet his friend Lisam who lives in his neighbour. He found him lying in the bed. Rohan asked him how are you? Lisam replied him that he was feeling uneasiness. Then he touched him body and said Lisam ! your body is hot ie your body has high temperature and so you got fever. But I canot say how much? For that we need a device to know about the temperature ie degree of the temperature.

Thermometer: Thermometer is a device for measuring temperature or indicating temperature.

Mercury capillary tube.

Thermometer

There are two types of thermometer.

i.**Celsius scale thermometer** :- In this thermometer the freezing point of water is $0^0$ C and boiling point of water is $100^0$ C. The distance between these two points is divided into 100 equal parts, each part is called $1^0$ C.

**ii.Fahrenheit scale thermometer**:- In this scale freezing point of water is $32^0$ F and boiling point of water is $212^0$ F. The distance between the two points is divided in 180 equal parts and each part is called $1^0$ F.

**Unit of measuring temperature**: The temperature of a body is measured in degree Celsius ($^0$ C) and degree Fahrenheit ($^0$ F).

- **Money:** The teacher should provide children experiences in dealing with collection of coins and notes. Help them to distinguish coins of different denominations. The children may be motivated to recognize currency notes of different denomination. Picture coins can be presented for discussion about their characteristics Let the children handle these coins and understand the value aspect in addition to the shape, size and colour. Let them identify the denomination for the coins. Real coins of one rupee, two rupee, 5 rupee, 10 rupee may be demonstrated in the classroom, if possible. Similarly pictures of currency notes for different denomination can be presented in the classroom. Children should be given opportunities to observe both sides of coins and currency notes and display some original.

The teacher may do the following suggestive activities:

i.Introduce coins and currency notes to the children through conversation by asking them.
a. From where do we buy things such as pens, pencils, note books, geometry box, vegetables, rations, dresses etc.
b. What do we give to shopkeepers at the time of buying above mentioned things in (a)
ii. After introducing the coins and notes of different denominations, ask them to sort all the coins say one rupee from a given collection of coins and so on.
iii.Bring empty packs/wrappers of pen, pencil, eraser, soap, tooth paste, Biscuit, Kurkure etc. Ask students to read the price tag on the pack and pick up a coin or note from the collection of coins/notes for which the said object can be brought.
iv.Give them some coins/ notes of same/different denominations and ask them to find the total value of the collection.
v.Ask students to make a given amount by using coins/notes of different denominations.

**Activity**: A group of students in group should be taken to near by post office and ask them to note down the different denominations of postage stamp and the activities to be carried out them.

## 4.2. Relationships between various units of some measures (length, mass, time and temperature)

- **Length:** Metric System

| | | |
|---|---|---|
| 10 | millimetre (mm) | = 1 centimetre (cm) |
| 10 | centimetre | = 1 decimetre (dm) |
| 10 | decimetre | = 1 metre (m) |
| 10 | metre | = 1 decametre (dam) |
| 10 | decametre | = 1 hectometre (hm) |
| 10 | hectometre | = 1 kilometre (km) |

---

1 inch = 2.54 cm = 25.400mm
12 inch = 1 foot
3 feet = 1 yard
1760 yard = 1 mile
1 mile = 1.609 km
1 km = 0.621 mile
1 Nautical mile = 1852 m = 6080 feet
1 megametre = 1000km
1 light year = $9.5 \times 10^{12}$ kms or $6 \times 10^{12}$ miles.

- **Weight/Mass**: Metric System

| | | | |
|---|---|---|---|
| 10 | milligram (mg) | = | 1 centigram (cg) |
| 10 | centigram | = | 1 decigram (dg) |
| 10 | decigram | = | 1 gram (g) |
| 10 | gram | = | 1 decagram (dag) |
| 10 | decagram | = | 1 hectogram (hg) |
| 10 | hectogram | = | 1 kilogram (kg) |

| | | |
|---|---|---|
| 100 | kg | = 1 quintal |
| 10 | quintals | = 1 tonne |

- **Time:**

| | | |
|---|---|---|
| 60 | second(s) | = 1 minute (m) |
| 60 | minutes | = 1 hour (h) |
| 24 | hours | = 1 day, 7 days = 1 week |
| 365 | days | = 1 year = 12 months |
| 366 | days | = 1leap year |
| 10 | years | = 1 decade |
| 10 | decade | = 1 century |
| 10 | centuries | = 1 millennium |

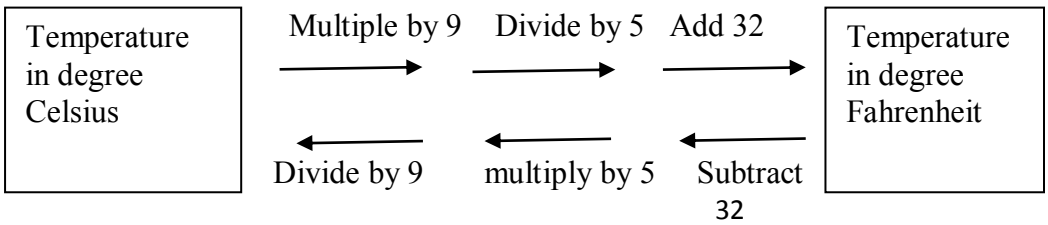
- **Temperature**: $\frac{F-32}{180} = \frac{C}{100}$

Or $\frac{F-32}{} = \frac{C}{}$

Q. 5

$$C = \frac{5}{}(F- 32) \text{ or } F = \frac{9}{} C +32$$

Q. 5




**Self check test:**

1. Identify the correct sequence::

   A. Kilometre, Centimetre, Metre
   B. Metre, Kilometre, Centimetre
   C. Centimetre, kilometre, Metre
   D. Kilometre, Metre, Centimetre.

**4.3. Skills of measuring through different measures:** Children should be encouraged to look around and see how length, mass, volume, time, temperature ete are measured in different ways using measuring devices. For that if it is possible, they should be taken to work situations that they feel how persons like Carpenter, Shopkeeper, milkman, salesman at oil pump, match referee, doctor etc. Use their skills to measure different measures.

**Example**:

**Activity:** The child is asked to measure the length of small nail with the help of scale. The teacher will facilitate him/her in the process of measuring. He discusses with the student about the scale to be used in the activity.


Scale

Length of nail = 2 cm.

Similar activities may be organised for developing skills for other measures.

## 4.4. Conversion of smaller unit into bigger and vice-vesa.:

- **Conversion of smaller unit to bigger unit**:
  **Length: Example:**

10 mm = 1 cm
1 mm = $\frac{1}{10}$ cm = 0.1 cm
100 cm = 1 metre
1 cm = $\frac{1}{100}$ metre =0.01 metre

1000m = 1 km
1 m = $\frac{1}{1000}$ km = 0.001 km

**Mass:** **Example**:

1000 mg = 1 g
1 mg = $\frac{1}{1000}$ g = .001 g
1000g = 1 kg
1 g = $\frac{1}{1000}$ kg = 0.001 kg

**Volume:** **Example:**

10 ml = 1 centilitre
1 ml = $\frac{1}{10}$ centilitre = 0.01 centilitre
1000 ml = 1 litre
1 ml = $\frac{1}{1000}$ litre = 0.001 L

**Time:** **Example**: Q. Convert 300 seconds into minutes.

**Solution:** 60 seconds = 1 minute
1 second = $\frac{1}{60}$ minute
300 seconds = $\frac{1}{60}$ x 300 minutes = 5 minutes.

**Money:** **Example:** Q. Convert 200 paise into rupees

**Solution:** 100 paise = 1 rupee, 1 paise = 100 rupee

When we convert smaller unit into bigger unit we divide the number with smaller unit by the number which shows the relation between the two.

200 paise = $\frac{1}{100}$ x 200 rupees = 2 rupees

**Temperature**: Example: Q. Convert $104^0$ F into degree Celsius.

**Solution:** We know that

Temperature degree in Fahrenheit → Subtract 32 → multiply by 5 → Divide by 9 → [Type a quote from the document

$104^0$ F = (104 -32) = 72 x 5 = 36 0 ------9 = $40^0$ C

$\therefore$ $104^0$ F + $40^0$ C

- **Conversion of bigger unit into smaller unit:**

**Length : Example**

Q. Convert 1 metre into centimetre

Solution: 1 metre = 10 decimetre
= 10 x 10 centimetre ∴ 1 decimetre =10 centimetre
= 100 centimetre

∴ 1 metre = 100 cm.

**Mass:** **Example**:

Q. Convert 1 kg into gram

**Solution:** 1 kg = 10 hectogram
= 10 x 10 decagram ∴ 1 decagram = 10 decagram
=10 x 10 x 10 gram ∴ 1 decagram = 10 gram
= 1000 gram
∴ 1 kg = 1000 gram

**Volume:** **Example:**

**Q. Convert 1 litre into millilitre**

**Solution:** 1 litre = 10 decilitre
= 10 x 10 centilitre ∴ 1 decilitre = 10 centilitre
= 10 x 10 x 10 millilitre ∴ 1 centilitre = 10 millilitre
= 1000 millilitre
∴ 1 litre = 1000 millilitre

**Time:** **Example:**

**Q. Convert 1 hour into second**

**Solution**: 1 hour = 60 minutes
= 60 x 60 seconds ∴ 1 minute = 60 seconds
∴ 1 hour = 3600 seconds.

**Money:** **Example:**

**Q. Convert 2 rupees into paise.**
∴ 1 rupee = 100 paise
∴ 2 rupees = 2 x 100 paise = 200 paise

When we convert bigger unit into smaller unit then the number which shows the relation between these units is multiplied with the number having bigger unit.

**Temperature:** **Example:**

**Q. Convert $35^0$ C into degree Fahrenheit**

**Solution:** 35 we know that

| Temperature in degree Celsius | Multiply by 9 | Divide by 5 | Add 32 | Temperature in degree Fahrenheit |
|---|---|---|---|---|

$\therefore$ 350 C ------35 x 9 = 315------ 315 ÷ 5 = 63 ------63 ---63 + 32 = $95^0$ F

$\therefore$ $35^0$ C = $95^0$ F

**Self cheek test:**

1. A teacher reached his school at ten minute past 9 o'clock in the morning what will be exact notation of time?
2. Convert 4640 millilitres into litres and millilitres.

## UNIT – 5
# Space and shape

The children observe various objects around them and enjoy which have different shapes and sizes. Some of them are rectangular, caboidal, spherical, cylindrical shapes etc such as a page of a note book, balloon, biscuit box, pencil etc. Observing such objects some times a child may be interested in making such shapes and show interest in their characteristics. They can discover patterns and relationships. At the same time they experience many problems which teachers can encourage them to solve. These situations provide right opportunities for teachers to introduce new concepts and enable students to learn them learning of space and shapes help children to understand many concept in arithmetic and measurement. They also observe at man made and natural things.

## 5.1. Geometrical Shapes:

- **Point:** **Example:**

  i. We make a small dot by a sharp tip of the pencil on a piece of paper. Sharper the tip, thinner will be the dot.
  ii. We make a prick in paper by a sharp alpin.
  iii. In a map of a country, the locations of towns are indicated by means of dots.
  iv. Look at the tip of a cone in the fig. 

In above examples tiny dots will give us an idea of a point. Further they help us in imaging a point. In fact they give us a physical or visual representation of a point. A point determines location.

Thus, we say that a point has an exact position. A point has no length, breadth and thickness. If we make three points a paper, we would be required to distinguish them. For this they are denoted by a single capital letter like A,B,C.

. B

. A

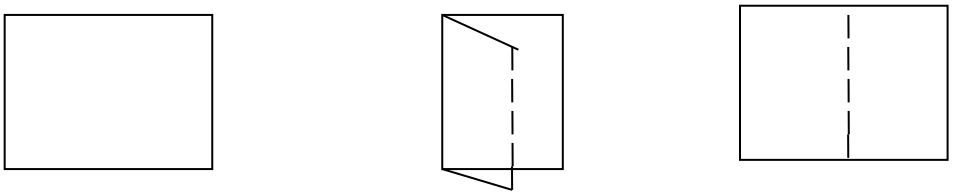
. C

These points will be read as a point A, point B and point C. But the dots have to be invisibly thin.

Activity: A star in the sky gives us an idea of a point. Identify at least four such situations in your daily life.

- **Line:** For giving the concept of a line we do an activity.

  **Activity**: We fold a piece of paper and press the two pasts together, on unfolding the two parts, we find that a straight crease is formed. The straight crease in the paper is an example of a visual representation of portions of a line.



Piece of paper Folded paper Crease

Fig

A thread is held by two persons. The positions where the two hands of the two persons hold the thread points. The thread represents a part of line.

Look at the edges of a cuboidal box say book. Each edge gives us an idea of a portion of a line. To get an idea of a complete line, we have to imagine the edge to be extended on both sides endlessly.

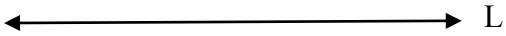
Thus, the basic idea of a line lies in its straightness and that it extends endlessly in both directions. It has length only. It has no breadth or thickness.

By a line we mean the complete line and not a portion of it. Naturally, we cannot draw or show complete line on a sheet of paper. So, we draw a portion of a line and put arrow heads on its two ends as shown in figure.

The arrow heads indicate that the line extends endlessly in both the directions.

**A line has no end points**.

A line is represented by a single small letter l,.m,n etc.

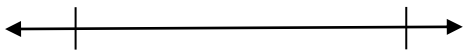



It is read as line l.

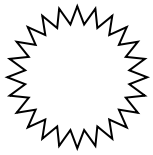
Or

It is also represented by taking two points on it with over head arrows as 

AB



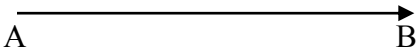
- **Ray**: The children are familiar with the word ray as they observe rays of light coming from the sun. They start from the sun and spread in all directions.



Sun ray

Ray of light from candle.

A ray is a portion of a line. It starts from a point called starting point and goes endlessly in a direction. It is representing by two capital letters as AB.




(Starting point)

| A ry has only one end point and it can be extended only in one direction infinitely |
|---|

- **Line segment**:

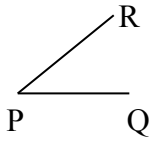
**Example:**





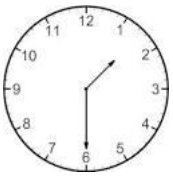
The point A (or B) in said to lie on the line. We also say that the line p-asses through the point A (or B). Any portion of the line such as the portion from A to B is called a line segment AB. The points A and B are called end points of the line segment AB. Therefore, we can say the line segment is a part of line between two points. The line segment AB can also be named as the line segment BA. It is denoted by AB or BA and is read as line segment AB or line segment BA. The edges of a note book, desk, table etc. Are examples of line segment.
The teacher may ask students to suggest more examples of line segments from the surrounding.

Q. Name the line segments in the figure. Is P, the common end point of each line segments?




**Angle:** The children might have observed the hands of a clock, the arms of a divider, the

blades of scissors. All of these have two arms joined together by a hinge and give us the idea of an angle.



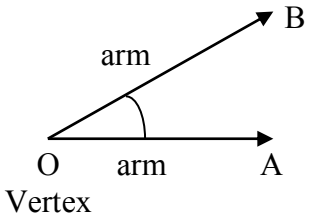
Clock

Divider

Scissor

If we consider the hinge as the initial point and the two arms as portions of two rays having the same initial point, then we can describe an angle.
Concept of as angle can be given by showing the meeting place of the straight edges of plane figures/shapes like a square or a rectangle or a triangle at their corners.

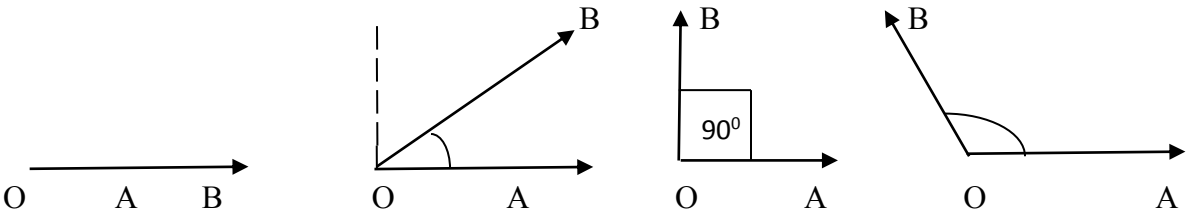
An angle is a figure by two rays with the same initial point. The common initial point O is called the vertex and the rays OA and OB are arms of angle.



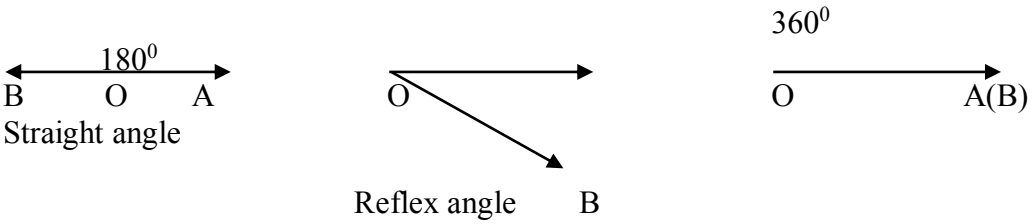

We use the symbol '<' to represent angle. In the above figure angle formed is denoted by <AOB or <BOA. It is read as angle AOB or angle BOA. Angles are measured in degree.

**Activity:** Take a piece of paper. Fold it in half; press the two halves to get a crease. Fold again along the crease. How many angles are formed by the meeting of the straight creases.

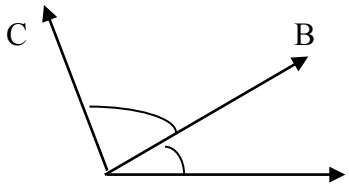
- **Kinds of Angle:**
  - Zero Angle: When two rays have common initial point and overlap each other they form zero degree ( $0^0$) angle.
  - Acute Angle: An angle whose measure is greater than $O^O$ and less than $90^0$ is called an acute angle.
  - Right Angle: An angle of measure $90^0$ is called a right angle.
  - Obtuse Angle: An angle whose measure is greater than $90^0$but less than $180^0$ is called obtuse angle.
  - Straight Angle: An angle who measure is $180^0$ is called straight angle.
  - Reflex Angle: An angle whose measure is greater than $180^0$ but less than $360^0$ is called reflex angle.
  - Complete Angle: An angle of measure $360^0$ is called complete angle.




$0^0$ angle  Acute angle  Right angle  Obtuse angle

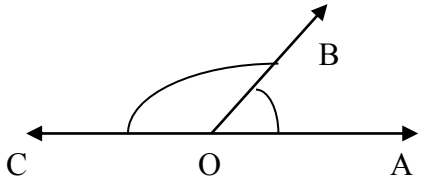



- **Adjacent angles**: Two angles in a plane are said to be adjacent angles, if they have a common vertex, a common arm and the other two arms on opposite sides of the common arm. Here, < AOB and <BOC are adjacent angles.




Q. A

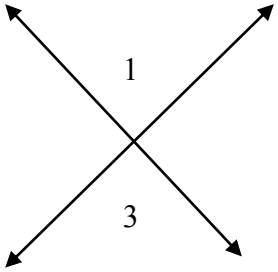
- **Linear Pair**: Two adjacent angles from a linear pair, if their two non-common arms form a straight line.



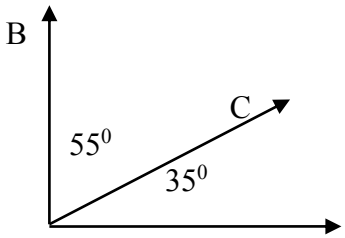

- **Vertically opposite Angles**: In the given figure two lines land on intersect at O making four angles < 1, < 2, < 3, and < 4. We get two pairs of angles < 1 and < 3; < 2 and < 4 which have no common arm. So angles < 1 and < 3 are called vertically opposite angles. Similarly angles < 2 and < 4 are vertically opposite angles. Thus two angles formed by two intersecting lines having no common arm are said to be vertically opposite angles.

Vertically opposite angles are equal.

Q. 2




- **Complementary Angles**: When the sun of the measures of two angles is $90^0$ the angles are called complementary angles.

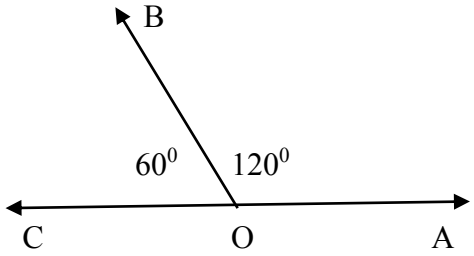



Q. A

Here $35^0 + 55^0 = 90^0$

So < AOC and < BOC are complementary to each other.

- **Supplementary Angles:** When the sun of the measures of two angles is $180^0$ the angles are supplementary angles.



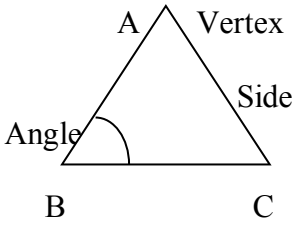

Here, $120^0 + 60^0 = 180^0$

So < AOB and < BOC are supplementary to each other.

Activity: Children should be involved in activities to gain

- **Triangle**: A triangle is a simple closed curve made of three line segments. The symbol 'A' is used to denote triangle. In the given figure , we find that in a triangle.

- There are three line vertices A, B and C.
- There are three line segments AB, BC and CA.




- There are angles < ABC, < BCA and < CAB.
- The six parts, namely three sides and three angles of a triangle taken together are called the six elements of the triangle.

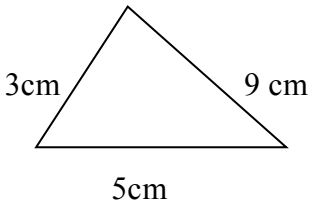
Activity: Children should be engaged to construct a triangle with help of three bamboo sticks and valves /rubber bands/threads.

## ❖ Classification of triangles:

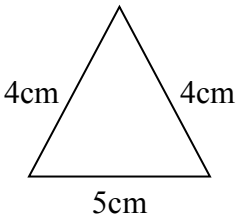
i. Triangles according to side.

**Scalene triangle:** A triangle having no two sides equal is called a scalene triangle.

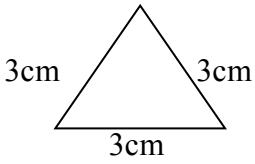
Example: The measurements of sides of triangles are 3 cm, 5cm and 9cm. The triangle is scalene.




**Isosceles triangle**: A triangle who two sides are equal is called isosceles triangle.

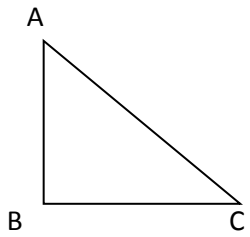


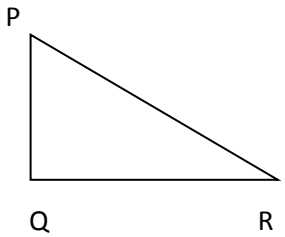

**Equilateral triangle**: A triangle having all sides equal is called an equilateral triangle.



**Triangles according to sides:**

**Activity**: Pupils are asked to measure the angles of the following triangles and fill up the table given below. The teacher will facilitate them in measuring and obtaining information.



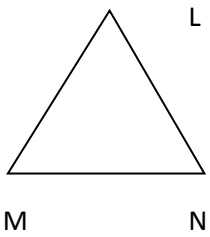




Table i

| Angle of Triangle | Measure of angle |
|---|---|
| ABC | |
| BCA | |
| CAB | |

Table ii

| Angle of Triangle | Measure of angle |
|---|---|
| PQR | |
| QRP | |
| RPQ | |

Table iii

| Angle of Triangle | Measure of Angle |
|---|---|
| LMN | |
| MNL | |
| NLP | |

Now they will answer the question with the help of above table.

**Q. What do you find from the above table**?

We find that

In the table (i) one angle is of $90^0$ and other are less than $90^0$ ie acute angles.

In the table (ii) one angle is more than $90^0$ and other are less than $90^0$ ie acute angles.

In the table (iii) all angles are less than $90^0$ ie acute angles.

The teacher will say that

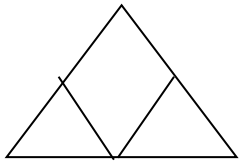
a) A triangle with one angle is right angle ($90^0$) is called a right angled triangle.
b) A triangle with one angle as obtuse angle is called an obtuse angled triangle.
c) A triangle with all its angles as acute angles is called an acute angle triangle.

**Properties of Triangle:**

**Angle sum property:**

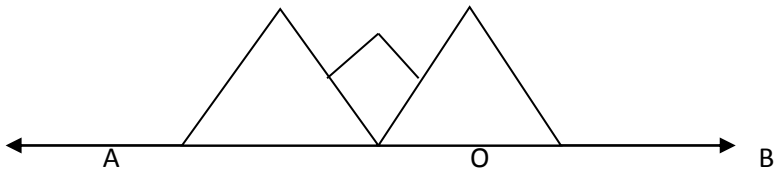
**Activity:**

i. Children are asked to draw a triangle on a chart paper and mark its angles as 1,2,3



ii. Cut out the triangular region. Further cut three angles 1,2,3 as shown above.

iii. Now three angles are arranged on a line AOB without any over lapping so that their vertices shown be at O.

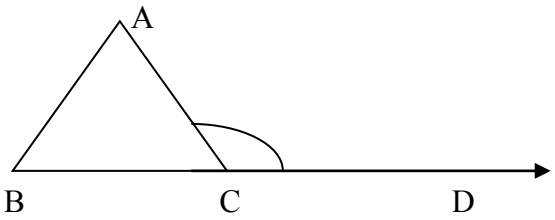



We observe that three angles 1,2, and 3 of the triangle make a straight angle AOB.
We know that the measure of a straight angle is $180^0$.
Hence, we find that sum of three angles of a triangle is $180^0$.
The activity may be repeated other triangles.

| Property 1: Sum of three angles of a triangle is $180^0$. |
|---|

**Exterior angle property**.

Activity: We draw a triangle ABC. One its side BC is produces to D form an exterior angle < ACD.



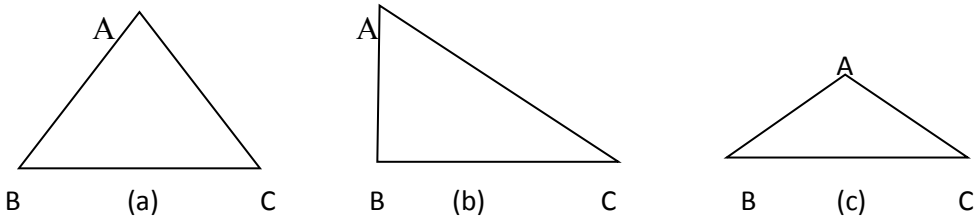

New children are asked to measure exterior < ACD and interior opposite angles < BAC and < ABC, using a protractor. Ask them to verify whether. M < ACD = m < BAC + m < ABC. They will find that the above relation is true.

Such activity may be repeated with other triangles.

| **Property** II. In a triangle an exterior angle is equal to the sum of two interior opposite angles. |
|---|

**Sum of the lengths of two sides of a triangle:**

**Activity**: Children may be asked to make three triangles using bamboo sticks of different sizes and say triangle is ABC.



Ask them to measure sides of triangles in each case and find

AB + BC, BC + CA and CA + AB.
As question : What do you observe?
Is (i) AB + BC > CA (ii) BC + CA > AB (III) CA + AB > BC for each triangle named as a, b and c?
They will reply yes.

| Property III: The sum of any two sides of a triangle is greater than the third side. |
|---|

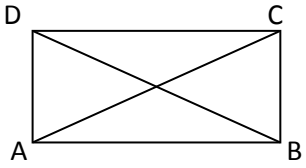
- **Quadrilateral:**
  Activity: Let us take four unequal bamboo sticks. Place a pair of two sticks on the table such that they have their ends points joined at one end. New place remaining two sticks meeting the free ends of the first pair as shown below.

  Is it a closed figure made up of four sticks or line segments?
  Yes, it is a closed figure. Its name is quadrilateral.
  In a quadrilateral, them are 4 vertices: A,B, C and D.

- 4 sides: AB, BC, CD and DA
- 4 angles : < ABC, < BCD, < CDA and < DAB
- 2 Diagonals: BD and AC.
- The sum of all interior angles of a quadrilateral is $360^0$.

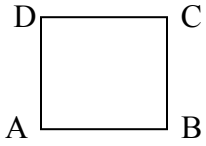
➢ **Kinds of Quadrilateral:**

Q. Rectangle: A rectangle is a quadrilateral whose each angle measures $90^0$ and opposites are of equal length.



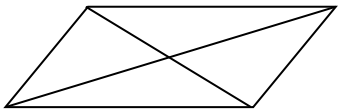

The diagonals of a rectangle are equal.

ii. **Square:** A square is quadrilaterals will all sides of equal length and each angle measures $90^0$. The diagonals of square are equal and they bisect each other at $90^0$.




iii. **Parallelogram**: It is quadrilateral in which pare of opposite sides are equal and parallel.

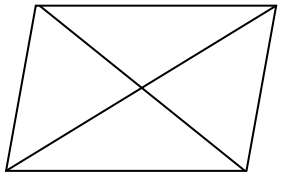
Q. N



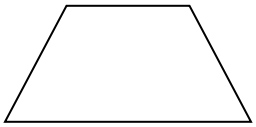
L M

Diagonals of a parallelogram bisect each other.

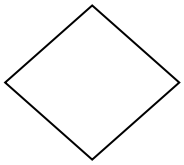
iv. **Rhombus**: Rhombus is a quadrilateral whose all sides equal and opposite sides are parallel. Diagonals of rhombus bisect each other at $90^0$.



v. **Trapezium**: trapezium is a quadrilateral in which two sides are parallel.

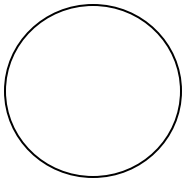


vi. **Kite**: Kite is a special type of a quadrilateral with exactly two pairs of equal consecutive sides.



**Suggested Activity**: As students know there are two set squares in their geometry instrument box. One is $30^0 – 60^0 - 90^0$ set square and other is $45^0 – 45^0 - 90^0$ set square. They should be asked to make all five types of quadrilateral with the help of set squares.

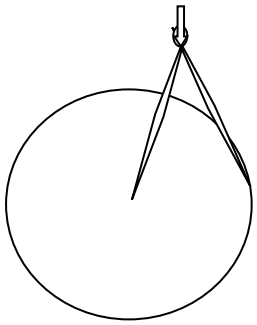
- **Circle**: Circle is the one of the most fascinating geometrical figure we came across in our daily life situations. We use several objects which have a circular shape. Some such objects are a bangle, rupee coin, airing, a dial of a clock, wheel, button etc. The circle is frequently use in the designs of public buildings, gardens, vehicles, toys, cloths etc. We can obtain a figure shown in figure following an activity:



Let us take a one rupee coin, we place it on a page of our note book. Touching the age of the coin, we put the pencil end and more it round the edge on the page. Now, we remove the coin. The figure thus we obtained is the one shown above.

The figure is, of course, a circle, but what exactly is a circle? Let us know.

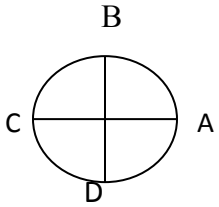
Mark a point O on the page of a note book. We keep needle like pointed end of the compass fixed at the point O and rotate the pencil end at a constant distance from O till it returns to the starting point say A. The figure so traced is called a circle. From the figure, we observe that the distance between the fixed point O and the pencil end of the compasses remains constant.



Thus , a circle is closed plane figure consisting of all those points of the plane which are at a constant distance from a fixed point. The fixed point is called the centre and the constant distance is called radius of the circle. In the figure O is the centre and OA is radius of the circle.

- **Radius of a circle**: Radius is also understand as the line segment joining the any point on the circle to its centre. In the figure, A,B,C,D are points on the circle. O is the centre. Thus the line segments OA, OB, OC,OD are radii (plural of radius) of the circle.

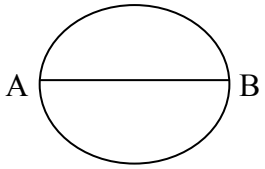
| A circle has infinitely many radii. |
|---|



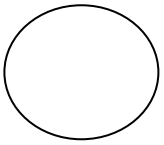

Now ask children to measure. OA, OB,OC and OD. What do they observe? They find that OA,OB, OC and OD are of the same length ie. OA = OB = OC =OD +r unit. Hence, all radii of a circle are equal.

- **Diameter of circle**: In the adjoining figure, the radius AO is extended to a point B on the circle. The line segment AB is called the diameter of the circle. Thus diameter of a circle is any line segment which passes through the centre of a circle whose end points lie on a

circle. We can draw as many diameters of a circle as we want. All the diameters of a circle are of the same length.

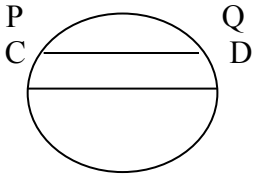



Now diameter AB = OA + OB
= OA + OA ( $\because$ OA = OB = r)
= 2 OA
Hence diameter = 2 r = 2 x length of a radius.



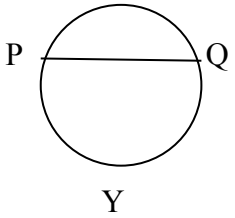
| Length of a diameter is twice the radius of the circle. |
|---|

- **Chord of a circle**: A line segment joining any two points P and Q of a circle is called chord of the circle. So PQ is a chord. Here CD, the diameter of the circle is also chord ie. Diameter is the longest chord of the circle. Acircle can have as many chords as we want.



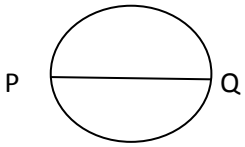

- **Arc of a circle**: Let pand Q be any two points on a circle with centre O. These two points divide the circle into two parts namely OXQ and PYQ are called arcs of the circle. The smaller part PXQ is called minor arc and the bigger one PYQ is called major arc of the circle.

X

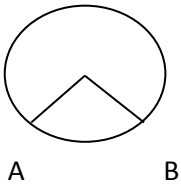



In case the two points P and Q divide the circle into two equal parts, then each part (or arc) is called semicircle.

A circle can have two semicircles.




- **Sector of a circle**: A sector of a circle is a region enclosed by an arc of he circle and the two radii to its end points.



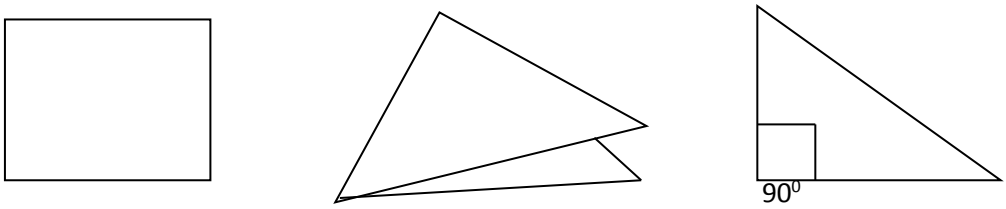
5.2. **Construction of geometrical shapes through paper folding, symmetry, Rongoli, Mosaic and other designs in the context of Arunachal Pradesh:**

- Construction of geometrical shapes through paper folding:

➢ **Construction of triangle:**

**Process**:

i. We take a square sheet of paper.
ii. The square sheet is folded along one of the diagonals.
iii. We get the shape of a triangle.

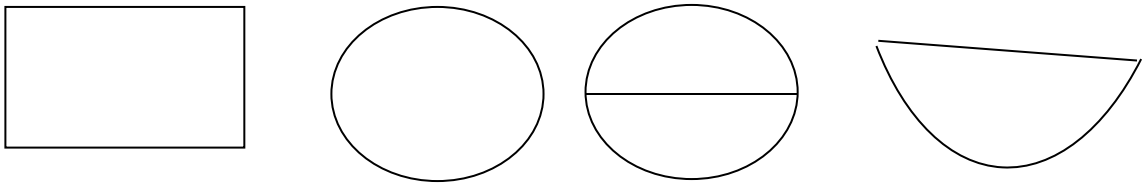



1. Square sheet ii. Process of folding iii. Shape of triangle

➢ **Construction of a semi circle:**

**Process:**

i. We take sheet of a paper
ii. We cut out a circular shape with the help of a circular object like bangle.
iii. We fold it once so as to cover two parts well
iv. We open it out, we find a semi circle.



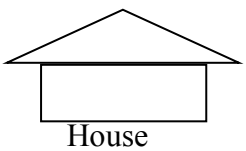
i.Sheet of paper ii. Circular shape iii. Process of folding iv. Semicircle

**Activity:** Construct a pentagon through paper folding

➢ **Symmetry**: Symmetry is quite a common term used in day to day life. When we see certain figures with evenly balanced proportions, we say, " They are symmetrical" The idea of symmetry is used in different activities like designing of clothing or jewellery, manufacturing of vehicles, constructing buildings etc we find symmetrical designs available in the nature such as the flowers, the tree leaves, butterflies etc.

The concept of symmetry can be given through demonstration of various things as shown below:

Leaf



House

Human face

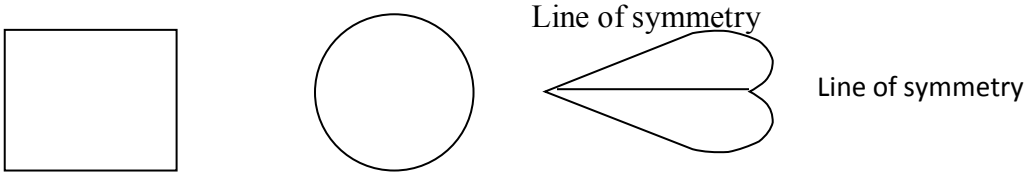
It can be shown that on folding the leaf, house, human face along a particular line, the two parts are found coinciding completely.

Similar activities could be performed with folding of paper of various shapes like rectangles, squares, circles and through such activities it could be shown that the following shape is symmetrical about certain lines.

A rectangle is symmetrical figure and there are two lines of symmetry represented by dotted lines in the figure.

Thus, if the figures are folded about a particular line, the two parts coincide with each other such figures are said to be symmetrical.

- **Line Symmetry:** If we can reflect a figure over a line and the figure appears unchanged, then the figure has reflection symmetry or line symmetry. The line that we reflect over is called the line of symmetry. A line of symmetry divides a figure into two mirror image halves. That is to say if we place a mirror on the fold then the image of one side of the picture will fall exactly on the other side of the picture.




Hence, a figure has line symmetry, if there is a line about which the figure may be folded so that the two parts of the figure coincide.

- **Rational Symmetry**: Children should be given experiences about the objects which rotate clock wise or anti clock wise or both. Such examples are available in our surrounding like movement of hands of a clock is clock wise rotation, blades of ceiling fan rotate clock wise, the wheel of a bicycle can rotate in both clock wise and anti clock wise.

  When an object rotates, the shape and size do not change. The rotation turns an object about a fixed point. This point is called the centre of rotation. The angle of turning during rotation is called the angle of rotation.

  **Example:** The paper wind mill in the picture looks symmetrical; but we can not find any line of symmetry. No folding can help us to have coincident helves. But if the wind mill is rotated by $90^0$ about the fixed point. So it will look exactly the same. We say that wind mill has a rotational symmetry.

In a full turn, there are four positions (on rotation through the angle $90^0$, $180^0$, $270^0$, $360^0$) when the wind mill looks exactly the same. Because of this, we say it has a rotational symmetry of order 4.

- If after a rotation, an object looks exactly the same, we say that it has a rotational symmetry.
- In a complete turn of $360^0$, the number of times an object exactly the same is called the order of rotational symmetry.

- **Rangoli, Mosaic and other designs in the context of Arunachal Pradesh:** Rangoli is a unique art work which is practised throughout our country. All houses are adorned with these beautiful rangoli designs, rangoli kolams during special occasions like festivals, marriage etc. Children love colours and they show the love in many ways like drawing shapes and designs and filling up with different colours. Rangoli patterns are used to make colourful designs on the floor.

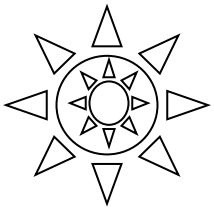
  Mosaic is a piece of decorative work produced by arranging together of small pieces of coloured stone, tile, glass etc. So as to form a pattern or picture. Mosaics are used to decorate floor, walls and ceilings.

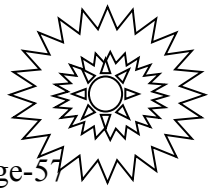
  Other designs are available in our state. These designs are made on well, mat, chair, daw cover, basket etc. Generally they are bamboo or cane work, designs and patters are created on ladies and gents' dresses.

  Rangoli, mosaic and other designs help children to develop mathematical thinking and creativity. They have aesthetic value too and provide them socio-cultural background on mathematic knowledge.

  There are some examples of rangoli produced below:

5.3. **Concept of region and space**: Perimeter and Area of rectilinear figure- triangle, quadrilateral; surface area and volume of cube and cuboid, area of four walls.







- **Concept of region**: Observe the following plane figures:

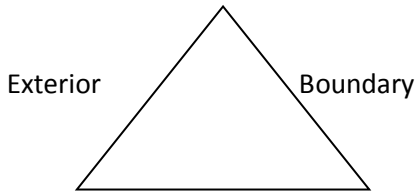



Fig (i)

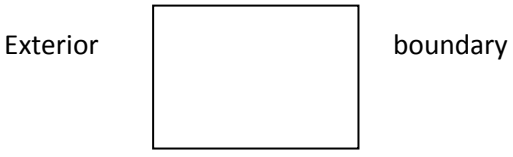


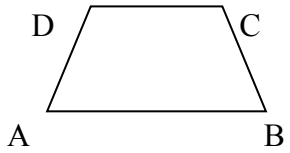

Fig. (ii)

The above figures divides the plane on which it is drawn into three different portions or regions.

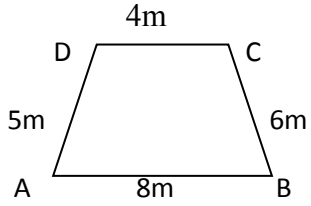
a) The figure it self is boundary of the interior region.
b) The portion of the plane inside the curve or enclosed /bounded by the figure is called the interior region.
c) The portion of the plane out side the curve is called exterior region.

So fig (i) is called a triangular region and fig. (ii) a rectangular region.

- **Concept of space**: All material bodies have a certain extension: length, breadth and height. They are variously placed in relation to each other and constitute parts of one or another system. Space is a form of coordination of co-existing objects and states of mater. It consists in the facts that objects are extra posed to one another ( such as along side, beside, beneath, under, on above, within, behind, infront etc.) and certain quantitative relationships.
- **Perimeter of rectilinear figures (made of line segments)**: Children observe fields and fences. Here one situation is given:
A farmer grows paddy, He needs a fence around his field. How much wire should he buy?




The farmer needs to find the length of the boundary of the field. He measures the length of each of side as




So, he finds the length of boundary = 8 m + 6 m + 4 m + 5 m
= 23 m

Now he decides that he has to buy 23 m wire for the fence of the field.

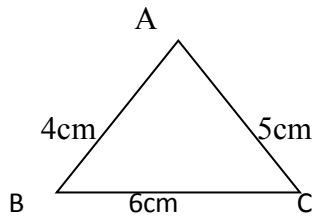
It can be understood in this way also: We start from the point A and move along the line segments then we again reach the point A. We have made a complete round of the field. The distance covered is equal to the length of the wire need to fence the field.
The distance is called the perimeter of the field ie closed figure. It is the length of the wire needed to fence the field.

Hence, perimeter is the distance covered along the boundary forming a closed figure when we go round the figure once. In other words we can say perimeter is the length of boundary of a closed plane figure.

In the above figure, the perimeter of the rectilinear figure ABCD is 23 m.

- **Perimeter of a triangle**:

Perimeter = length of boundary
= 6cm + 5cm + 4cm
=15 cm

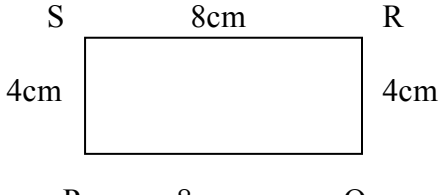



Again perimeter of 4 ABC = BC + CA + AB = a + b + c where a, b, c, denote sides
Semi perimeter of triangle (s) $= \frac{a + b + c}{2}$

- **Perimeter of Quadrilateral:**

Perimeter = AB + BC + CD +DA
= 9cm + 7cm + 6cm + 4cm
=26cm

- **Perimeter of Rectangle**: Let us consider an example:




Perimeter of rectangle PQRS
= PQ + QR +RS +SP
=PQ + QR +RS +SP
=PQ + QR+ PQ+ QR (∵ opposite sides of rectangle are equal)
=PQ+ PQ+QR+QR
=2PQ + 2QR
=2 (PQ +QR)
=2(9cm + 7cm)
=2 x 16cm
=32cm

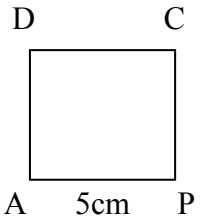
From above example, we find that

∴ perimeter of a rectangle = l + b + 1 + b
= 1 + 1 +b + b
= 2 1 + 2 b
= 2 (l + b), where 1 =length & b= breadth

∴ Perimeter of a rectangle = 2 (l +b)

- Perimeter of a square: Let us take an example of a square

  Perimeter of = AB + BC +CD +DA
  = AB +AB +AB AB
  = $ x AB




(. ˙ . all sides of a square are equal)

. ˙ . perimeter of rectangle = 4 x AB = 4 x5 cm =20 cm
Hence, perimeter of rectangle = 4 x length of a side

Q. The perimeter of a square field is 100m. Find the length of its each side.
Q. Find the cost of fencing a rectangular park of length 200m and breadth 150m at the rate of Rs. 50 per metre.

- **Area of rectilinear figures**: Children have already learnt the concept of area of a figure. The area of a rectilinear figure is the measure of the region enclosed by it. In the figures given below the area of fig (a) is more than that of fig (b) because the region enclosed by (a) is more.

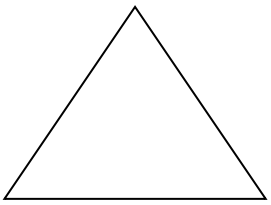


Fig (a)

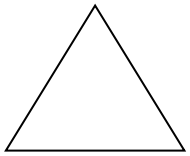
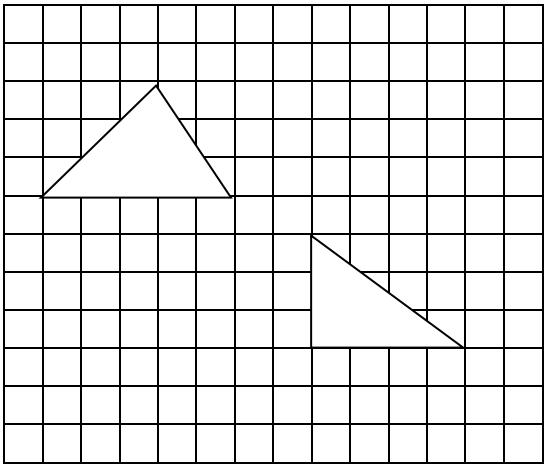


Fig (b)

- **Area of a triangle:** The area of a triangle can be estimated with the help of squared paper or graph paper where every square measures 1cm x 1cm.

  Activity: The triangles are traded on the graph paper. We look at the squares enclosed by these two triangles (i) and (ii). We count squares enclosed by them by adopting a convention.

- The area of one full square is taken as 1 sq, unit.
- We ignore portions of the area that enclose less than half a square.
- We consider more than half of a square as enclosed by the area as one square.



In the above figures (i) and (ii) , we count the square s enclosed and find that their areas are: 7.5 sq.cm and 6sq.cm

In the above triangles it is observed that the area of each of them is the product of its base and height (altitude)

ie Area of $\triangle$ (i) = $\frac{1}{2}$ x 5 x 3 = 7.5 sq.cm

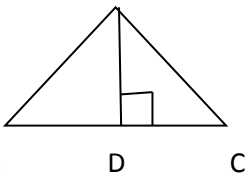
Area of $\triangle$ (ii) = $\frac{1}{2}$ x 4 x 3 = 6 sq.cm

Hence, we can establish the formula for area of a triangle

= $\frac{1}{2}$ x base x height (altitude)

**Example:** Find the area of the following triangle with the following measurements.

BC = 6 cm, AD = 4 cm




**Solution:** Area of $\triangle$ ABC = $\frac{1}{2}$ BC x AD

= $\frac{1}{2}$ x 6 x 4

= 12 sq.cm

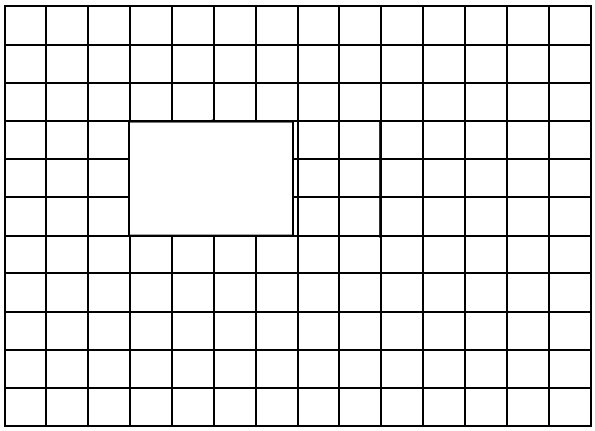
∴ Area of $\triangle$ ABC = 12 sq.cm.

- **<u>Area of a rectangle:</u>** The area of rectangle can be calculated with the help of a squared / graph paper having 1 cm x 1cm. Squares.

  **<u>Activity:</u>** We draw a rectangle whose length is 4 cm and breadth is 3 cm on a graph paper. The rectangle covers 12 squares on the graph paper completely. So, the area of rectangle = 12 sq .cm

  It can be written as

  4 x 3 sq.cm
  ie length x breadth



Now students are asked to draw rectangles on the graph paper whose lengths and breadths are given below. Find there areas by counting number of squares.

| Length | Breadth | Area |
|---|---|---|
| 5 cm | 3 cm | ------ |
| 6 cm | 4 cm | ------ |

What do we infer from this?

We find that

**Area of a rectangle = (length x breadth)**

**Q. Find the area of the floor of your classroom.**

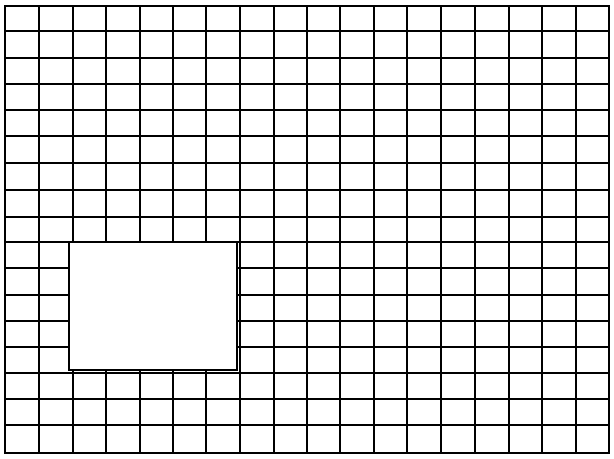
- **<u>Area of a square</u>:** Children have learnt how to find the area of a rectangle. They will be able to find the area of a square easily. Now we consider a square of 5cm and it is placed on the graph paper. What we observe? We find that it covers 16 squares on the graph paper.

So, the area of square = 16 sq. Cm
= 4 x 4sq.cm

Children are given exercised to find the area of few squares with different lengths. What result can we drawn from such exercises? We find that

| Area of square = side x side |
|---|

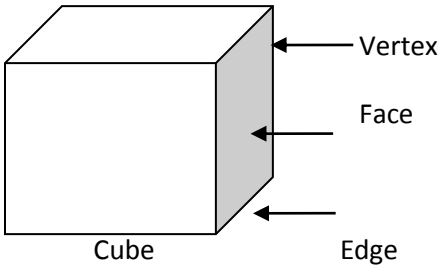
**Check your self:** Find the length of side of a square whose area is 36 sq.cm.

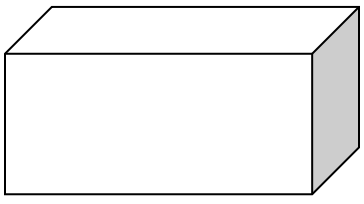


- **Area of parallelogram**: Teacher may ask children to find the area of parallelogram with the help of graph paper by using their understanding in the case of rectangle and square. They will be able to establish formula as area of parallelogram = Base x corresponding attitude.

**Surface area and volume of cube and cuboid.**

- **Surface area of cube and cuboid**: Children see many three dimensional shapes in the surrounding such as dice, chalk box, text book, brick etc. For giving the concepts of surface area of cube and cuboide, the teacher should present their models in classroom and ask them to get practical ideas of their faces and other features by handling them. The teacher facilitates learning.




Example: Chalk box, dice etc.

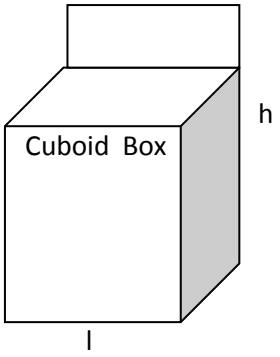
Example: note book, text book

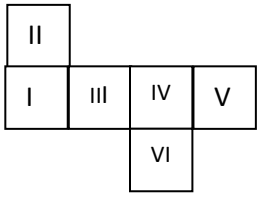
**After observing children can build up their ideas about cube and cuboid as below**.

| Shape | No. Of vertices | No. Of edges | No. Of faces | Identical faces |
|---|---|---|---|---|
| Cube | 8 | 12 | 6 square faces | 6 equal faces |
| Cuboid | 8 | 12 | 6 rectangular faces | 3 pairs of identical l faces |

- **Surface area of cube**: Science cube has 6 equal square faces and children know the area of square is side x side.

  If the length of side a square be l then area of 6 square faces are
  $l^2 + l^2 + l^2 + l^2 + l^2 + l^2 = 6\ l^2$
  Hence, surface area of cube $= 6\ l^2$
- **Surface area of cuboid**: Children are familiar with cuboidal shape. Its area can be calculated by cutting and opening of such shape.
  Let us take an example of cuboidal box with length, breadth and height as l, b and h respectively. Now we cut the box and open it. We get 3 identical rectangular faces which are given below:




So, the surface area of cuboid = Area I + Area II + Area III + Area IV + Area V + Area VI

$= l \times h + l \times b + b \times h + l \times h + b \times h + l \times b$

$= 2\ lb + 2bh + 2\ lh$

$= 2\ (lb + bh + lh)$

Hence, surface area of a cuboid = 2(lb + bh + lh)

**Questions for reflection:**

i. Find the total surface area of a 10 cm cube.
ii. Three cuboids each of the dimensions 3 cm x 2 cm x 2 cm are place together as shown in the fig. Find the total surface area of cuboid so formed.

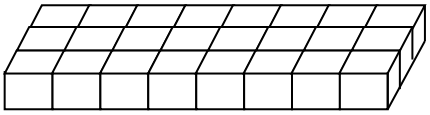
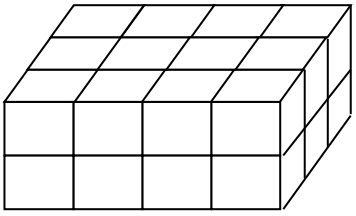
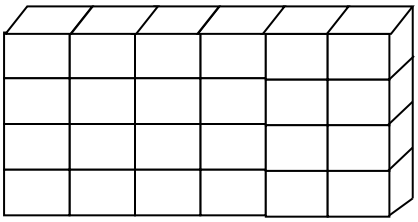
- **Volume of a cuboid**: Children learnt previously that amount of space occupied by a three dimensional object is called its volume:

We will use cubic units to find the volume of a solid, as cube is the most convenient solid shape. We can say that the volume of a solid is measured by counting the number of unit cubes it contains. We explain cubic units as follows.

1 cubic cm = 1 cm x 1 cm x 1 cm = $1cm^3$

1 cubic m = 1 m x 1 m x 1 m = $1m^3$

**Activity:** We do an activity for finding the volume of cuboid. We take 24 cubes of equal size (ie length of each cubes same). Now we arrange them in many ways to form a cuboid. We fill up the given table and observe.

| | Cuboid | Length | Breadth | Height | l x b x h = v |
|---|---|---|---|---|---|
| i. |  | 8 | 3 | 1 | Q. x 3 x 1 = 24 |
| ii. |  | 4 | 3 | 2 | Q. x 3 x 2 = 24 |
| iii. |  | 6 | 1 | 4 | Q. x 1 x 4 = 24 |

- From above activity what do we observe?

Since we have used 24 cubes to form above cuboids. The volume of each cuboid is 24 cubic units. Further the volume of each cuboid is equal to the product of length, breadth and height of cuboid. From above table we can say that volume of cuboid =l x b x h

We can also say that volume of cuboid = (l x b ) x h
= area of the base x hight.

**63**

**Q. How many bricks will be required for a wall 8 m long, 6 m high and 22.5 cm thick, if each brick measures 25 cm x 11.25 cm x 6 cm?**

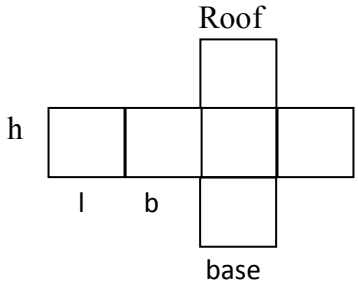
- **Volume of cube**: If in a cuboid l = b = h
  then it becomes a cube ie it is a special case of cuboid

  . ˙ . Volume of cube =l x l x 1 = $l^3$

**Q. Find the volume of a cube whose total surface area is 486 $cm^2$.**

- **Area of four walls:** The side walls ( the faces excluding the top and bottom) make the lateral surface area of the cuboid. For example , the total area of all four walls of the cuboidal room in which we are living is the lateral surface area of this room.

  Hence, the area of four walls
  = h l + b h + h l + b h
  = 2 h l + 2 b h
  = 2 h( l + b)




**Check your progress**:

Q.1. A chord of a circle 16 cm in length and its distance from the centre is 6 cm. Find the radius of the circle.

Q.2. The area of a rhombus is 28 sq.m. if its perimeter is 28m, find the length of its altitude.

Q.3. The measures of the three angles of a quadrilateral are $75^0$, $90^0$ and $75^0$. Find the measure of the fourth angle.

Q.4. A cuboidal wooden block contains 36 cu cu cm of wood. If it is 4 cm long and 3 cm wide., find its height.

Q.5. The internal measures of a cuboidal room are 12 m x 8 m x 4 m. Find the total cost of white washing all four walls of a room, it the cost of white washing is Rs. 5 per $m^2$.

**UNIT: 6**

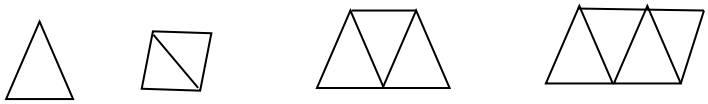
# Play with Mathematics

Play is essential part of your children's lives. Play has been regarded as a critical element of early child hood curriculum and pedagogy. In addition to being recognised as a vehicle of learning, play is described as a context in which children can demonstrate their own learning and help scaffold the learning of others (wood, 2008). Despite this, educators often struggle to explain what it is about play than promotes learning and ways in which they can activity facilitate both play and learning (Ranz-Smith,2007). While this situation applies generally, van oers (1996) notes that the potential of play to facilitate children's mathematical thinking depends largely on educators' ability to "seize on the teaching opportunities in an adequate way".

Therefore, play is an effective vehicle for fostering mathematical concepts and developing positive attitudes to mathematics.

## 6.1 Patterns:

Patterns mean things that are arranged following a rule or rules.

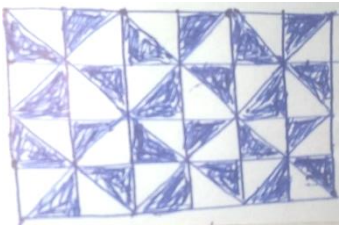
**Example:** 

These tiles are arranged in patterns. There is a pattern in these numbers.
2, 7, 12, 17, 221----------

It is a list of numbers that follow a certain sequence or pattern; starts at 1 and jumps 3.

Pattern is a regularly repeated arrangement of lines, shapes or colours, on a surface that has or intends to have decorative or pleasing effect.

**Example:**



**Example:** Let us consider an example of square of particular type of numbers.

$1^2 = 1$
$11^2 = 121$
$111^3 = 12321$

Students may be asked to first verity these by actual multiplication. They may be asked to write the square of 11111 or any such number without actually multiplying.

Such examples of pattern can lead a learner to develop the power of observation which leads to discover the specific property under the given set of conditions. Moreover, the learner will also develop an appreciation for the beauty of numbers and thus will get interested in learning mathematics.

Hence, the study of pattern supports children in learning to observe relationships to find connections, and to make deductions, generalizations and predictions. Understanding pattern nurtures the kind of mathematical thinking that helps children become problem solves and thinkers.

Q. Look for the rule and continue the growing pattern:
12 A, 13 B, 14 C, _____, _____, _____.

Q. Odd natural numbers are 1, 3, 5, 7, ----------. Write the sum of first one, first two, first three, ------- odd numbers. What pattern emerges?

**6.2. Puzzles:** The literary meaning of puzzle is to find the answer to a problem by thinking hard. Mathematical puzzles make up an integral part of recreational mathematics. They have specific rules as do multiplayer video games, but they do not usually involve competition between two or more players. Instead to solve such puzzle, the solver must find a solution that satisfies the given conditions. Mathematical puzzles require mathematics to solve them.

The word puzzle comes from pushe, meaning "bewilder, confound" which is a frequentive of the obsolete verb pose (From Medieval French aposer) in the sense of " perplex". The use of the word to mean "a toy contrived to test one's ingenuity" is relatively recent.

Mathematical puzzles have existed since ancient times. Both the Egytians and the Greeks posed problems involving puzzles. In India also, puzzles were normally posed before each other during academic discussions. Such puzzles mainly arithmetic or geometric in nature became quite common and created interest among people. These puzzles are numerous in nature but some of the common types are based on number curiosities, algebraic and geometric fallacies, tricks with numbers, arithmetic story problems, geometric dissections, magic squares etc.

**Example**: Choutan took some pebbles. He made groups of five with them, and found that one pebble was left over. He tried making groups of six and groups of four. Each time one pebble was left over. What is the smallest number of pebbles that Choutan had?

**Solution:** Multiples of 4 are: 4, 8, 12, 16, 20, 24, 28, 32, 36,40, 44, 48, 52, 56, 60.....
Multiples of 5 are: 5,10,15,20, 25, 30, 35, 40, 45, 50, 55, 60,.....
Multiples of 6 are: 6, 12, 18, 24, 30,36, 42, 48, 54, 60.....
Smallest common multiple of 4, 5 and 6 is 60.
Hence, the smallest number of pebbles that Choutan had = 60 + 1
= 61

**Example:** Find the number which satisfies the following conditions:

- ❖ It is longer than half of 100
- ❖ It is more than 6 tens and less than 7 tens
- ❖ The tens digit is one more than the ones digit
- ❖ Together the digits have a sum of 11

**Solution:** Half of 100 = 50. So number is longer than 50
6 tens = 60, 7 tens = 70
The required number lies between 60 and 70.
The numbers between 60 and 70 are: 61, 62, 63, 64, 65, 66, 67, 68, 69.
In above numbers we find that in 65, the tens digit 6 is one more than ones digit 5.
(6 = 5 +1)
Also sum of digits in 65 = 6+ 5 = 11
The number 65 satisfies all the given conditions. Hence the required number = 65.

**Try these puzzles**:

1. If A is substituted by 4, B by 3, c by 2, D by A, E by 3, F by 2 and so on, then what will be total of the numerical values of the letters of the word "SICK"?
   (a) 11 (b) 12 (c) 10 (d) 9
2. Divide the clock free into three parts so that the sum of the numbers in each part is the same.

6.3 **Number games:** Games are the source of generating enthusiasm among the players as well as viewers. Games generate enthusiasm, excitement, total involvement and enjoyment. This provides a joyful experience in teaching learning process which makes a learner to get himself/ herself completely involved in the process. In this regard Zoltan P. Dines suggests that all mathematics teaching should being with games.

Example**:** **Concept of greater than or less than in numbers.**

**Activity**: Let us play a game for giving the concept of greater than or less than in numbers. This game can be played individually or in groups. It requires a box containing pieces of card sheets with different numbers written on them. These numbers should be familiar to the group. A student picks up a card and speaks the number written on this. Now another student is asked to select a number from the box which is greater than this number. The next student selects a number which is greater than the second number and the game continues till the highest number from the box is Chosen.

This activity can be repeated for the property 'less than'.

**Example:** Take the first two odd numbers. Now add them, see what you get. Now, at every step, add the next odd number.

**Solution:** 1 + 3 = 4 = 2 x 2 (First two odd numbers)
1 + 3 + 5 = 9 = 3 x 3 (First three odd numbers)
1 + 3 + 5 + 7 = 16 = 4 x 4 (First four odd numbers)
Thus when we odd the first n odd numbers, we will get the sum as n x n

Q. In the following arrangement, replace only one match stick and rearrange it in such a way that both sides become equal.

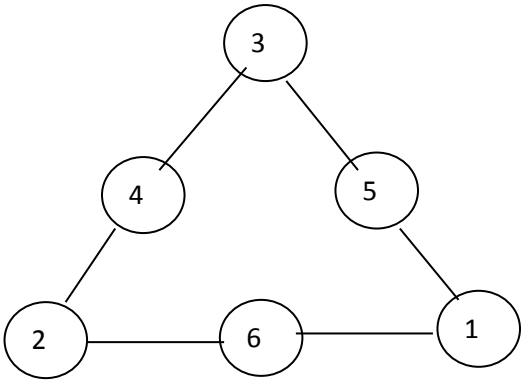
**Solution:**

**Check your Progress**

Design a suitable game for addition of numbers.

**6.4.Magic triangle:** The game of magic triangle is such a game through which we can develop mathematical behaviour in child. In a magic triangle each side has the same sum of 3 numbers. It is also a number patter.

**Example:**




Activity: The children are involved in the activities O odd numbers on a side of triangle. What we get?

3 + 4 + 2 = 9 We get the sum of numbers as 9.

Now odd numbers on the other sides. What do you observe?

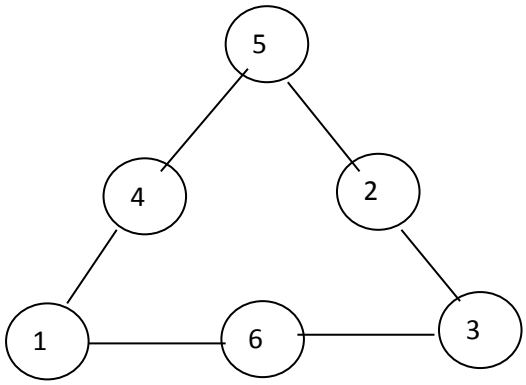
3 + 5 + 1 = 9

2 + 6 + 1 = 9

We find that sum of numbers on other two sides of triangle are also 9.
Hence, we can say that sum of three numbers on each side of a triangle remains the same. Thus above triangle is called magic triangle.

**Example:** Use natural numbers 1-6 to make a magic triangle in such way that the sum of numbers on each side must be 10.

**Solution**:




The sum of 3 numbers on each side is :

5+ 4 + 1 = 10

1+ 6 + 3 = 10

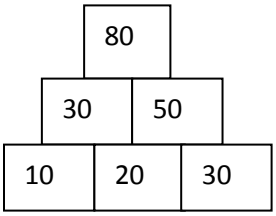
5+ 2 + 3 = 10

We find that the sum of numbers on the each side is 10.
Hence, the given triangle is a magic triangle.

**Question for reflections:** Construct a magic triangle by using six numbers.

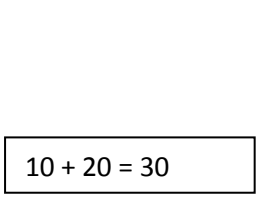
6.5. **Number towers:** A number tower is a kind of number pattern in which numbers can be arranged as a tower by following a rule.

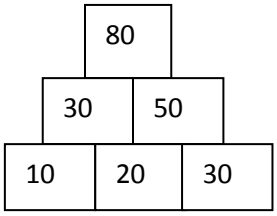
**Example:**

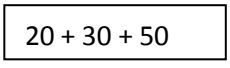


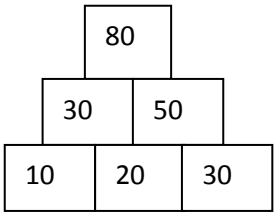

Can you see the rule for this pattern?

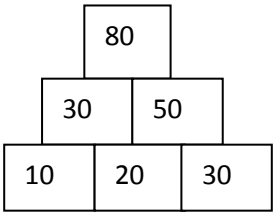
Rule: Here, we add 2 numbers below to get the number in the box above them.

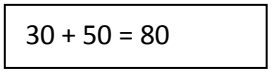


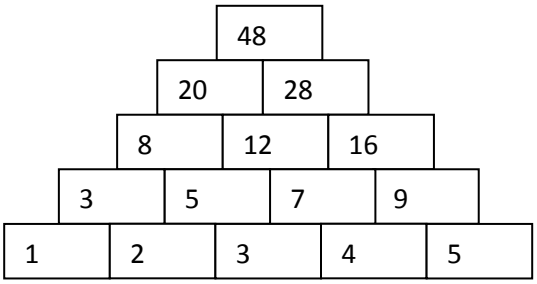



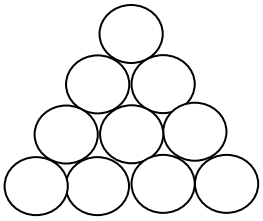



**Example:**




**Question**: Using the same rule, complete the number tower.



| |
|---|
| Check your progress<br>Q. Write four steps more of the following pattern.<br>0 x 9 + 1 = 1<br>1 x 9 +2 = 11<br>12 x 9 + 3 = 111<br>- - - - -<br>- - - - - |
| Q. describe a game to give the concept of multiple.<br>Q. A horse and mule, both heavily loaded, were going side by side. The horse complained of his heavy load. What are complaining about? "If I take one such off your back, my load will become twice as heavy as yours but I remove one sack from my back, your load will be the same as mine" |

**UNIT-7**

# Planning for Teaching

Planning is essential in all spheres of life. It is key to success of all kinds of activities. The teaching learning process also depends upon proper and meticulous planning. It is done at different levels. Such as year planning, unit planning, lesson planning etc.

'One of the most important principles of good teaching is the need for planning. Far from compromising spontaneity, planning provides a structure and context for both teacher and students, as well as frame work for reflection and evaluation (speneer, 2003).

- 7(a) **Unit planning**
- **7**(a)1. **Meaning and importance of unit planning.**
- **Meaning of unit planning:**

A unit in mathematics comprises of a chunk of interlinked competencies/concepts/ content which have some common basics. So, within any area of mathematical learning several units can be formed.

A unit is a large segment of subject matter having a common idea. It can be split up to smaller sub units called topics/lessons and the topics are linked to one another by a common ideas. Each lesson presents a certain feat of the unit. Unit plan permits the application of Gestalt Psychology in that an over view of the unit may be presented by the teacher with the help of the pupils before the actual assimilation activity of the unit begin. Hence, a unit is a logical division of class work or activities. A unit in maths may be covered in one day, several days or week.

Having arranged the mathematical competencies in a graded manner and divided into units for purpose of classroom transaction, you worked like to think of ways of communicating the same to the children. This will obviously make you think of sequence of lesson within a unit, the method of teaching, teaching aids, students' activities and the evaluation procedures. This decision if presented in an organised manner. World result in to a nit plan.

**Definition of unit plan**:
According to wisely- "The unit is an organised body of information and experience designed to effect significant out come for the learner".

**Importance of unit planning**

Unit planning may bring about significant changes in the quality of teaching learning. Some of the suggested points given below high light the importance of unit planning:

- Unit plan breaks up a lengthy unit into smaller sub-units or topics that pupils can easily grasp the scope of these during a brief over view.
- It helps teachers to have a holistic view of teaching- learning, which may help in organising time and resources available at his/her disposal.

- It helps in designing a systematic, sequential and graded arrangement of course content which may give insight to develop teaching activities in the best possible manner.
- It enables the pupils to see clearly the relationship between the various facts, processes and principles that make up the unit.
- It helps the teacher to plan a variety of learning experiences, keeping in mind the individual differences, the nature of content and objectives to be achieved.
- It anticipates future needs e.g, illustrative material to be arranged.
- It provides an opportunity for teacher and pupil interaction.
- It may help unit-wise evaluation of children and in organising remedial teaching and under taking enrichment measures as per need.

➢ 7(a).2**. Steps in Unit Planning:**

Unit planning involves two major processes, namely sequencing and selection. The main focus of unit planning should be to ensure effective learning on the part of children. Some steps to be followed are suggested below:

(i) Select a unit/chapter;
(ii) Divide the unit/chapter into sub-units;
(iii) For each sub-unit, formulate learning objectives;
(iv) Develop instructional procedures for each sub-units. Instructional procedures would include number of periods, main teaching points, teaching –learning activities, methods and teaching aids;
(v) Plan and prepone evaluation questions;
(vi) Have bench marks in place. Once the transaction of the unit has begun, use bench marks to keep you on track for time and to ensure that learning objectives are being met.

➢ 7(**a).3. Developing a Unit Plan:**

A unit plan may be developed as per given format:

Name of the Institution:
Subject: Mathematics
Unit:..... Class: .....

| Sub-units | No. of periods | Specific learning objectives | Teaching points | Teaching-learning Activities | | Methods | Teaching Aids | Evaluation |
|---|---|---|---|---|---|---|---|---|
| | | | | Teacher's Activity | Student's Activity | | | |
| | | | | | | | | |

| Activity: Select a unit of class –II Mathematics and develop unit plan. |
|---|

Q. What do you mean by unit plan?

- 7(b) **Lesson planning**:
- 7(b).1**. Meaning and Importance of Lesson Planning:**

- **Meaning of Lesson Planning.**

Planning for instruction is a part of a teacher day-to-day activity for teaching. It out lines in detail the various steps which the teacher proposes to undertake in his/her class. As such, a lesson plan concerns itself with the teaching of one period. It specifies the learning objectives, content, methods, materials/ equipment, application and evaluation for each lesson that is taught. A teacher who goes to the class without planning for the lesson takes the risk of wasting of time and effort. Thus a lesson plan is a means of taking advance decisions about the selection, sequencing and execution of various activities to be performed in a classroom with a view to ensuring learning of children. Therefore, lesson planning is an essential pre-requisite for good teaching.

- **Definition of Lesson plan**:

Good defined a lesson plan as an " outline of the important points of lesson arranged in the order in which they are to be presented to students by teacher."

- **Importance of Lesson Planning:**

When we go to a classroom for teaching a lesson, usually we get prepared for it through informally. But sometimes we find that we are not able to teach the entire content which you prepared or on the other hand, the content to be covered is not sufficient for full period. Some times we may get stuck-up while teaching and so get nervous. How to overcome all such problems? This can be done through systematic lesson planning. We get a chance of thinking about all these problems in advance while planning our lesson and deciding about taking connective steps for possible obstacles. The process of developing a lesson plan is such that these problems get tackled automatically.

R.L. Stevenson states the importance of lesson plan as, "To every teacher I would say, always plan out your lesson beforehand but do not be slave to it."

- **Application:** In this step the knowledge gained is applied to new and Unfamiliar situations in order to solve the problems related to students' everyday life.

- **Recapitulation**: This step is used for asserting how well the students have understood the concepts and to assess how effective the method of teaching has been.

- 7(b).2. **Steps in Lesson Planning**

A lesson may be planned in various ways. Several approaches have, therefore, been evolved. John Fredrik Herbart, a German Philosopher and educationist (1776-1841) advocated Pedagogy-based lesson planning. Herbartian approach to lesson planning involves the following stapes:

- **Preparation:** It pertains to preparing and motivating the children to learn the new topic. The teacher calls previous learning experiences to the learner's attention.

- **Presentation:** In this step the actual teaching takes place. The students acquire new knowledge and ideas. For an effective learning outcome, the teacher should ensure active student participation by providing a number of learning activities. A teacher should make use of different teaching aids to make the learning interesting, effective and meaningful.

- **Association:** The new ideas are compared, associated and integrated with old i.e. already existing knowledge. This step is significant when we are establishing principles or generalizations.

- **Generalization:** In this step riles and general principles are derived from the new materials as it is important in mathematics where students are often required to establish.

**7(b).3. Developing a lesson plan:**

Lesson plan can be developed on the basis of the following format.

**Format of a Lesson Plan**

**General Entries:**

Name of Pupil-Teacher:
Name of School: Date:
Class: Period:
Subject: Duration:
Topic: Attendance: Present:
Absent:
Total:

<table>
<tr><td>Phase-I<br>Pre-active stage /preparatory stage.</td><td>

- General objectives: i.<br>ii.<br>iii.
- Specific objectives:<br>i.<br>ii.
- Class room setting:
- Teaching Aids :
- Method of Teaching :

</td></tr>
<tr><td>Phase-II<br>Interactive stage/Process communication/Actual Delivery of the lesson</td><td>

- Previous knowledge:
- Introduction:
- Statement of Aim/Announcement of the topic:
- Presentation:

<table>
<tr><td rowspan="2">Teaching point</td><td colspan="2">Teaching learning activity</td><td rowspan="2">Black board work</td><td rowspan="2">Evaluation</td></tr>
<tr><td>Teacher's activity</td><td>Pupil's activity</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
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</table>

- Generalisation if any:
- Application:
- Recapitulation

</td></tr>
<tr><td>Phase-III<br>Out put/ Post Active stage/Real learning out come/post delivery stage</td><td>

- Home Assignment:
- References:
- Identification of learning difficulties:

</td></tr>
</table>

Signature of Mentor/Supervisor Signature of Pupil- Teacher

**Activity**: i. Write the merits of lesson planning
ii.Develop a lesson plan on certain topic of Primary Mathematics text book.

Q. Distinguish between unit planning and lesson planning.

## UNIT-8
# Assessment in Mathematics

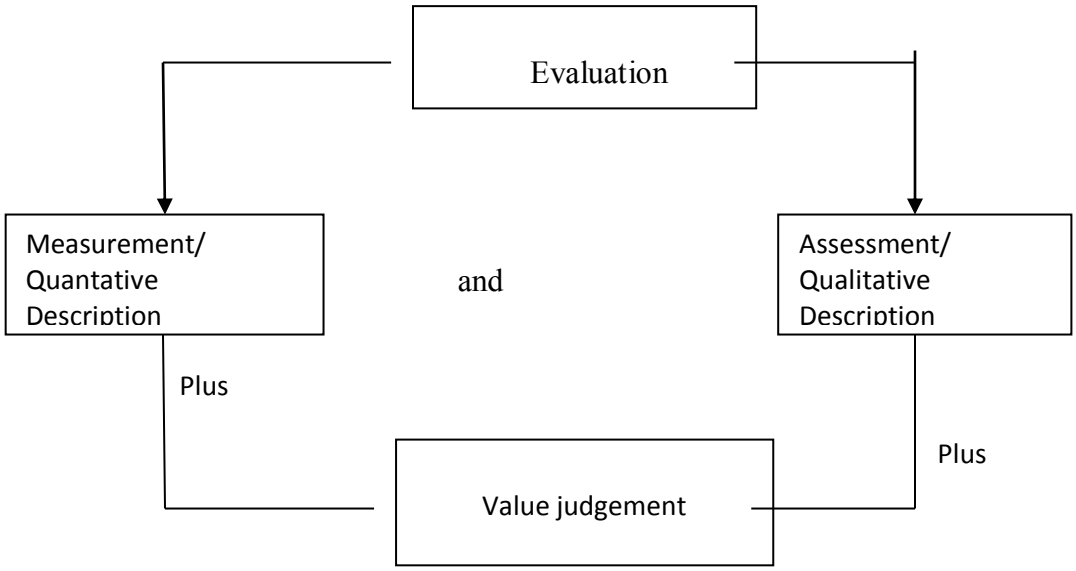
Assessment plays a significant role in strengthening learning process. Its purpose is judging the quality of performance of children while learning is going on.

8.1. **Concept of Evaluation:** It is human nature to know one's quality of work while an intelligent person tries to improve performance by knowing drawbacks and bring to gether all relevant data or information for analysis and interpretation in terms of value judgement on the basis of collected data. The process is known as evaluation. Thus, the statement of the type " the achievement of a student A in the second test is much better as compared to his/her achievement in first test" attempts to evaluate the achievement of the student in two different tests. Evaluation is done on the basis of data or measurement.

**Example:** A class V student scored in English, Hindi, Mathematics and EVS as 90, 85, 75 and 70 respectively in an examination. It is written in his progress report that_he improved significantly in comparison to his performance i.e. earlier examinations and stood first in his class.

Here, scores like 90, 85, 75 and 70 are quantitative description of the student. So, these quantitative values are measurement. It is the first step of evaluation on the other hand the description that he improved significantly and stood first in the class is his qualitative aspect and represents assessment. When we add value to the assessment of student performance. Assessment is the second step of evaluation. We carry out evaluation of their performance.

Thus evaluation is a process of collecting information on the basis of which comparison of two or more sets of information is carried out and judgements about attainment level, in terms of intended learning outcomes are formed, which in turn are used for making decisions. We can understand evaluation by a flow chart given below:




Flow chart: Measurement, Assessment and Evaluation

Hence, evaluation is a process of collection, analysis and interpretation of information on all aspects of a learner's progress to judge the effectiveness of the entire teaching-learning process for further improvement.

**Definition of Evaluation:** " Evaluation is the process of gathering and interpreting evidences on changes in the behaviour of pupil's as they progress through school" Quillen and Hanna.

**Activity:** The teacher may ask students the following questions for their reflection/discussion.

i. How measurement differs from evaluation?
ii. What is the difference between assessment and evaluation?

8.2 **Purpose of Evaluation:** Evaluation is done for various purposes. The following are the purposes of evaluation:

- To determine the present status of the children in the teaching- learning process.
- To permit teachers and supervisor evaluate the effectiveness of curricular experiences, activities and instructional methods.
- To motivate the children for better attainment and growth.
- To help parent to know the progress of their children.
- To provide basis for guidance and counselling.
- To diagnose children's weaknesses and strengths, to point out areas where remedial measures are desirable.
- To provide a basis for modification of curriculum or for the introduction of experiences to meet the needs of the individuals and groups of pupils.
- To encourage teachers for conducting action research.
- To give reinforcement and feed back to both the teacher and pupils.

| Activity: discuss in group situation and think what could be other purposes of evaluation. |
|---|

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## 8.3 Planning Assessment—C C E

Continuous and Comprehensive Evaluation (CCE) refers to a system of school based evaluation of a student which is conducted to assess the strength and weakness of the students frequently and periodically, it also covers all aspects of the students' development. Broadly, CCE emphasises on two objectives:

i. Continuity in evaluation and
ii. Comprehensiveness in evaluation.

The term 'continuous' refers to regularity in assessment. The development of a child is a continuous process. Therefore, students' development should be assessed continuously. It includes 'continual' and 'periodicity' aspect of evaluation. Continual aspect refers to the assessment of learners progress on various aspects from very beginning of instruction i.e. assessment of entry behaviour (Placement evaluation). Continual aspect also includes the

evaluation of learners during the instructional process through various formal or informal methods of evaluation (Formative evaluation). Diagnostic assessment is conducted along with formative assessment during the instructional process to remove learning difficulties of learner.

Another aspect associated with continuous evaluation is periodicity of evaluation. Periodicity means evaluation of performance of learners should be done frequently at the end of every unit or term called Summative evaluation.

The 'comprehensive' objective of CCE means getting a sense of 'holistic' development of child's progress. It includes assessment of both scholastic and co-scholastic areas covering objectives under all domains like cognitive, affective and psychomotor i.e. knowing, feeling and doing.

While the teaching-learning process in Mathematics is going on, it is important for the teacher to assess and monitor the child's learning focusing on identifying different levels of learning, appropriateness of the activity for the class, find out what the child has learnt. Continuous assessment during teaching-learning will also provide inputs/ feedback to the teacher to improve her/his teaching methods.

Planning assessment is the process of thinking about and organising the activities required to achieve a desired goal of bringing out all round or holistic development of learners planning is essential for evaluating pupils' performance. The following aspects need to be considered before designing evaluation.

i. Are the objectives and minimum learning known?

ii. What was the purpose and approach of instruction (teaching) undertaken?

iii. Can information collected through tests the easily interpreted for decisions regarding pupils' progress, placement, achievement and improvements needed?

Different types of tests need to be designed for different objectives, such as for (i) identifying weakness in teaching –learning (ii) promotion to the next grade. Where pace of learning of child is different, a variety of techniques can be used such as oral and written tests, project and practical work. Such techniques provide opportunities to adjust evaluation to the level or pace of learning of the individual child.

Q.1. Differentiate Formative and Summative assessment.

Q.2. Discuss with examples how placement, formative, diagnostic and summative assessment are used in school.

**Activity:** Identify some curricular areas in mathematics where you, as student had not been able to get sufficient experience for learning. Think of the steps you can take to improve it

## 8.4. Tools and Techniques of Evaluation:

Perhaps in all measurement some sorts of instruments are needed. The tool and technique of evaluation is advice that will facilitate the process of measuring and recording the characteristics of pupils.

The tools and techniques of evaluation may be classified as follows:

| Tools | Techniques |
|---|---|
| • Questions<br>• Observation<br>• Interview schedule<br>• Rating scale<br>• Cheek list<br>• Anecdotal records<br>• Test and inventories<br>• Portfolio analysis | Examination: oral/written/practical<br>Assignment<br>Quizzes<br>Projects<br>Debates<br>Elocution<br>Group discussion<br>Club activities<br>Demonstrations |

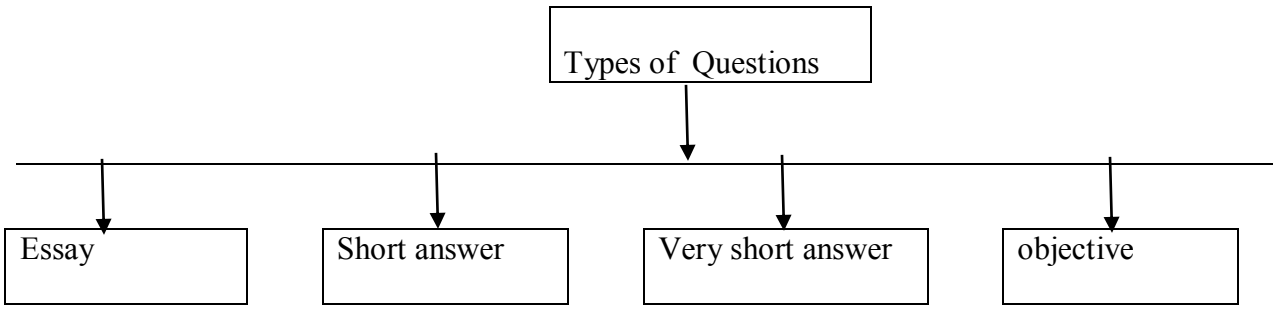
At the elementary level, multiple tools can be used for pupils' assessment. Similarly, more than one assessment tool can be used in several assessment techniques.

Here we describe about the tool 'Question'.

1. **Questions:**

Questions are the most commonly applied assessment tool for finding out what children know, think, imagine and feel. A teacher, during teaching, comes to know about pupils' learning difficulties by asking questions. Questions as a tool are primarily used in examinations.

- **Types of Questions:** Questions may be divided into four categories for proper assessment of the students.




i. **Essay Type Questions/ Long Answer Type Questions (LA):** The term essay implies a written response which is sustained form of writing. The student is free to choose the answer and present it with full freedom of expression.

**Example:** a. A godown is in the form of a cuboid measuring 60 m X 40 m X 30 m. How many cuboidal boxes can be stored in it if the volume of one box is 0.8 $m^3$?

b. Explain fractional number with examples.

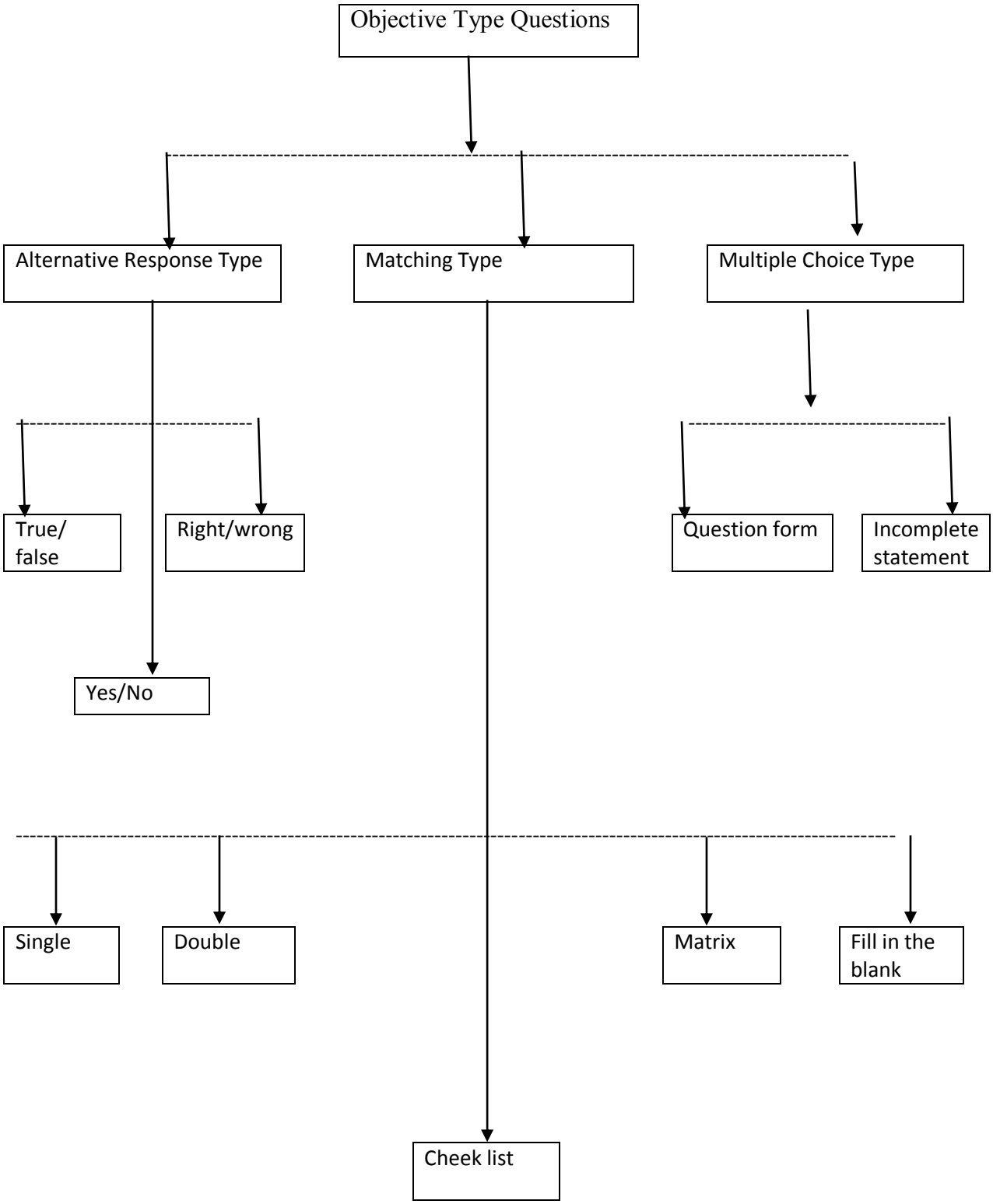
ii. **Short Answer Questions: (SA):** In this section student is restricted to word limit/steps during answering.

**Example:** Find the H.C.F of 48, 64 and 72.

**iii.** **Very Short Answer Questions: (VSA):** The response of such question should be in one word/one sentence/one step. Such item basically tests the knowledge of the learner.

**Example:** a. How many prime number is between 6 and 10 ?
b. Find all factors of 4.

**iv.** **Objective type Questions:** In objective type questions students have to answer them by selecting the correct answer among the provided choices. These may be divided as shown in the following diagram.


Objective Type Questions
Alternative Response Type
Matching Type
Multiple Choice Type
True/ false
Right/wrong
Yes/No
Question form
Incomplete statement
Single
Double
Matrix
Fill in the blank
Cheek list

**a. Alternation Response Type:** In these types of questions students have select one out of two alternatives as a correct answer. The different type of alternative response questions are given below:

1. **True /False or Yes/ No Question:** In this type of question a statement is given and the student is asked whether it is true or false (T/F). It measures student's understanding particularly in the class testing.

- The place value of 4 in the number 246 is 40 ☐
- 6 is a multiple of 5 ☐

**ii.Right/wrong type or yes/no type**: Put a tick (✓) mark if statement is right and (x) if wrong.

**Example:**

- Triangle is a two dimensional figure. ☐
- 8 is completely divisible 3 ☐

**b. Matching :** In this type of questions there are two columns. The student has to pair each item of the first column with some other item in the second column on basis of some criteria given in the item. The matching type question may be of the following:

i.**Single Matching:**

**Example:** Match the words given in column A with column B to make a correct pair.

| Sl. No. | Column A | Column B |
|---|---|---|
| 1 | Rectangle | ◯ |
| | Circle | ▭ |

ii.**Double Matching:** In this type of item one list of information is provided to test two areas of knowledge. So three columns are used in place of two columns.

**Example**:

| Column I sides | Column II geometrical figure | Column III angles |
|---|---|---|
| Four sides | Triangle | Three angles |
| Three sides | Quadrilateral | Four angls |

iii.**Checklist:** In this type of item, students are provided two or three alternatives as the checklist to make decisions about a number of statements on the basis of the checklist provided.

**Example:** For each of the following numbers use letters to indicate whether the number is Even (E)/ Odd (O)

| Number | Type |
|---|---|
| 3 | |
| 16 | |
| 23 | |

iv.**Matrix**: These are extension of double matching type items where in more than two responses are linked to an item.

**Examle:** Put tick mark (✓) below the type of number against the number name.

| Number name | Natural | Whole | Even | Odd | Prime | Composite |
|---|---|---|---|---|---|---|
| Two | | | | | | |
| Twelve | | | | | | |
| Sixty Four | | | | | | |

v.**Fill in the blanks type**:

**Examle:** The time 90' clock in the morning is written as 9:00 (a.m/p.m)

c. **Multiple Choice:** In multiple choice questions, there is a stem which poses the problem. The stem may be in question form or in the form of an incomplete statement. Then there are four of five choices given for an answer. The student has to select the correct answer from the given alternatives.

i.**Question form:**

**Examle:** When one of the following figures all the four sides are equal and each angle is a right angle?

i.Rectangle
ii. Trapezium
iii.Square
iv.Rhombus

ii.**Incomplete Statement Form:** The common property shared by a triangle and a quadrilateral is of

i.Three angles
ii.Four angles
iii.Three vertices
iv.Four vertices
v.Two dimensional figure

- 49: 81 : :----------: 144
- Right angle:----------: :Straight angle : $180^0$

iv.**Interpretive Type:** Read the train journey table given below and answer the following questions that follow:

| Distance from Naharlagun: (in km) | Station |
|---|---|
| 19.4 | Harmuti |
| 162.1 | Rangapara North Jn. |
| 284.9 | Rangia Jn. |
| 393.9 | New Bangaigaon Jn. |

Q. Find the distance between.

i.From Harmuti to Rangia Jn.
ii.From Rangapara North Jn. To New Bongaigaon Jn.

**Activity:** Discuss with your peer groups and develop a matrix type test item for primary level mathematics.

Q. Make objective type questions of five multiple choice type on the topic of your choice.

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