Understanding Mathematics

Teacher's Guide for Class 2

Department of School Education
Ministry of Education and Skills Development
Royal Government of Bhutan
Thimphu

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Cultivating the Grace of Our Mind

ཞེས་རིག

Foreword

I am at once awed and fascinated by the magic and potency of numbers. I am amazed at the marvel of the human mind that conceived of fantastic ways of visualizing quantities and investing them with enormous powers of representation and symbolism. As my simple mind struggles to make sense of the complexities that the play of numbers and formulae presents, I begin to realize, albeit ever so slowly, that, after all, all mathematics, as indeed all music, is a function of forming and following patterns and processes. It is a supreme achievement of the human mind as it seeks to reduce apparent anomalies and to discover underlying unity and coherence.

Abstraction and generalization are, therefore, at the heart of meaning-making in Mathematics. We agreed, propped up as by convention, that a certain figure, a sign, or a symbol, would carry the same meaning and value for us in our attempt to make intelligible a certain mass or weight or measure. We decided that for all our calculations, we would allow the signifier and the signified to yield whatever value would result from the tension between the quantities brought together by the nature of their interaction.

One can often imagine a mathematical way of ordering our surrounding and our circumstance that is actually finding a pattern that replicates the pattern of the universe - of its solid and its liquid and its gas. The ability to engage in this pattern-discovering and pattern-making and the inventiveness of the human mind to anticipate the consequence of marshalling the power of numbers give individuals and systems tremendous privilege to the same degree which the lack of this facility deprives them of.

Small systems such as ours cannot afford to miss and squander the immense power and privilege the ability to exploit and engage the resources of Mathematics have to present. From the simplest act of adding two quantities to the most complex churning of data, the facility of calculation can equip our people with special advantage and power. How intelligent a use we make of the power of numbers and the precision of our calculations will determine, to a large extent, our standing as a nation.

I commend the good work done by our colleagues and consultants on our new Mathematics curriculum. It looks current in content and learner-friendly in presentation. It is my hope that this initiative will give the young men and women of our country the much-needed intellectual challenge and prepares them for life beyond school. The integrity of the curriculum, the power of its delivery, and the absorptive inclination of the learner are the eternal triangle of any curriculum. Welcome to Mathematics.

Imagine the world without numbers! Without the facility of calculation!

Tashi Delek.

Thakur S Powdyel

Thank you, Teacher. I can read this!

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INTRODUCTION

BACKGROUND

Mathematics is a beautiful and a profound subject. Apart from this fact, it is a necessary tool in the study of science, technology and other specialized areas of studies at the higher levels. It also has immense utility to offer in our daily lives, now more so than ever in this age of technology and information. By this, we are taking into account the broadened understanding of what mathematics is, which includes mathematical processes and competencies like reasoning, mathematical communication, connection, representation, and problem solving and decision making along with the knowledge of mathematical contents.

For these reasons, the prominent place that mathematics occupies in the school curriculum will only continue. But, while there has been no dispute about this fact, mathematics has not always been an enjoyable subject for students, as much as it should have been. The unpopularity of the subject, in general, is also evidenced in the students' generally low performance in examinations. There are many reasons for this, some of which are: certain myths surrounding mathematics such as that the subject is difficult by its nature, mathematical competency is determined by certain genetic leans in terms of gender and race; a not so exciting experience of adults and their attitude towards mathematics, which in turn influences the attitude of children towards it; and shortfalls in curriculum and instruction, and assessment systems which predominantly test and reward knowledge memorization without fostering true understanding. This scenario is specific not only to Bhutan, but all over the world, at least until quite recently. Fortunately, this need not continue. Every student can enjoy, understand and do reasonably well in mathematics. And, every student needs to learn significant mathematics. Researches, studies and initiatives around the world advocate and confirm this.

Realizing these, the Ministry of Education decided to invest in the improvement of teaching and learning of mathematics in our schools during the 9th and the 10th Five Year Plan periods (2003-2008, 2008-2013) as a priority. Thus, the following plan of action was set:

- Development of the School Mathematics Curriculum Framework PP-12
- Development of Textbooks and Teachers' Guide
- In-service Teacher Trainings to Implement the New Curriculum

The development of the School Mathematics Curriculum Framework PP-12 was undertaken and completed in 2004. The framework states the mathematical standards, mainly in terms of the mathematical contents and competencies, for each class from PP to 12. Since getting the framework correct was crucial for subsequent curriculum development, it is appropriate to mention two features of the developmental process related with it here. First, to ensure that the standards are at par with the international standards, the framework was developed with technical assistance from an international consultant. The standards in the framework was also informed and influenced to a great extent by the Mathematics standards set for the North American schools by the National Council of Teachers of Mathematics (NCTM), based in the United States of America. Second, to ensure that the standards address our specific requirements and situations, the draft framework was widely consulted with relevant stakeholders, including schools and teachers, relevant educational institutions and professionals for comments, feedback and reactions before its endorsement. So the framework we now have is a blend of international norms and our local needs.

With the development of the new Textbooks and Teacher's Guides the implementation of the new mathematics curriculum for classes 4 to 12 has been achieved, in stages, between the years of 2006 and 2009. To ensure quality by incorporating international and current best practices, the books for classes 4 to 12 were developed with technical assistance from a team of renowned international authors and mathematics educators. The new mathematics curriculum for class PP to 3 is being implemented during the years of 2011-2013, starting with class PP in 2011. The main curriculum documents for classes PP to 2 consist of Teacher's Guides and Student Activity Books while students in class 3 will start using a textbook. Effective use of these documents will help to achieve the objectives outlined in the framework.

The mathematics contents appropriate for Class 2 to achieve the standards set in the Framework are logically sequenced and elaborated upon through the chapters and lessons. The lesson activities in this Guide were carefully designed so that teachers can use them with or without modifications. It is, however, not intended to restrict the teachers from using their own ideas and styles. In fact, we would like to urge the teachers to go beyond the ideas presented in this Guide to access other relevant resources and, more importantly, to try out innovative, creative and resourceful methods in their teaching.

We would like the teachers to critically review the contents of this Guide as they teach and urge you to give your comments and opinions on any aspect of the book to the Primary
Mathematics Section of DCRD for its improvement.

HOW MATHEMATIC HAS CHANGED

Mathematics is a subject with a long history. Although newer mathematical ideas are always being created, much of what your students will be learning is the mathematics that has been known for hundreds of years, if not longer.

There are some changes in the content that you will teach in Class 2. Some of the contents are new. For example, content and ideas on Patterns and Probability are new. Some contents from the previous curriculum were not included in Class 2. For example, formal contents on Money, Multiplication and Division are not included in class 2 as per the Framework.

What you may notice most is a change in the approach to mathematics. Worldwide, there is now a greater emphasis on the need for students to understand the mathematics they learn rather than to memorize rote procedures. There may be so many reasons for this.

- In the long run, it is very unlikely that students will remember the mathematics they learn unless it is meaningful. It is much harder to memorize “nonsense” than something that relates to what they already know. The importance of learning core mathematical facts remains important, however.

- Some approaches to mathematics have not been successful; there are many adults who are not comfortable with mathematics even though they were successful in school.

In this program, you will find many ways to make mathematics more meaningful for the students.

- We will always talk about why something is true, not simply that it is true. This becomes the norm for students when they provide an answer to a question. For example, when students say that a sequence is a pattern, they have to always have a reason for why they think it is a pattern.

- As far as possible most of the teaching situations and contexts are drawn from the immediate surroundings of the students themselves, so that they can connect and relate easily to the mathematical ideas presented to them in the context of everyday lives. For example, the data for Data Management and Probability chapters are all collected from within the classroom, either related to students themselves or from the simple experiments they perform.

- Students will find direct connections among the mathematical ideas learnt in one chapter with those learnt in other chapters. For example, the concepts on shapes are used in making patterns and learning numbers.

- Students are required to exhibit their understanding of mathematical ideas through the need to communicate, talk, explain, and give reasons and use models or physical objects.

- When discussing mathematical ideas, we expect students to use the processes of problem solving, connecting mathematical topics to each other) and representation (representing mathematical ideas

in different ways, using manipulatives, graphs, and/or tables, for example).

- A significant amount of research evidence has shown that these more meaningful approaches work. Scores on international tests are higher when emphasis on higher levels of thinking accompanies the application of skills.

THE DESIGN OF THE TEACHER'S GUIDE FOR CLASS 2

The Teacher's Guide for Class 2 contains 10 chapters as detailed in the Table of Contents, to teach the curriculum for Class 2. Each chapter of the Guide has the following features:

- Chapter Overview
- Lessons
- Chapter Assessment

Chapter Overview

The Chapter Overview describes the mathematical background to the chapter. It clarifies the key concepts and ideas in the chapter. It also describes briefly the general pedagogical aspects related with teaching the chapter. It has the following subsections.

Basic Principles

This contains the key mathematical ideas of the chapter, along with its pedagogical aspects, summarized in bulleted statements. This offers the benefit of easy reference to the key ideas.

Chapter Goals

These are broad but attainable goals that the students should achieve by the end of the chapter. The students' learning progress under each chapter should essentially be gauged against the chapter goals.

Maths Words

The key mathematics words and terms used during the lessons and which the students should use with understanding are stated here. These words should be put up, with appropriate illustrations, on the Maths Wall, either at the beginning of the chapter or as and when they appear for the first time during the course of the lessons.

Lessons

Each chapter is divided into a number of lessons, as can be seen from the Table of Contents. Each lesson has the following subsections.

Objective

One or two specific objectives pertaining to the lesson are stated here.

Materials

The required and suggested materials for the lesson are enlisted here.

Activity Description

This section, which appears right below the Materials section, describes how the lesson may be carried out. It usually contains activities for the students to carry out either in pairs or small groups. The activities are designed in logical sequence to provide the students with essential knowledge, skills and experience of mathematics so that the students achieve the objects set for the lesson. It usually contains sentences in boldface type: these are models of sentences that the teacher could use in talking about the activity including giving instructions and asking questions to the students. Although the activities are carefully designed to be suitable for use in schools across the country, they should be treated as samples only. As such they could be modified, adapted, or even replaced according to the teacher's classroom needs and the school's unique learning situations.

Maths Note

This section talks about specific mathematical concepts and issues related to the lesson, including some of the common mathematical misconceptions that students could have, and how to avoid them.

Assessment for Learning

This reminds the teacher of the main and related learning outcomes and processes that the students should experience during the course of the lesson. It also suggests how to support the students in alternative ways to help them achieve the objectives.

Extensions

Most of the lessons have a section called Extensions. It describes additional activities related to the lesson which would help toward achieving the lesson objectives. It will be important to carry out these extended activities to consolidate the concepts in the lesson.

Chapter Assessment

The overall purpose of the assessment is to improve student learning. Assessment should be an integral part of instruction. As such, assessment should be carried out on an on-going basis, both formally and informally. Students exhibit their learning primarily by doing, showing and talking. As such, we should use strategies such as observing, listening, and asking probing questions to understand their learning progress.

Assessment is generally put under two types – Formative Assessment and Summative Assessment. Formative Assessment is the assessment that is carried out to see whether and how the students are learning. It is not meant to measure the students' learning. As such, no grades or marks are used in formative assessment. Formative Assessment is sometimes known as Assessment for Learning. Summative Assessment is assessment that is used to measure the students' learning (or level of it) against the learning standards or goals, at the time of using it. Letter grades or numerical marks are used as the measure of learning. Summative Assessment is sometimes known as Assessment of Learning.

For the purpose of assessing and helping the students understand and achieve the chapter goals, the assessment tips and ideas are all provided in an integrated manner within the lessons. On top of this, to provide for systematic record keeping, two main types of assessment methods are to be used to assess the students with each chapter. These methods are the Chapter Checklist for Formative Assessment and the Interview-based Performance Task for Summative Assessment. Further details on how to carry out the assessments are provided at the end of each chapter.

THE CLASSROOM ENVIRONMENT

This new curriculum requires a change in the classroom environment to include more pair and small group works, and an increased emphasis on communication. This way, students will become genuinely engaged in mathematical thinking instead of being mere spectators.

The lesson activities in this Guide are all designed for use in pairs or small groups. Of course the opportunity for whole class instruction is always there, especially for the introduction and the closure of the lessons. The benefits of group work and communication are elaborated below. To facilitate these, the seating of the students in the classroom should necessarily be in small groups as opposed to all the students sitting facing the blackboard in neat rows.

Pair and Group Work

There are many reasons why students should be working in pairs or groups, including:

- to ensure that students have more opportunities to communicate mathematically (instead of competing with the whole class for a turn to talk)
- to make it easier for them to take the risk of giving an answer they are not sure of (rather than being embarrassed in front of so many people if they are incorrect)
- to see the different mathematical viewpoints of other students
- to share materials more easily

Sometimes students can work with the students who sit near them, but other times you might want to form the groups so that students who are struggling are working together. Then you can help them while the other students carry out the task mostly on their own. Students who need enrichment can also work together so that you can provide an extra challenge for them all at once.

You should set down rules of behaviour for the students when they work in groups, so that each student participates fully in the group task. You need to avoid a situation where four students are working together, but only one of them is really doing the work. You might explain and post Rules for Group Work, as shown here. It may take time in the beginning, but gradually, this would become a norm in your classroom in running group works effectively.

Rules for Group Work

- Make sure you understand all of the work produced by the group.
- If you have a question, ask your group members first, before asking your teacher.
- Find a way to work out disagreements without arguing.
- Listen to and help others.
- Make sure everyone is included and encouraged.
- Speak just loudly enough to be heard.

Once students are used to working in groups, you might sometimes be able to base assessment on group performance rather than on individual performance, for both formative and summative assessments.

Communication

Students should be communicating regularly about their mathematical thinking. It is through communication that they clarify their own thinking as well as show you and their classmates what they do or do not understand. When they give an answer to a question, you can always be asking questions like: How did you get that? How do you know? Why did you do that next?

Communication is practised in small groups, but is also appropriate when the whole class is working together.

Students will be reluctant to communicate unless the environment is risk-free. In other words, if students believe that they will be reprimanded or made to feel bad if they say the wrong thing, they will be reluctant

to communicate. Instead, show your students that good thinking grows out of clarifying muddled thinking. It is reasonable for students to have some errors in their thinking and their use of language; you must help shape that thinking with encouragement. If a student answers incorrectly, you must ask follow-up questions that will help the student clarify his or her own thinking.

Many of the questions in the Guide require students to explain their thinking, or give reasons. This enhances both their communication skills and mathematical thinking.

MATERIALS NEEDED

The new mathematics curriculum and the Teacher's Guide require the use of concrete materials for the teaching and learning of mathematics. The use of concrete materials helps in representing and clarifying mathematical ideas. The following materials should be made available in the classroom for the proper teaching and learning of mathematics in Class 1.

Snap cubes

An adequate number of snap cubes in various colours should be available. Snap cubes are required in almost all of the chapters.

Pattern blocks

A set of pattern blocks consists of five 3-D shapes with the shape of the bases as a hexagon, a trapezoid, a square, a rhombus, and an equilateral triangle, as shown here. The pattern blocks may be made of wood, plastic, or rubber. They are normally coloured. It would be nice if the blocks in all three of these materials are available in the class. The pattern blocks are required especially for chapters on Geometry and Measurement.

Counters

Counters are simply, and normally, circular disc shaped roughly the size of a normal coin. Counters may be made of wood, plastic or rubber and are coloured. Counters are required especially for chapters on Numbers, Data Management and Probability.
Counters can be easily improvised using stiff paper or plastic materials. They can also be substituted by other items in uniform size and shape such as snap cubes, pattern blocks, pebbles, buttons, and seeds for their intended uses.

3-D Geometric Shapes

A set of 3-D geometric shapes would consist of a cylinder, a cone, a cube (rectangular prism), a cuboid (rectangular prism), a sphere and a pyramid. About 3 to 4 such sets would be required for a class of about 30 students. These shapes are required especially for chapters on Geometry. 3-D shapes can be and should be improvised in the school. Some of them such as rectangular prisms, cylinders and spheres are found in the forms of common objects such as boxes, containers and balls.

Geo-board

Geo-boards are required for students to exploring making different 2-D shapes. Geo-boards can also be made or improvised in the school.

Student Activity Book

The Teacher's Guide for Class 2 has an accompanying Student Activity Book for individual students. The Student Activity Book is intended to help the teachers with extended activities for the students at the end of and during the lessons. The activity book also contains reproducible pages and assessment sheets to help the teachers with time and resources for teaching and assessment. Every student should get a copy of the Student's Activity Book.

Other Teaching Learning Materials

Besides the above materials, the following teaching learning materials would be necessary through the year:

Scissors – about 10 for a class size of 30 students
Newsprint papers – about 70 sheets to last for a year
Chart papers – about 30 to last for a year
Duct tapes – about 5 rolls to last for a year
Sellotapes – about 3 rolls to last for a year
Glue (preferably glue sticks) – about 3 for a year
Crayons – a packet for each student
Papers (duplicating papers) – about 2 reams for a year
Rulers (15 cm long, 30 cm long, 1 m long) – about 10 to 15 for a class
Feely bags – about 10 to 15 for a class
Dice - about 10 pairs for a class

MATHS WALL

There should be a designated wall space for displaying relevant mathematical materials like charts, sight words, and students' works. The displays could be changed depending upon the chapters and topics being taught.

MATERIAL CORNER

It would be nice if a material corner could be set up in the class. It could be a cupboard, or a shelf at a suitable corner, where the materials are neatly placed and can be reached by students as and when required. The various materials could be placed in various containers with proper labeling. Students could help in the sorting, caring and maintenance of the materials.

MODE OF SUMMATIVE ASSESSMENT FOR CLASS 2

The Summative Assessment in Class 2 is to be done through the following three means.

- Interview-based Performance Task (for Continuous assessments)
- Half-yearly Examination
- Annual Examination

Interview-based Performance Task for Chapters

An Interview-based Performance Task is a small task, usually a hands-on one, which you give the students

to do, to see if the student understands certain embedded concepts and can perform the associated skills. You should make the task interactive between you and the student by asking related probing questions.

The Interview-based Performance Task for a chapter should be conducted towards the end of it with each student. It may not be necessary to carry out this assessment in a very formal setting. Instead, it could better be done in an informal manner, but with advanced planning. Carrying out the Performance Task will reinforce the observations done with the Chapter Checklist and other formative assessments, and can assess the student against many of the chapter goals in a related manner.

Because the Interview-based Performance Task is required to be carried out for every chapter, it can be referred to as Continuous Assessment.

A ready-made format for one Interview-based Performance Task for each of the chapters for each student is provided as Summative Assessment Recording Sheets. They are included in the Student Activity Book at its end. You will need to cut out these sheets and file them in a ring binder file or folder for use and maintenance for each student.

A student's performance in each task is to be marked out of a total of 10 marks. As it will be clear from the formats in the Summative Assessment Recording Sheets, each task provides an opportunity for the teacher to assess the student's proficiency against the essential chapter goals. The interview prompts or the probing questions that go with the task should be focused towards eliciting the desired responses from the student, which would in turn serve as evidence of the student's acquirement level of the concepts and skills.

As far as the marking scheme is concerned with the Interview-based Performance Task for the students, each key concept or skill mentioned is worth a total of 2 marks. If the student displays the understanding of a key concept or a performance of a key skill easily and proficiently, 2 marks can be awarded for it. If the student needed much probing and support to do that, 1 marks should be awarded. It the student needed a moderate amount of support to do that, 1.5 marks should be awarded. The total marks the student obtains for the complete task should then be converted to be out of 10 marks. In case a student cannot perform even at a minimum level, student should be retaught the key concepts and skills rather than failing the child until he or she is able to do the minimum. This approach ensures that no child is left behind in the learning process. As can be seen, such an assessment provides for opportunities to teach even when a student is being assessed.

Examinations

The students in Class 2 will be required to write both the half-yearly and the annual examinations.

Half-yearly Examination

The question paper for the half-yearly examination should be set out of 30 marks, with a writing time of 1 hour. The paper should not be divided into any section. There could be a total of 15 to 20 questions in the paper. The questions should be set from the chapters covered during the Term I period. The questions or instructions should be simple, direct, appropriate, and easy to understand by the students. Some of the students may also require help with explanation of the questions during the examinations, which should be provided. You could include appropriate questions similar to the ones in the Student Activity Book.

Annual Examination

The question paper for the annual examination should be set out of 50 marks, with a writing time of 1 hour. The paper should not be divided into any section. There could be a total of 15 to 20 questions in the paper. The questions should be set from all the chapters. The questions or instructions should be simple, direct, appropriate, and easy to understand by the students. Some of the students may also require help

with explanation of the questions during the examinations, which should be provided. You could include appropriate questions similar to the ones in the Student Activity Book.

Student Progress Report Card

The scores from the two methods of summative assessment will then be used to generate the Student Progress Report Card. The split of weighting between the Continuous Assessment (CA) and the Examinations for the whole year will be as given below:

The total CA mark obtained before the half-yearly break, depending on the number of chapters covered by then, should be converted to be out of 30% to be entered in the Student Progress Report Card. The CA marks after the half-yearly break should also be converted to be out of 30%, for entering in the Student Progress Report Card, giving a total of 60% for the CA for the entire year.

The marks obtained by the students in the half-yearly and annual examinations should be converted to 15% and 25% respectively for entering in their progress report card.

Term 1		**Term 2**		**Total**
CA (Interview-based Performance Tasks)	Half-yearly Exam	CA (Interview-based Performance Tasks)	Annual Exam	
30%	15%	30	25 %	**100%**

CHAPTER 1 NUMBERS TO 100

Chapter Overview

The students would have developed a fairly good understanding of number concepts and basic number skills by the experiences provided in Classes PP and 1. In particular, the students would be able to read and write numerals and number words to 100, represent numbers with concrete materials and drawings, compare numbers, describe numbers in relation to other numbers, describe a number in terms of its parts and/or in terms of tens and ones, and use numbers in counting with correct techniques, including skip counting. They have also used numbers in simple measurement contexts, and in operations such as addition and subtraction. This chapter will consolidate and build further on the students understanding and skills with numbers to 100.

The overarching emphasis remains as the conceptual understanding along with the development of mathematic skill in the students. Therefore, as mentioned in the introduction to this book, you should create and provide opportunities for the students to explore, discuss, express and present ideas in groups, whole class and individually on a daily basis. A lot of these opportunities created for the students may entail taking risks on the part of the students to engage. So, a consistent awareness of this, and patience and providing encouragement may be required from your side to the students until a healthy learning environment is established in your class with the students.

This chapter has 10 lessons as detailed in the Table of Contents. The conceptual learning of numbers will be extended further in both chapters 4 and 8.

Basic Principles about Numbers

- Numbers tell us how many or how much.
- It does not matter in which order you count; the number of the set does not change. But when using ordinal numbers, order does matter. If 8 items are moved around, there are still 8 items, but the one that was 3rd may no longer be 3rd.
- In counting, one and only one, number is said for each object, and the last number spoken tells how many.
- To understand what a number means, the students must experience and create many representations for the number.
- Relating numbers to benchmark numbers, such as 5, 10, and 20 helps to compare numbers, give meaning to those numbers, and support subsequent work in addition and subtraction.
- Tools such as 10-frames, number lines, and 100-charts help highlight patterns and number sequences, in addition to being useful for comparing numbers to familiar benchmarks.

Chapter Goals

- Use ordinal numbers when talking about the dates of a month.
- Relate the dates on a calendar to the days of the week.
- Skip count by 2s, 5s, and 10, both forward and backward.
- Estimate the number of objects in groups ranging from about 30 to 100 objects.
- Represent numbers with concrete materials, drawings, ten-frames and counters, and tally marks.
- Compare two numbers up to 100 using number lines and 10-frames.
- Use the symbol > for ‘more than’ or ‘greater than’ and the symbol < for ‘less than’.
- Describe numbers by relating them to other numbers.
- Describe simple repeating, growing, and shrinking number patterns.
- Compare simple number patterns.

- Extend simple repeating, growing and shrinking patterns.
- Explain or describe their rule for extending the patterns.
- Recognize even numbers as numbers that are doubles.

Maths Words

Ordinal number, skip counting, estimate, count, 10-frames, tally marks, number line, more than, greater than, less than, repeating pattern, growing pattern, core, increasing pattern, shrinking pattern, decreasing pattern, pattern rule, even number, odd number, double.

Initial Assessment

Before you begin the chapter formally, it is important to assess the students' readiness level. Essentially, invest some time in assessing, and helping the students in the following areas.

- The students should be able to say the counting numbers from 1 to 100 orally.
- The students should be able to read and write both the numerals and number words to 100. Some students may need to be supported and provided practice in this through the year even during the teaching of other chapters.
- Read, write and use ordinal numbers to 10th.

Lesson 1 Calendar Numbers

Objectives

Use ordinal numbers when talking about the dates of a month.
Relate the dates on a calendar to the days of the week.

Materials

Real calendar(s) (preferably large calendars)
Chart papers
Marker pens

Maths Note

A calendar provides a natural context for students to see and use the numbers from 1 to 31. They have an opportunity to read and represent numerals and to see the order of the first 31 numbers. The calendar is also a natural place for using ordinal numbers like first (1st), second (2nd), third (3rd), and so on, up to thirty-first (31st).

The student would have to be provided opportunities to practise saying and writing the dates (as ordinal numbers) over several days beyond this lesson.

Briefly discuss (and revise if necessary) the students' knowledge on the basic facts about months and weeks, by asking questions such as: **What month is it now? How many months are there in a year? What are the names of the months? What is the first month of the year? What is the second month of the year? What is the last month of the year? What did you do in January? How many days are there in a month? Which year is this year? How many days are there in a week? What are the names of the days?**

Display a large calendar. Introduce all of the months to the students. Then focus on the month of January as an example to show the essential features of a calendar, such as the dates and the names of the days. Make sure the students realize that there are 7 columns, for the 7 days, and that the number 1 may appear in any column, depending on the day of the 1st of the month. Help them notice that the numbers increase by 1s. Have the students say aloud the numbers on the calendar from 1 to 31, as you point to them, one by one, in sequence.

Proceed to take the students through a similar process with the months of February, March and April. Help them notice that the number of days in a month is either 30 or 31, except for February with only 28 (or 29 in the case of a leap year). Later in the year you can clarify the number of days in each month.

Use the calendar for the current month as the basis of a whole class discussion. If a large calendar is not available, a calendar could be prepared on a chart paper using the format shown below.

Month: _____						
Sunday	Monday	Tuesday	Wednesday	Thusday	Friday	Saturday

Have the students say aloud the numbers on the calendar once again as you point to them in sequence. Ask questions such as: **What is the current month? How many days are there in this month?** Explain that the

numbers tell the dates of the month, and that we use ordinal numbers to say the dates. Point to the dates, initially from 1st to 10th in sequence, and have the students say them as **first, second, third, fourth, fifth, … tenth.** Then, ask questions such as: **Which day is the 4th in the month? the 5th? the 10th? the last?**

Then, practise using the ordinal numbers past 10th, namely, the 11th (eleventh), 12th (twelfth), 13th (thirteenth), 14th (fourteenth), 15th (fifteenth), 16th (sixteenth), 17th (seventeenth), 18th (eighteenth), 19th (nineteenth), 20th (twentieth), 21st (twenty-first), 22nd (twenty-second), 23rd (twenty-third), … 31st (thirty-first). These will have to be introduced with an emphasis on the endings as in th in 9th, rd in 23rd, nd in 2nd or st in 31st. The appropriate endings will be practiced and learned over time, as the calendar can be used as a daily resource.

Students should relate the numbers to the appropriate ordinals for the dates. Have a student show a date by asking: **Can someone show me the sixteenth of the month?** Repeat this for a few more dates, choosing a different student each time.

Then, ask questions such as: **What day is the 1st day of the month? What day is the 7th day of the month? What numbers can you see in the column for Sunday? What are the dates of the month that fall on a Sunday?**

Assessment for Learning

See that the students can say the dates as ordinal numbers up to the 31st. Also, see that they can read the calendar and relate the dates with the days of the month.

Extension

Have the students practise saying and writing the dates, as ordinal numbers to 31st in their notebooks.
Have, and help the students complete the related activities in their Student Activity Books.

Without looking ahead on the calendar, see if they can name the days and dates for the first week (several days). See if they can correctly name the date of the first Tuesday next month

Lesson 2 Counting on a Number Line

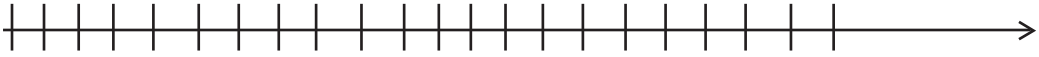
Objectives

Use number lines to count forward by 2s, 5s, and 10s.

Materials

Number line drawn on a chart
Marker pens

Put up a number line with the numbers from 0 to 50. You could extend the number line later to 100, when the students become ready for it.



Have the students chant the number names from 1 to 50 by 1s, as you point to each number on the number line. Ask the students if they could count the numbers in another way. Then, have the students chant the numbers by 2s, as you point to the multiples of 2 on the number line to 50. Explain that this is called skip counting, and that they have skip counted by 2s. In skip counting, you leave out some numbers in between. Then, practise skip counting by 5s, and then, by 10s to 50.

Students should look at the patterns of the numbers to help them skip count forward with multiples of 2, 5, or 10. For example, the endings of the numbers when you count by 2s starting from an even number are 2, 4, 6, 8, 0, in that order. Hence, after 36 must be a number ending in 8 as in 38, then 0 as in 40, and so on. The endings of the numbers when you count by 5s alternate between 5 and 0. The endings of the numbers when you count by 10s are always 0. In order to make these evident, you could write the numbers for each type of skip counting on the blackboard with the help of the students, as shown below.

Skip counting by 2s: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, …50
Skip counting by 5s: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50
Skip counting by 10s: 10, 20, 30, 40, 50

Ask questions such as:

You are counting by 2s. Continue after 36, 38, …
You are counting by 5s. Continue after 25, 30, …
You are counting by 10s. Continue after 20, 30, …
You say the number 40. What could you have been counting by? What else?
You say the number 45. What could you have been counting by?

Maths Note

Skip counting is a helpful skill in counting greater numbers of items. Although, the focus is on skip counting by 2s, 5s and 10 in this lesson, the students could apply the skill with other numbers, which will also be useful later on when students work on multiplication. Practising the skill with a number line provides the students with visual support they are likely to need at this early stage.

Assessment for Learning

See that all the students can skip count fluently by 2s, 5s, and 10s at least by using a number line.

Extension

Practise skip counting forward by 2s, 5s, and 10s until the students are able to do them without using number lines fluently. Consider using the number line to 50 and then seeing if they can continue to 100 without the number lines.

Have the students complete the relevant activities in their Student Activity Book.

Lesson 3 Counting Backward

Objectives

Count backward by 1s, 2s, 5s, or 10s from multiples of 1, 2, 5, or 10 respectively.

Materials

Number line (from the last lesson)
Empty tin can and 30+ pebbles or snap cubes (for the Extension)

Practise counting forward again a few times by 1s, 2s, 5s, and 10s. Then, tell the students that they will practise counting backward. Begin with students counting backward from 20 to 0 by 1s as you point at the numbers on the number line in sequence. Practise this again a few times. This should be fairly easy for the students after their experience from Class 1.

Next, begin at 20 and say you want to get back to 4 in jumps of 2; ask what numbers they would land on. Then, practise skip counting backward by 2s as you point at the appropriate numbers on the number line from various starting points such as 20, 26, or 34. Each of the starting numbers should be a multiple of 2. Present similar problems where they begin at a multiple of 5 and step back in jumps of 5 or multiples of 10 where they step back in jumps of 10.

Toward the end, ask questions such as:

You are counting backward by 2s. Continue after 42, 40, …
You are counting backward by 5s. Continue after 80, 75, 70, …
You are counting backward by 10s. Continue after 80, 70, …
You say the number 40. What could you have been counting back by? What else?
You say the number 45. What could you have been counting back by?

Maths Note

Students often get a lot of experience counting forward, but not as much counting backward. This is important to help them later on with both subtraction and division. Perhaps, even more important than that is that it consolidates their knowledge and skill of counting forward.

Assessment for Learning

Make sure students realize that they say the same numbers they would say to count forward, just in reverse.

Extension

Bring an empty container, preferably a tin can and about 30 pebbles (or snap cubes). Have the students count as you put about 30 pebbles in the container, one by one. At the end, ask: **How many pebbles are there in the can?** Then, take out one pebble, and ask: **Now how many pebbles are there in the can?** Take out another pebble, and ask: **Now, how many are there?** Repeat this process until there are no pebbles left in the can.

Put about 30 pebbles in the can so that the students know it. Then take out 5 pebbles, and ask: **How many pebbles are there in the can?** Then take out 5 more pebbles, and ask: **Now how many pebbles are there in the can?** Continue in this process until there are no pebbles in the can.

Lesson 4 Estimating Quantity

Objectives

Estimate the size of groups of about 30 to 100 objects.

Materials

Paper clips, toothpicks, pebbles (of about the same size), snap cubes, bean seeds, maize seeds, buttons, bottle tops, etc.

Have sets of the materials, as suggested above ready, in transparent plastic bags or tray-like containers. Each set should contain from 30 to 100 items. Show the students a handful of bean seeds (about 40 seeds), spread on a tray-like container, and ask: **How many bean seeds do you think are there?** Let the students estimate. Record their estimates on the blackboard. Encourage them to explain how they estimated. Suggest a number which would clearly be too less, or too great, for the estimate, and ask why that number cannot be a good estimate.

About how many beans seeds are there?

10 seeds

Separate 10 seeds from the above set, and show them how big the size of 10 seeds is. Let them estimate the number of seeds in the whole set again: **Now, how many bean seeds do you think are there? Is it very different from your earlier estimte?** Record some of the estimates again. Then count the seeds and record the count. Compare the count with their estimates.

Distribute a set of each of the above materials to groups of students. Have each student estimate the number of items in their sets. Encourage them to explain how they estimated. Then, have them count the items and compare actual numbers of objects with their estimates.

Have groups exchange their materials to carry out the estimating exercise with new sets. As they work, circulate and ask questions such as: **About how many (paper clips) were there? How did you know? How did knowing the size of a group of 10 help? Was it easier to estimate smaller or larger groups? Did your estimating improve as you went along?**

Extension

Draw sets of pictures, such as dots, letters, stars, fish, leaves, leaves and triangles on chart/newsprint papers. Have the students estimate the size of the sets of pictures. Encourage them to explain their estimation strategies. Use orderly and disorderly arrangements of objects. You may provide referents such as showing the size of a set of 10 objects.

Have the students complete the relevant activities in their Student Activity Books

Maths Note

It is important that students learn the value of a referent, a known quantity that is used to help estimate an unknown quantity. This is useful in both number and measurement situations. By using referents, students are much more likely to make reasonable estimates of the size of a set. Encourage the students to estimate using a "ten number", i.e. 10, 20, 30, 40,...

Assessment for Learning

Ensure that the students can explain the strategies they used to make their estimates

Lesson 5 Representing Numbers

Objectives

Represent numbers with concrete objects, drawings, tally marks, and 10-frames with counters.

Materials

Snap cubes, counters, toothpicks, pebbles, bean seeds, etc.
10-frames and counters
Papers and scissors
Numbers from 30 to 60 each written on a strip of paper

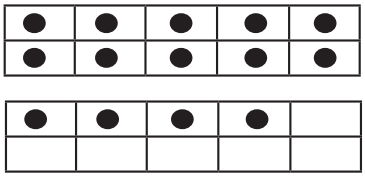
Maths Note

Representing numbers in different ways is the key to number sense.

Write a numeral, say 14, on the board, and ask: **What number is this? Where can you see the number 14 in the classroom? How can you show 14?** Encourage students to suggest how they would show 14. If they are not forthcoming, probe them: **Can you show 14 with these snap cubes?** Have a student come in the front and represent 14 by snap cubes. Then, have a few more students come in the front and represent 14 with other materials such as suggested above.

Then, two students stand up and show 14 with their raised fingers. Ask questions such as: **How many days are there in one week? How many days will there be in 2 weeks? Who has a brother or sister who is 14 years old? What day is the 14th of this month?** (Referring to the calendar for the month)

Tell, and model that they can also show 14 with 10-frames. Students should be familiar with 10-frames from their experience in Classes PP and 1. Also, draw the picture of 10-frames showing 14 on the board.



14

Assessment for Learning

See that the students can use tally marks to show the numbers. Tally marks also provide an opportunity for them to reinforce their skill of skip counting by 5s.

Tell, and demonstrate that they can also show 14 with tally marks. This should also be familiar to the student from their experience with recording data in Class 1.

14

Provide each student with a number, from 30 to 60, written on a cut strip of paper, and ask them to show their number in one way, using materials or drawings. Make accessible to them counters, 10-frames, toothpicks and other materials as suggested above. Once all students are done, ask them to move around to see what others have done. Ask questions like: **Which method (or material, or drawing) did most of you use to show your number? Why?**

Extension

Have the students complete the relevant activities in their Student Activity Book.

Lesson 6 Comparing Numbers

Objectives

Compare two numbers up to 100 using the number line and 10-frames.
Use the symbols > for 'more than' or 'greater than' and < for 'less than'.

Materials

Number line (from Lesson 1)
10-frames and counters

Write two numbers on the board, say 5 and 10, and ask: **Which number is more, 5 or 10?** Encourage the students to answer in full sentence as: **10 is more than 5.** Then, ask: **Which is less then?** Again, have the students say: **5 is less than 10?** Ask the students to explain/show how 10 is greater than 5. After listening to their suggestions/explanations (and if they do not suggest it), tell that they could also use 10-frames to represent and compare the two numbers. Represent 10 and 5 on two separate 10-frames, and say: **10 fills a complete 10-frame, whereas, 5 fills only half of a 10-frame. So, 10 is greater than 5.** Compare another pair of numbers, say 16 and 24, using 10-frames. Make the students realize and describe the comparison as: 24 completely fills two 10-frames with some left over. But, 16 fills only one 10-frame and part of a second 10-frame. So 24 is greater than 16.

Provide pairs/groups of students with 10-frames, counters and a pair of numbers each to compare. As they work, circulate to help them. Encourage them to describe how they know a number is greater than (less than) another: **How do you know that 38 is greater than 30?**

After the above activity, bring students' attention to the front of the class. Ask a group to tell what numbers they compared, and how they found out which of the two numbers was more. Locate the two numbers on the number line, and point out that the number which is more is to the right on the number line. Repeat this process with all groups. Have the students realize that in comparing two numbers using a number line, the number on the right is always greater or more.

Provide the students with some practice to compare and tell why a number is more or less than another using number line. Ask, for example: **How do we know that 37 is more than 27?** Encourage the students to respond in a manner such as: **37 is more than 27 because it is on the right of 27 on the number line; 27 is less than 37 because it is on the left of 37 on the number line** (for a question like: **Why is 27 less than 37?**)

Maths Note

10-frames and number lines are useful models for representing and comparing numbers. It is easy for students to learn the "rule" that a number to the right on a number line is greater, but 10-frames may help them see why it is greater – there are more counters for the greater number.

In comparing two numbers, a and b, if a > b (i.e. if a is greater than b), then b < a (i.e. b is less than a). For example, 19 > 12 says that 19 is greater than 12 and also, 12 is less than 19.

Assessment for Learning

Ensure that the students can describe/ explain how a number is more than (less than) another either by referring it to the use of 10-frames or number lines (and preferably both).

Extension

The activities described below are continuations of the lesson, and it is essential that they be carried out to achieve the objectives.

Continue practising with the students explaining how a number is more or less than another. Once the students have gained fluency, introduce the symbols > and <. You could do that by writing on the board as:

10 is more than 5 10 > 5	5 is less than 10 5<10
63 is more than 47 63 > 47	47 is less than 47 47<63
100 is greater than 70 100 >70	70 is less than 100 70<100

You could suggest to the students a method of remember using these symbols as: **The symbol looks like an open mouth of a snake, and the snake is always after more number of rats.** Another possibility is to see that the greater amount gets the big part of the arrow and points to the lesser amount.

Have the students practise writing the two symbols in their notebooks. Write pairs of numbers on the board, and ask students to come to the front to write the appropriate symbol in between, as shown below. Have the student who comes to insert the symbol explain why she or he wrote the symbol that way.

10 ___ 13	33 ___ 55	70 ___ 5
45 ___ 25	55 ___ 33	31 ___ 29
23 ___ 32	40 ___ 41	9 ___ 19

Have the students, then, complete the related activities in their Student Activity Book.

Lesson 7 Describing Numbers

Objectives

Describe numbers by relating them to other numbers.

Materials

100-chart (prepared on a chart paper)
Sticky note pad

Display a 100-chart prepared on a chart paper. Spend some time discussing some of its features including its structure of 10 rows and 10 columns, and extending to some of the number patterns in it. Cover a number up, with a sticky note pad, and ask students what number is covered and how they know. Talk about how it compares to other numbers on the chart, for example, what number it is one less than, one more than, 10 more than, 10 less than etc. Encourage the students to come up with other kinds of clues that could be used to describe the covered number. Repeat the process by covering up another number.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Ask a student to come to the front and cover up a number. Then, have the students describe the number in relation to other numbers in the chart.

Toward the end, ask and discuss questions such as:
What are some good clues for 38?

Suppose you don't want someone to guess your number right away, but you want to give a true clue. What might you give as a clue for 71?
If a number is less than 18, what other numbers must it be less than?
If a number is more than 37, what other numbers must it be more than?
Can a number be less than 40, but more than 20? Can it be less than 20, but more than 40?

Maths Note

Number sense is enhanced when students can compare a number to many other numbers. For example, 23 may be thought of as requiring one more 10-frame than 13, as 20 + 3, 10 + 10 + 3, 1 more than 22, or 1 less than 24.

Being able to see and describe numbers in these ways is very useful. One application is mental mathematics. For example, by thinking of 29 as 1 less than 30, later on, when students add 29, they can add 30 instead (which is much easier) and then subtract 1.

Assessment for Learning

See that the students can describe a number in relation to other numbers.

Extension

Ask the students to write the numbers in the 100-chart in their Student Activity Book, and answer the questions that follow it.

Lesson 8 Describing Number Patterns

Objectives

Describe simple repeating, growing, and shrinking number patterns.
Compare simple number patterns.

Materials

None

Write a simple repeating pattern on the board, as shown below, and ask the students to tell what they understand or see with it. Encourage them to describe it. Ask probing questions such as: **How is this a pattern? What part or what numbers do you see repeating over and over again in this pattern? What kind of a pattern is this?** Explain the meaning of core of the pattern. The core in this case is 123.

1, 2, 3, 1, 2, 3, 1, 2, 3, 1, 2, 3, …

Write another repeating pattern, as shown below, and discuss similarly as above.

2, 3, 2, 3, 2, 3, 2, 3, …

Have the students compare the two patterns: **What is the same about these two patterns? What is different about them?**

Have the students create a repeating number pattern in their notebooks. As they work, circulate to help and encourage them. Encourage them to share/ show their patterns with each other. You could also ask a few students to write their patterns on the board and them.

Then, write a simple growing number pattern, as shown below, on the board, and encourage the students to describe it. Ask probing questions such as: **Is that a pattern? How is it a pattern? Do you see a repeating part or repeating numbers in it?** Discuss, and/or explain how each number is growing or increasing in this pattern. Explain that such a pattern is called a growing or increasing pattern.

2, 4, 6, 8, 10, 12, ….

Have the students compare this pattern with the second pattern above: **What is the same about this pattern and this pattern** (referring to the second pattern above)**? What is different about them?**

Have the students create a growing number pattern in their notebooks. As they work, circulate to help and encourage them. Encourage them to share their patterns with each other. You could also ask a few students to write their patterns on the board, and explain their patterns.

Then, write a simple shrinking number pattern, as shown below, on the board, and encourage the students to describe it. Ask probing questions such as:

Maths Note

A pattern is a sequence in which the items occur in a predictable manner. A pattern in which a part of it repeats over and over again is called a repeating pattern. The repeating part is called the core of the pattern. A pattern in which each successive item increases or decreases in a predictable manner, such as by a constant amount, is called a growing or a shrinking pattern respectively.

The students have had experience with simple repeating and growing patterns in Classes PP and 1. Any regular counting forward (backward) sequence is an example of a growing (shrinking) pattern. This lesson and the next lesson will extend their knowledge of exposure to simple number patterns including repeating, growing or increasing, and shrinking or decreasing number patterns.

Is that a pattern? How is it a pattern? Do you see a repeating part or repeating numbers in it? Discuss, and/or explain how each number is decreasing in this pattern. Explain that such a pattern is called shrinking or decreasing pattern.

20, 18, 16, 14, 12, 10, …

Have the students create a shrinking number pattern in their notebooks. As they work, circulate to help and encourage them. Encourage them to share or show their patterns with each other. You could also ask a few students to write their patterns on the board, and explain their patterns.

Have the students compare this pattern with the growing pattern above: **What is the same about this pattern and this pattern** (referring to the growing pattern above)**? What is different about them?**

Assessment for Learning

Ensure that the students can describe simple patterns that are repeating, growing, or shrinking.

Extension

Have the students complete the relevant activities in their Student Activity Book.

Lesson 9 Extending Number Patterns

Objectives

Extend simple repeating, growing and shrinking patterns.
Explain or describe their rule for extending the patterns.

Materials

None

Write a simple number pattern (e.g., 2, 4, 6, 8, ...) on the board, and ask the students how they might extend it. Have the students explain why they think the pattern should be extended in the manner they suggested.

Encourage students to think of and extend the pattern in a different way. There are at least two valid possibilities in extending this pattern. If the students see it as a growing pattern, it would be extended as: 2, 4, 6, 8, 10, 12, 14, 16, …. On the other hand, it could also be seen as a repeating pattern, in which case it could be extended as: 2, 4, 6, 8, 2, 4, 6, 8, …. Both are valid, if no pattern rule is given. And, students should be made aware of this.

Present students with the start of both increasing and decreasing patterns as shown below, and have them extend them. have them describe or explain how they extended each of the patterns.

5, 10, 15, 20, ….
1, 2, 3, …
45, 40, 35, 30, ….
22, 24, 22, 20, ….

Then, ask the students to create a pattern by giving them pattern a rule, such as the following.

Start a pattern with number 2. The numbers after it should always increase by 2.
Create a pattern starting with the number 5. The numbers after it always increase by 5.
Create a shrinking pattern. Start with the number 100, and the numbers after it should always decrease by 10. (When discussing this, you can show that both100, 90, 80, 70 and 100, 90, 80, 70, 60, 50, 40, 30, 20, 10, 0 would be acceptable, among other possibilities.)

Most of the growing and shrinking patterns should be based on skip counting up or back from multiples of 2, 5 or 10 by 2, 5, or 10.

Extension

Give students some numbers that must appear in the middle of a pattern, and have them make a pattern. For example, if the numbers 25, 26, 27 are given, the pattern will likely be an increasing pattern and it could be 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30. Alternatively, the numbers could be taken as the core of a repeating pattern like 25, 26, 27, 25, 26, 27, 25, 26, 27.

Have the students complete the relevant activities in their Student Activity Book.

Maths Note

In the course of extending simple growing and shrinking patterns, students need to meet the idea that without being told what the pattern rule is, they cannot really be sure how the pattern continues. For example, although the next number in 2, 4, 6, 8,… could be 10 if the pattern is a grow by 2 pattern, it need not be. The pattern could continue in many ways including these:
2, 4, 6, 8, 2, 4, 6, 8, 2, 4, 6, 8, … (repeat 2, 4, 6, 8)
2, 4, 6, 8, 12, 14, 16, 18, 22, 24, 26, 28…. (use the even numbers except for the tens)

Most of the growing and shrinking patterns should be based on skip counting up or back from multiples of 2, 5 or 10 by 2, 5, or 10.

Assessment for Learning

See that the students can describe or explain their pattern rules verbally. Also, see that they realize that a number pattern can be extended in more than one valid way if no rule is provided.

Lesson 10 Even and Odd Numbers

Objectives

Recognize even numbers as numbers that are doubles.

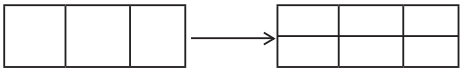
Materials

None

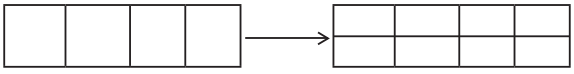
> **Maths Note**
>
> Although students often learn that an even number is a number ending with 0, 2, 4, 6 or 8, it is important that they understand that an even number is a double, i.e. it can be represented as two equal amounts. Tell them that the other numbers are called odd. The idea of even numbers as sharing numbers may be helpful. That is, sharing numbers correspond to numbers of objects that can be shared fairly with two people and having no objects left over.

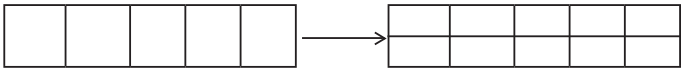
Students might be familiar with the word "double", and the phrase, "double of a number" from their experiences in Class 1 (chapter 8: Addition and Subtraction Strategies). Revise the students' knowledge on double facts. Ask questions such as: **What is the double of 1? What is 1 + 1?** Discuss how, or why, 1 + 1 is 2. Encourage the students to explain/describe/show this. **What is the double of 2? What is 2 + 2? What is the double of 3 (or 3 + 3)?** Encourage the students to explain/describe or show how they get the double in each case, using concrete materials, drawings or fingers.

One of the easiest ways to show a double number is by using rectangles. Show the students how to do it as shown below: For example: **To show the double of 3, just draw a rectangle using 3 columns, and then cut it across the middle into two rows. Count the number of smaller rectangles, and that is the double.**



Similarly, show them how to show the double for 4 and 5:





Have the students show the doubles for 6, 7, 8, 9 and 10 with rectangles in their notebooks. As they work, go circulate to help the ones needing it, and to motivate the one doing well. Although, neatness and proportion of the drawings should be encouraged, as in other forms of student writing and drawing, they should not be the focus here.

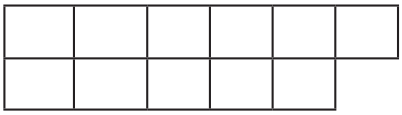
After everyone has finished with their drawings, record the numbers and their

Number	Double
1	2
2	4
3	6
4	8
5	10
6	12
7	14
8	16
9	18
10	20

doubles on the board with the help of the students, as shown below.
Have the students observe and describe the pattern with the doubles. Ask probing questions such as: **Do you see a pattern with the doubles? Can you describe it? What kind of a pattern is it? What numbers do you not see in the doubles?**

Tell that any number which is a double is called an even number. So 2, 4, 6, 8, 10, etc. are all even numbers. Ask the students to tell what other numbers would be even numbers. The numbers which are not doubles are called odd numbers. Have the students tell what numbers would be odd.

Odd numbers cannot be shown by a rectangle as a double. For example, to show 11 in two rows, there is one small rectangle left over:



Assessment for Learning

See that the students can tell an even number is a double number, and identify even and odd numbers. Also, see that that they can show or represent an even number with rectangles.

Extension

Have, and help the students complete the relevant activities in their Student Activity Book

Chapter Assessment

Formative Assessment

Formative assessment ideas, tips and reminders are provided within each lesson under the heading called Assessment for Learning. In addition, you should use a formative assessment tool called the Chapter Checklist. Prepare the Formative Assessment Recording Sheet for the chapter as shown below. You should look for evidence in each student, throughout the teaching of the chapter, that he or she has understood the key concepts and can perform the key mathematical skills by ways of observing, listening and asking probing questions. Accordingly, keep the records for each student by putting a mark, such as a tick mark, for each of the chapter goals once you are convinced that the student has achieved them. You could also keep relevant anecdotal records.

Using the Chapter Checklist purposefully will give you the benefit of ensuring that each student's learning progress is assessed in a systematic manner. What is even more important is the opportunity it will provide you to help each student along in achieving the chapter goals. Since this is meant as a formative assessment tool, you will not be giving any mark to the students by using it. However, investing time in carrying out this assessment technique will contribute positively in the students being able to do well in the summative assessments, including the examinations. You can also refer back to these records as you look for progress during the year and/or seek to address areas of concern.

Formative Assessment Recording Sheet
CHAPTER 1 NUMBER TO 100

Chapter Checklist (Look for evidence throughout the chapter that the student has understood the key concepts and can perform the key skills.)

Student Name		Chapter Goals (The student is able to):						
		Use ordinal numbers when talking about the dates of a month.	Skip count in 2s, 5s, and 10s both forward and backward.	Make reasonable estimates of sets of size from 30 to 100.	Represent numbers in various ways	Use the symbols < and > to compare numbers	Describe and extend simple repeating, growing and shrinking number patterns	Identify even and odd numbers.
1								
2								
3								
4								
5								
6								
7								
8								

Summative Assessment

As explained in the Introduction to the Teacher's Guide, the student's learning in each chapter will be measured primarily through the use of an assessment method called the Interview-based Performance Task. The primary purpose of this assessment is to thoroughly assess the level of understanding of the students in terms of the key concepts and skills as required in the chapter. It provides an opportunity for the students to display their understanding by ways of telling, describing, showing, and demonstrating in a non-threatening environment.

One of the beauties of this assessment method is that it allows you to teach and clarify things even as you are assessing the students. The fact that you have to provide marks to the students through the use of Interview-based Performance Tasks should be considered a secondary purpose. The Summative Assessment Recording Sheet (shown on the next page) is included in the Student Activity Book for your use with each student. Please refer to the Introduction to the Guide for the details on the marking scheme.

Summative Assessment Recording Sheet

Student Name: _____ Roll no.: ____ Section: ____

CHAPTER 1 NUMBERS TO 100

Interview-based Performance Task (Please refer to the Introduction to the Teacher's Guide for Class 2 for the marking scheme while using the Interview-based Performance Task.)

Task and Interview prompts	Key concepts and skills to look for
Have 10-frames, counters and a calendar for the month ready. Present the student with a number, say 25, and tell/ask: **Show me this number on the calendar. What date does it show? What day is the 25th of this month?** **Skip count by 5s backward from 25 to 0.** **How can you show 25 on 10-frames?** **Which number is more: 25 or 18? How can you show that? Or, How do you know that 25 is more than 18?** **Which of these two numbers, 18 and 25, is an even number? Can you show it is an even number?** Present shrinking pattern (like; 12, 10, 8, …), and ask: **Can you extend this pattern? What kind of a pattern is this? Can you create/make a simple growing pattern? Explain how the pattern works.**	The student is able to: - Say the dates in ordinal number form. - Read and relate dates with days on a calendar. - Skip count by 5s. - Represent numbers on 10-frames. - Compare numbers and say which is more/less. - Identify even numbers. - Show/represent even numbers. - Identify simple growing and shrinking patterns. - Extend simple patterns. - Create simple patterns.

Comments and Marks

Strengths:

Areas of Need:

Follow up Steps:

Teacher's Signature and Date:

Summary of the Summative Assessment for Chapter 1

CA marks from Chapter 1 (Marks out of 10): _____

CHAPTER 2 ADDITION AND SUBTRACTION STRATEGIES

Chapter Overview

The students have been introduced to the concepts of addition and subtraction informally in Class PP, and formally in Class 1. In order to understand the concepts of addition and subtraction properly, the students were taken through the process of modeling addition and subtraction through simple story-telling, representing them with concrete objects and pictures, and subsequently with number sentences and symbols. The students have also learnt various strategies of adding and subtracting such as "Counting Forward and Counting Backward", "Using Double Facts" and "Facts for 10", although the numbers used were single digits and teen numbers.

A thorough understanding of addition and subtraction concepts with proficiency in adding and subtraction numbers, using various strategies, helps students in gaining a good sense of numbers. Such proficiency and skills with numbers is also useful in the real world life, even as adults. As such, the strategies of adding and subtracting, from Class 1, are reviewed and then extended further in this chapter.

At the same time, the concepts of addition and subtraction are reviewed here. There are basically two situations involving addition. The first is called active addition, in which some objects join a set and result in the number of objects in the set being increased. We determine the total number of objects in the set. The other is called static addition, in which a whole is made up of two or more parts, and we determine the number in each part for the purpose of adding them all together. Similarly, there are basically two situations involving subtraction: active subtraction and static subtraction. In the active subtraction, some objects from a set are removed, or separated, or taken away, thus, decreasing the number of objects in the set. We determine how many objects are left in the set. In the static subtraction, we compare two sets, and determine which set has more items and by how many more.

This chapter has 15 lessons as detailed in the Table of Contents.

Basic Principles about Numbers

- Addition and subtraction both involve changes in quantity.
- Addition involves combining. The combining can be active, where some objects join other objects, or static where a whole is made of two or more parts.
- Subtraction involves removal or taking away or separation, comparison, or finding a missing addend.
- An equation is a statement of balance. It simply indicates that the quantity on one side balances, or is an alternate representation for, the quantity on the other side.
- Addition and subtraction are intrinsically related. In any situation involving an addition, there is an equivalent subtraction situation and vice versa.
- Numbers (two or more of them) can be added in any order without affecting the result.
- There are many strategies that can be effectively used to solve any addition or subtraction problem.

Chapter Goals

- Use Counting On and Counting Back to solve addition and subtraction problems respectively.
- Use Double facts to solve addition and subtraction problems.
- Use Facts for 10 to solve addition and subtraction problems.
- Determine missing addends in an addition sentence.
- Determine the missing subtrahend in a subtraction sentence.
- Determine the missing total in a subtraction sentence.
- Write the fact family for an addition sentence or a subtraction sentence.
- Recall addition and subtraction facts to 18.

Maths Words

Addition, subtraction, addition sentence, subtraction sentence, plus, minus, add, subtract, sum, difference, equals, double, facts for 10, strategy, fact family.

Lesson 1 Modeling Addition and Subtraction

Objectives

Represent simple addition and subtraction situations or stories with number sentences.

Materials

None

Tell the students that you would be telling them a short story, and ask them to represent the story with a number sentence. Tell a story such as: **Three deer were eating grass in a meadow. Two other deer joined them. How many deer were there altogether? How can you write a number sentence for this story?** Listen to their suggestions. Help them write the number sentence on the board as 3 + 2 = 5. Help the students describe, or explain, what each of the numbers and symbols mean in this sentence. Tell that this is called an addition sentence, and ask why this is called so.

Tell another story: **So, there are these five deer in the meadow. One deer leaves the meadow to search for water. How many deer are there then? Write a number sentence for this story.** Students would write 5 – 1 = 4. Have them explain what each number and symbol means in this sentence. Tell that this is called a subtraction sentence, and ask why it is called so.

Provide a variety of simple situations which students represent using addition or subtraction sentences. The situations should also include static ones, such as:

There are six pets at home. Three are cats and three are dogs.
Pema has 8 pencils. Kaka has 2 pencils. Who has more pencils? How many more?
Sunita has 5 Ngultrums. Dema has 10 Ngultrums. How many Ngultrums do they have together?

In representing and discussing each situation, ask questions such as:

What number sentence did you write for that story? What made that an addition story or a subtraction story?
What kinds of situations might subtraction describe? What kinds of situations might addition describe? How did you get the sum? How did you figure out the difference?

Extension

Write on the board an addition sentence or a subtraction sentence. Then have students create a story for that number sentence. (This can be done in groups, or as an entire class. Lesson 2 will require more of this but on an individual basis.)

Have the students complete the relevant activities in their Student Activity Books.

Maths Note

In Class 1, students learned various meanings or situations related to addition and subtraction. They were also introduced to representing them with number sentences.

This lesson reviews some ideas they learned about situations that involve addition and subtraction. The addition and subtraction should involve only single digit numbers at this stage. You may need to represent a story with concrete objects or pictures for the benefit of some students.

Assessment for Learning

See that the students can explain or describe what each of the numbers in a number sentence mean in relation to the story or situation, besides being able to represent the story or situation.

Lesson 2 Creating Addition and Subtraction Stories

Objectives

Create and tell simple stories from addition and subtraction number sentences.

Materials

Addition and subtraction sentences written on pieces of paper

Present a subtraction sentence on the board, such as 5 – 3 = 2, and ask the students what story it might represent. Have each student think of a story for it. Encourage as many students to tell their stories based on this subtraction sentence. If all the stories the students tell are active situations, encourage them to think of a comparison situation and have them describe the comparison.

Present an addition sentence, such as 7 + 3 = 10, and repeat the above process with the students.

Distribute an addition or a subtraction number sentence, written on pieces of paper, to pairs of students. A sample of the number sentences is provided below. Have them discuss in pairs, decide on a story, and present the story to the class. The presenter from the pairs should first show or tell the class the number sentence they got. Encourage them to use concrete objects to help them represent and tell their stories.

8 + 2 = 10	3 + 2 = 5	4 + 2 = 6	5 + 0 = 5
2 + 2 = 4	5+ 1 = 6	1 + 1= 2	5 + 5 = 10
7 + 3 = 10	3 + 3 = 6	10 + 10 = 20	3 + 1 = 4
8 – 2 = 6	7 – 1 = 6	5 – 2 = 3	4 – 3 = 1
4 – 0 = 4	10 – 1 = 9	10 – 2 = 8	5 – 5 = 0

Maths Note

Students should learn to think of and tell simple stories from addition and subtraction number sentences. This will deepen their understanding of addition and subtraction concepts while also improving their communication skills.

The stories the students create should consist of both active and static situations, for both addition and subtraction number sentences. You should encourage them to create more than one story for a number sentence.

Assessment for Learning

See that the students can at last convey their stories.

Extension

Have the students complete the relevant activities in their Students Activity Books.

Lesson 3 Counting On and Counting Back

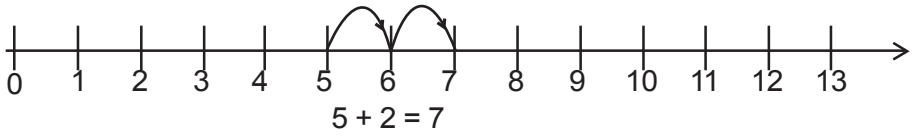
Objectives

Use Counting On as a strategy to add, and Counting Back as a strategy to subtract.

Materials

Number line with numbers to 100
Marker pens

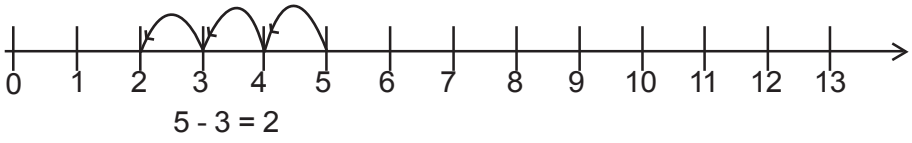
Ask: **What is the sum of 5 and 2?** Encourage the students to tell the sum. Explain (or remind the students since they have already come across the word) that the number we get when we add one number to another is called a sum. Write the equation, 5 + 2 = 7 on the board. Explain how to read it properly as: **5 plus 2 equals 7; or the sum of 5 and 2 is 7**. Encourage them to explain, or show how 5 + 2 is 7. Tell the students that we could use a number line to add two numbers. Model or demonstrate how to do that. To add two numbers using the number line, we start at the first number, and then move on or forward the number of units equal to the second number. The number we land on at the end is the sum.



Use a few more examples showing addition using the number line. Have some students come in the front to model the additions. Also use large numbers to add, such as: 20 + 10, 50 + 20, 25 + 15, 18 + 8, 22 + 12, and 30 + 40. It would make more sense to use skip counting for such additions, although students might count on by 1s also.

Ask: **What is the difference of 5 and 2?** Encourage the students to tell the difference. Explain the word difference as the number we get when we subtract one number from another. Write the equation, 5 – 2 = 3 on the board. Explain how to read it properly as: **5 minus 2 equals 3**; or **the difference of 5 and 2 is 3.**

Model how to subtract using counting back on the number line. Repeat the process similar to the addition as above, using a blend of small and large numbers.



Extension

Use the number line addition models with three addends, such as 5 + 3 + 4, or 20 + 50 + 10. Keep the sums under 100 at this stage.

Have the students complete the relevant activities from in their Student Activity Books.

Maths Note

Students have used counting on and counting back as strategies to add and subtract respectively in Class 1. This chapter reviews these strategies. It is also appropriate to use larger numbers, to 100, to add and subtract. The number line should be used in the beginning with these strategies. Some students may not have to rely on number lines later on. Students could also use skip counting by 2s, 5s, and 10s both in counting on and counting back, now that they would know this from chapter 1.

Assessment for Learning

See that the students can model counting on and counting back, including skip-counting to add and subtract the numbers using the number line.

Lesson 4 Using Double Facts to Add

Objectives

Recall the double facts for numbers to 10.
Use the double facts to determine the sum of two numbers which are almost equal.

Materials

Chart paper and maker pens

Recall, and record, the double facts for numbers to 10 on a chart paper with the help of students. Encourage the students to explain, or show how each double fact is true. This can be based on the work they did with even numbers in chapter 1.

1 + 1 = 2	
2 + 2 = 4	
3 + 3 = 6	
4 + 4 = 8	
5 + 5 = 10	
6 + 6 = 12	
7 + 7 = 14	
8 + 8 = 16	
9 + 9 = 18	
10 + 10 = 20	

Invite the students to observe patterns in the sums above, and encourage them to describe them.

Finally, they can relate "almost doubles" to these facts by using a combination of reasoning and models. For example, after knowing 7 + 7 = 14, the students can reason that 7 + 8 must be one more, so 7 + 8 = 15, or that 7 + 6 is one less, so 7 + 6 = 13. It may be that the "one less" idea is not used so much, and that 7 + 6 is seen as one more than 6 + 6 = 12 instead. (Alternatively, the sum 7 + 8 could be obtained by seeing it as one less than 8 + 8 = 16.)

Ask students to use doubles to figure out sums for addition problems such as 4 + 3, 8 + 9, 6 + 5, 4 + 5, etc. At the end, ask questions such as: **How much is 6 + 6? How does that help you figure out 6 + 7?**

Post the above chart for the double facts on the wall for future reference. Provide practice and encouragement for the students to commit the double facts to memory.

Maths Note

Children seem to learn double facts more quickly than other facts. It makes sense to take advantage of this and to help students use these facts to learn other facts. For example, once students know that 7 + 7 = 14, they know that 7 + 8 must be one more, giving 7 + 8 = 15 or that 7 + 6 is one less, giving 7 + 6 = 13.

Students have learned the double facts to 10 in chapter 1 when talking about even numbers.

Assessment for Learning

See that the students can use reasoning to solve addition problems that are almost doubles using the appropriate double facts.

Extension

Have the students complete the relevant activities in their Student Activity Book.

Lesson 5 Using Double Facts to Subtract

Objectives

Recall the double facts for numbers to 10.
Use the double facts to determine the difference between two numbers that are almost equal.

Materials

Double facts chart (prepared in the previous lesson)

Review the double facts to 10 with the students. Then, record the related subtraction facts on the chart as shown below.

1 + 1 = 2	2 – 1 = 1
2 + 2 = 4	4 – 2 = 2
3 + 3 = 6	6 – 3 = 3
4 + 4 = 8	8 – 4 = 4
5 + 5 = 10	10 – 5 = 5
6 + 6 = 12	12 – 6 = 6
7 + 7 = 14	14 – 7 = 7
8 + 8 = 16	16 – 8 = 8
9 + 9 = 18	18 – 9 = 9
10 + 10 = 20	20 – 10 = 10

Use reasoning to confirm the related differences. For example, 6 – 3 = 3, because 3 + 3 = 6. You may have to use models to show the subtraction for some students. For example, to show 6 – 3 = 3, you could represent 6 with 6 counters, and then remove or take away 3 counters to find out how many are left.

Have the students observe the pattern in the differences.

Ask the students to use doubles to figure out differences such as 10 – 5, 12 – 7, 12 – 5, 8 – 5, 8 – 3, 9 – 5, 11 – 5, 20 – 11, 20 – 9, 14 – 6, 14 – 8, etc. Toward the end, ask questions such as: How much is 12 – 6? How does that help you figure out 12 – 7?

Maths Note

The double facts could also be used for determining the difference between a number and a number that is about half of it. For example, since 6 + 6 = 12, students know that 12 – 6 = 6. Therefore, 12 – 5 is one more (since one less is being taken away), so 12 – 5 = 7 and 12 – 7 = 5 or one less than 6 (since one more is being taken away).

Assessment for Learning

See that the students can use reasoning based on the double facts, or related subtraction facts, to solve subtraction problems.

Extension

Have the students complete the related activities in their Student Activity Books. Have the students practise, and even commit to memory, these subtraction facts and addition facts, based on the double facts, over the next several days.

Lesson 6 Using Facts for 10 to Add

Objectives

Tell the facts for 10.
Use facts for 10 to determine the sums of two single-digit numbers.

Materials

10-frames and counters
Chart paper and marker pens

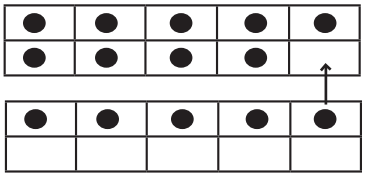
Review students' knowledge of "facts for 10". Record the facts for 10 on a chart paper with the help of the students. You may have to model with 10-frames and counters in two colours or use the counting on strategy with a number line to show sums of 10 in each case.

9 + 1 = 10	1 + 9 = 10
8 + 2 = 10	2 + 8 = 10
7 + 3 = 10	3 + 7 = 10
6 + 4 = 10	4 + 6 = 10
5 + 5 = 10	

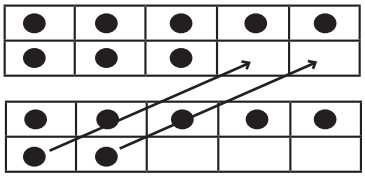
Students should gain mastery of facts for 10, by even committing to memory if possible. Tell the students that they could use their knowledge of facts for 10 to solve addition problems.

Review the idea that it is easy to add numbers to 10. For example, 10 + 2 = 2, 10 + 3 = 13, and so on, up to 10 + 9 = 19.

Ask: **What is the sum of 9 and 5?** Write the sentence 9 + 5 = ___ on the board. Have the students explain how they have determined the sum. Some students might have used counting on strategy. Tell that this is correct. Some students might have already used facts for 10. Tell that they will use facts for 10 to add in this lesson. Explain that they could take 1 from 5 and combine it with 9 to make 10, and then the sum would be 10 + 4 = 14. Model this with 10-frames and counters as shown below.



Ask: **What will be the sum for 8 + 7?** Repeat the above process.



Maths Note

Students met this concept in Class 1, but it is being reviewed here. First, the idea that it is easy to add a single digit number to 10 should be reinforced. For example, 10 + 5 = 15 since 15 is equivalent to 1 ten and 5 more; similarly, 10 + 8 = 18 since 18 means 1 ten and 8 more.

Students should also master the facts for 10. To add two numbers with a sum greater than 10, students might use what they know about sums for 10. For example, to add 8 + 6, students might first add 8 + 2 and then the other 4. Some students might continue to need to use 10-frames with this strategy in the beginning to understand visually.

Provide the students with double 10-frames and counters, and have them solve various addition problems such as those given below. Have them record the addition sentences in their notebooks: 9 + 3, 9 + 6, 9 + 7, 9 + 8, 9 + 9, 8 + 4, 8 + 6, 8 + 9, 5 + 6, 5 + 7, 7 + 5, etc.

As the students work, circulate and help them where needed.

Toward the end, ask questions such as:

When you added 9 + 3, was it easier to move counters from the group of 9 or from the group of 3? Why?

How much less is 7 + 4 than 10 + 4?

Why might it be useful to know that 7 + 3 = 10 to add 7 + 8?

Assessment for Learning

See that the students can first tell the facts for 10 in their application of this knowledge in solving addition problems involving two single digits for which the sum is more than 10.

Extension

Have the students complete the relevant activities in their Student Activity Books.

Lesson 7 Using Facts for 10 to Subtract

Objectives

Use facts for 10 to determine the difference between 10 and a number smaller than 10.
Use facts for 10 to determine the difference between numbers between 10 and 20 and a single-digit number.

Materials

Double 10-frames
Counters

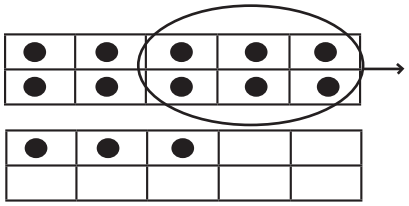
Maths Note

Students met this concept in Class 1, but it is being reviewed and developed further here. Students should first review the facts for 10 and the related subtraction facts. Then, extend this concept to solve a subtraction problem like 13 – 6, in which the strategy is to first think about the problem as 10 – 6 to get 4, and later add 4 to 3 to get 7. It will be beneficial for some students to model these with 10-frames and counters.

Review and record the facts for 10 with the students, as shown in the first column below. Then, discuss and record the related subtraction facts as shown in the second column. Have the students observe and discuss the patterns in the differences. You might need to model the related subtraction facts. For example, to show how 10 – 6 = 4, first, place 10 counters on a 10-frame, then, remove 6 counters and see how many counters are left. Another strategy is to represent only the 6 counters on the 10-frame and see how many more counters would be needed to completely fill the 10-frame. This can effectively be envisioned as well with the use of two 10-frames, the first with 10 counters and the second with 6 counters. The difference is clearly 4 counters.

9 + 1 = 10	10 – 9 = 1
8 + 2 = 10	10 – 8 = 2
7 + 3 = 10	10 – 7 = 3
6 + 4 = 10	10 – 6 = 4
5 + 5 = 10	10 – 5 = 5
4 + 6 = 10	10 – 4 = 6
3 + 7 = 10	10 – 3 = 7
2 + 8 = 10	10 – 2 = 8
1 + 9 = 10	10 – 1 = 9
0 + 10 = 10	10 – 0 = 10

After the students are comfortable with the above subtraction facts related to 10, ask them what the difference for 13 – 6 would be. Encourage the students to tell the difference, and how they determined it. Some students might have used the counting back strategy; some might have used a double fact strategy (for example, 12 – 6 = 6, and then add back 1 to 6 to get 7). These are valid and correct strategies, and the students should be encouraged to use them. But, tell them that they could also use another strategy related to the facts for 10. Explain that to solve 13 – 6, they could first think of 13 as 10 + 3. So, 13 – 6 now begins with 10 – 6, for which they know the difference as 4 from facts of 10. Then they add back 3 to 4 to get 7. Model this on a double 10-frame as shown below.



Assessment for Learning

See that the students can tell the related subtraction facts for the facts for 10, and then extend these facts in solving subtraction problems such as 13 – 6.

Once the students have understood this strategy, tell them that they will practise using this strategy to solve some more subtraction problems. Ask the students how they might find the difference for 14 – 9 using this strategy. Encourage them to use reasoning to think of 14 – 9 as 10 – 9 to get 1 first, and then, add back 4 to 1 to get 5 as the final difference. Also, encourage them to model the problem on 10-frames.

Have the students solve similar problems, such as those provided below.

13 – 8, 14 – 5, 14 – 7, 11 – 4, 12 – 5, 16 – 7, 15 – 7, 15 – 8, etc.

As they work with the problems, go around and help them. Encourage the students to explain how they solved each of the problems.

Towards the end, ask questions such as:

What is the difference for 13 – 8? Why is 13 – 8 three more than 10 – 8?

What is the difference for 10 – 6? How do you know that?

How might you calculate 15 – 7?

Extension

Although, only one lesson has been designed, the students should be encouraged and provided to practise this strategy, as well as the other strategies in the earlier lessons, over the next several days. The ideas below may be incorporated in this process.

The strategy can be extended to differences that will result in two-digit answers using examples like 19 – 7, 16 – 5, 14 – 3, and so on. Whether such examples should be used depend on your judgment. Other strategies will emerge with such examples, as some students may wish to count on 10 immediately, like with
19 – 7, counting on 10 from 7 gets us to 17 and so 2 more is needed giving 10 + 2 = 12 as the difference.

Have the students complete the relevant activities in their Student Activity Books.

Lesson 8 Adding More Than Two Single-Digit Numbers

Objectives

Add three single-digit numbers applying principles of addition and strategies.

Materials

Cards or slips of paper with the digits from 1 through 9 (at least two of each)

Provide the students with 3 single-digit numbers to add. For example, write 3 + 5 + 7 on the board, and ask what the sum might be. Encourage the students to explain or show how they added. Then, show them that you could add the three numbers in different ways to lead to the same sum, as suggested below. Bring three students forward and give each of them a card: 3, 5, or 7. Now have them organize themselves in different ways to do the addition. Observe that the sum is always the same but the addition is easier or more difficult depending upon the arrangement. Then, write addition sentences below, explaining which two numbers were added first in each case, and how the final sum remains the same.

3 + 5 + 7 = 8 + 7 = 15

3 + 5 + 7 = 10 + 5 = 15

3 + 5 + 7 = 12 + 3 = 15

Tell the students that they could use any of the above ways. They might observe that some ways might be simpler than others. Then, have the students solve addition problems such as those given below. Try a few more with the whole class using three volunteers each time. Then have them work alone or in groups. As they work on the problems, circulate to provide help, and ask them how they solved the problems.

2 + 6 + 8, 3 + 5 + 3, 4 + 7 + 6, 1 + 5 + 9, 5 + 7 + 5, 1 + 8 + 8

Note: Try having facts for 10 or double facts incorporated into examples so that they can see the value of organizing the numbers to facilitate addition.
Once everyone has finished solving the problems, ask questions such as:
What are some different ways you could add 5 + 8 + 5? Suppose you are adding 3 + 5 + 8. Where would you start? Why would you start there? How do you know the sum of 4 + 4 + 8 will be more than 10?

Extension

Turn the cards over and have the class work on examples with four single-digit numbers that are chosen. (You could make up some instead like 3 + 4 + 7 + 2 or 5 + 3 + 5 + 1.)

Have the students complete the relevant activities in their Student Activity Books.

Maths Note

Many strategies that will help students learn addition and subtraction facts involve using more than two numbers at a time. For this reason, it is important for students to be comfortable with working with more than two addends.

Students need to see that they can add in any order. For example, for 2 + 4 + 8, they could add 2 + 4 to get 6 and then add 8, or add 2 + 8 to get 10 and then add 4 to get 14. These principles are called the commutative principle (adding in any order) or the associative principle (you can add the first two numbers and then the third or you can add the first number to the sum of the last pair). It is not necessary for students to name the principles, but just use them.

Assessment for Learning

See that the students can explain how they solved the additions involving three single-digit numbers.

Lesson 9 Using a Variety of Strategies to Add

Objectives

Use a variety of strategies to add single-digit numbers

Materials

None

Write an addition problem such as 6 + 8 on the board, and ask the students to determine the sum. Encourage the students to use any strategy to solve it, and have them explain their strategy. Ask them to then determine the sum using a different strategy.

Students could use any of the following strategies and/or reasoning to solve this problem:

- Since 6 + 4 is 10, 6 + 8 is going to be 4 more than that, and hence, 14.
- Since 8 is made of a 6 and 2, add 6 + 6 to get 12, and then add the 2 to get 14.
- Since 6 is 2 less than 8, add 8 + 8 to get 16, and then subtract 2 to get 14.
- Since 8 is 4 + 4, add 6 + 4 to get 10, and then add the other 4 to get 14.
- Since 6 is 4 and 2, add 2 + 8 to get 10, and then add the 4 to get 14.
  6 is one less than 7 and 8 is one more than 7, so 6 + 8 is the same as 7 + 7, or 14.

Propose a few more addition problems, one by one, for the students to solve, such as provided below. Encourage them to come up with as many ways as they can to reasonably calculate each sum.

7 + 6, 8 + 7, 9 + 5

Once everyone has finished solving the above sums, ask questions such as:

Why is 7 + 5 the same as 7 + 3 and then 2 more?
Why is 7 + 5 the same as 5 + 5 and then 2 more?
Why is 7 + 5 the same as 7 + 7 and then 2 less?
Describe different ways you could calculate 7 + 8 + 3.

Maths Note

Students have learned three important strategies of adding such as counting on, using double facts, and facts for 10 to help them simplify calculations.

They have also learnt that order does not matter in addition. Here they will review those strategies, and use them either singly or in combination to solve further addition problems.

Assessment for Learning

See that the students can use and explain the strategies reasonably

Extension

Have students practice adding numbers that are 2 apart. They can use double facts and often, facts for 10. However, they can be introduced to another strategy. This uses the idea of compensation or balancing. For example, 5 + 7 must have the same result as 6 + 6. Why? 5 is one less than 6 and 7 is one more than 6, so together they make up 6 and 6.

You may wish to have the students make a chart to see the pattern: 1 + 3 = 4, 2 + 4 = 6, and so on up to 8 + 10 = 18. If necessary, revisit the double facts at that time: 2 + 2 = 4, 3 + 3 = 6, and so on up to 9 + 9 = 18.

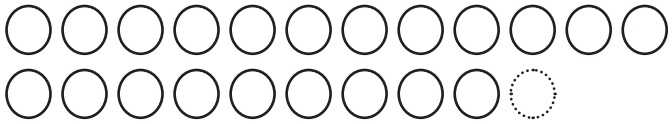
Lesson 10 Subtracting by Comparing

Objectives

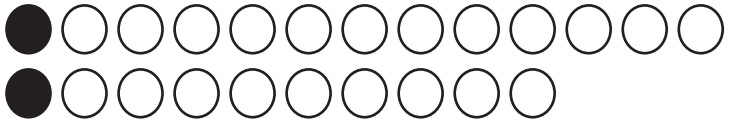
Use efficient strategies to solve subtraction comparison problems.

Maths Note

Because we seem to focus more on the take away meaning of subtraction, it is good to provide some additional time on comparison situations. Note that the idea of a difference implicitly suggests a comparison that is focused upon what is not common. In subtraction at this level, we are concerned only with differences in quantity. Thinking about comparison also suggests strategies students might use to subtract efficiently.
For example, since 12 – 9 tells how much more 12 is than 9, the student can figure out 12 – 10 (how much more 12 is than 10) and add 1 more since 9 is one less than 10.



Or students could relate that 12 is as much more than 9 as 13 is than 10. (This reinforces the emphasis on the difference, as adding on the extra counter to each set does not affect the difference. That is 12 – 9 is quantitatively equivalent to 13 – 10.) The idea of changing a subtraction to an equivalent but simpler calculation is a good strategy.

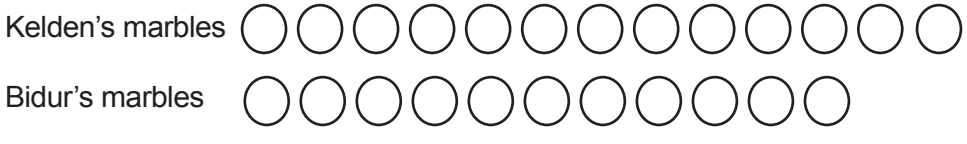


In each case, a more difficult calculation is made easier since subtracting 10 is easy.

Materials

Counters or snap cubes (in different colours)

Tell a simple story in which students will have to compare two quantities and determine the difference. For example: **Kelden has 13 marbles. Bidur has 11 marbles. How many more marbles has Kelden than Bidur?** Listen to the students, and encourage them to represent the situation with concrete materials such as counters or snap cubes. You could also represent the situation with a drawing, and then a subtraction sentence.



13 - 11 = 2

Provide a few more comparison stories/situations, and ask the students to represent them by subtraction sentences and then to determine the difference in each case. In each case have the students explain how they determined the difference. Examples of the comparison stories could be:

There are 14 boys and 9 girls in a class. How many more boys are there than girls?

A farmer has 15 cows and 8 horses. How many more cows than horses does the farmer have?
Jigme ate 12 momos. Tenzin ate 7 momos. How many more momos did Jigme eat than Tenzin?

Assessment for Learning

See that the students can represent comparison situations by subtraction sentences, and determine the differences using reasonable strategies.

With each of the subtraction problems, see how the students solve them. Although students should not be forced to use any particular strategy, it might be useful to suggest reasonable strategies learned earlier such as using double facts andfacts for 10. Return to the same problems and have each student do the problem a different way than the first time. One of the two methods, for the purpose of this lesson, should include a picture. The other should use another strategy like double facts or using facts for 10 or restating the problem as an easier version.

Toward the end, ask questions such as:

How much more is 14 than 9? How do you know?

How could you calculate 15 – 6?

Extension

Give one story example and have the students go to the board or share in groups as many different ways as possible to solve the problem. It is probable that five or more methods will be used. You could return to one of the problems mentioned earlier in the lesson.

Have the students complete the relevant activities in their Students Activity Books.

Lesson 11 Missing Addends

Objectives

Solve equations involving the sum of two single-digit numbers where one of the addends is missing.

Maths Note

Open sentences with a missing addend come in four forms, though these are closely related. Here is one way of looking at the picture. Addends can be combined to obtain the whole. That is, we can start with a given amount (a) and need the missing addend to reach the whole, as with a + ☐ = c, or vice-versa, as with ☐ + b = c. Students usually find the first one easier since they have a starting point. They know an amount and need to figure out what to add on to end up with c. In the second case, they do not know the start, but know what was added. Some students will use the commutative principle and just change the second question to one like the first one. But, other reasonable strategies should be explored and used too.

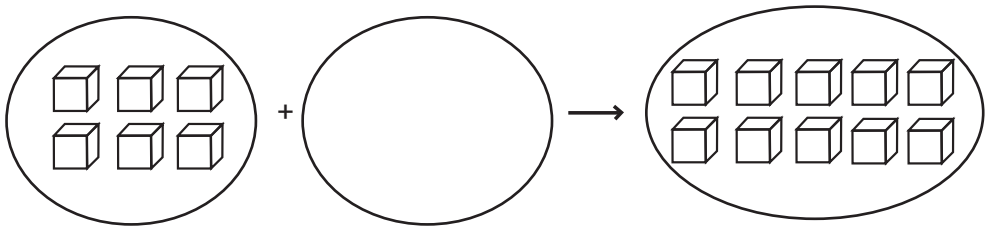
The sentences c = a + ☐ and c = ☐ + b appear similar to those above. However, their significance is different in that here it is the whole that is being broken into parts. That is, given the whole there is a need to find the missing part. As with the above examples, it is generally easier to have the first part known and need to find the second addend, rather than the other way around.

Students should be presented with a broad collection of these types of open sentences and asked to solve them. They should also be presented with situations that would lead to the open sentences. It is expected that the core principles and strategies of addition will be developed in building fluency here. Probably few students will become comfortable with all forms in such a short time. Rather this idea will be developed further through the year. Connections to subtraction facts, facts for 10, and the commutative property for addition are likely to be helpful.

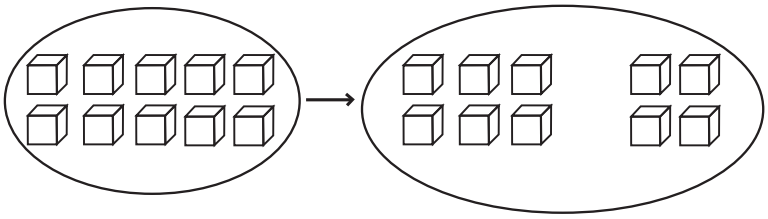
Materials

Counters and snap cubes

Tell the students of a situation that would lead to an open addition sentence. For example: **I have 6 cubes. (Sonam) has some cubes. We have 10 cubes altogether. How many cubes does (Sonam) have?** Have the students tell the number. Encourage them to explain or show how they determined the number. Then, write the open sentence on the board to represent the situation as:
6 + □ = 10. Explain what each number and symbol in the sentence means. You could also model this with cubes, as shown below.



The above illustration shows 6 + ☐ = 10. Below we have a picture that begins with the whole of 10 cubes and splits this into two parts. Note how covering either of the two parts would provide a picture for 10 = 6 + ☐ or 10 = ☐ + 4.

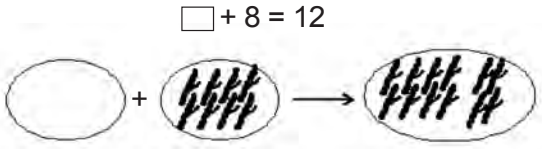


Present a few more similar situations and ask the students to represent them by open sentences, and then ask them to determine the number added. With each problem, encourage the students to explain or show how they determined the missing addend.

Assessment for Learning

See that the students can represent the simple situations with appropriate open sentences, and use reasonable strategies to determine the missing addend in each case.

Next, present the students with a situation in which the initial number is not known, but the number added and the total is known. For example: **I had some twigs and got 8 more. Now I have 12 twigs. How many twigs did I have before?** Encourage the students to tell the number. Ask them how they might write the open sentence for this situation. **How would you write the number sentence for this?** You might ask a student to write it on the board, and have the other students confirm or review it.



Present a few more similar situations and ask the students to represent them by open sentences, and then ask them to determine the initial number. With each problem, encourage the students to explain or show how they determined the missing addend. Some of these should be modeled using the cubes.

Toward the end, ask questions such as:

What strategies can you use to figure out what number is missing: 9 + □ = 15?
Why can you subtract 8 from 12 to solve 8 + □ = 12?
There are 13 pebbles. 8 are dark. How many are not dark?

Extension

It is important that students can move from the whole to the parts as well as combining parts to make the whole. Hence, there should be examples like the following incorporated into the lesson. Such examples can be practiced during the year.

13 = 9 + □	12 = 7 + □	15 = □ + 5
10 = □ + 3	14 = 8 + □	16 = 7 + □

Have the students complete the relevant activities in their Student Activity Book.

Lesson 12 Missing Subtrahends

Objectives

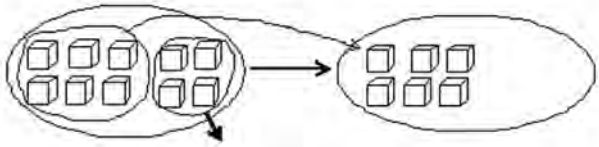
Solve equations involving subtraction in which the subtrahend is missing.

Materials

Counters and snap cubes

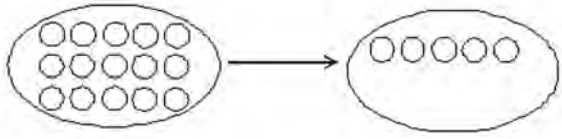
Tell the students of a situation that would lead to an open subtraction sentence. For example: **I have 10 cubes. I gave away some of the cubes to (Sonam). Now I have 6 cubes left. How many cubes did I give to Sonam?** Have the students tell the number. Encourage them to explain or show how they determined the number. Then, write the open sentence on the board to represent the situation as: 10 – □ = 6. Explain what each number and symbol in the sentence mean. You could also model this with cubes and act it out. You could start with the 10 cubes and remove some of the cubes such that only 6 remain. To determine the missing number in the sentence, count the number of cubes removed.

10 – □ = 6

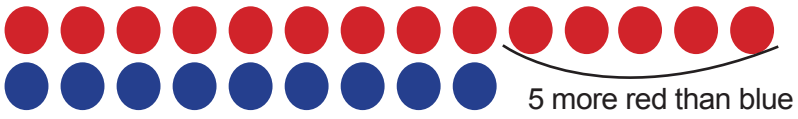


Next, you might present a situation as this: **Karma brought a plate of 15 momos. He passed the momos around for others to enjoy. There were 5 momos left when Karma got the plate back. How many momos were taken from the plate?** Encourage the students to tell the number. Ask them how they might write the open sentence for this situation. **How would you write the number sentence for this?** You might ask a student to write it on the board, and have the other students confirm or review it. You could also have the situation represented with a drawing.

15 – □ = 5



Next, you could present a comparison situation. For example: **There are some red counters and some blue counters in a bag. When Maya counted the counters, she found out that there are 14 red counters and it is 5 more than the blue counters. How many blue counters did Maya count?** Encourage the students to explain how they solved the problem. You might model this situation as:



14 – □ = 5

Maths Note

In this lesson, students learn to solve equations of the forms a – □ = c and □ – b = c. Such equations represent, or describe, both active subtraction situations and comparison situations.

The students should use some of the strategies they have learned to solve them. Also, the connections to addition should be made. For instance, the idea of starting with the end amount and working backwards can get us to a larger initial amount.

(Note: One of the confusing ideas with resources and subtraction is that it may surprise you to see how many students wish to have more than 10 cubes to do such a problem. Any representation of two amounts, or a comparison situation, will require many more resources. Hence, be generous with the allocation of resources to allow for different methods to emerge. More resources with groups are preferable to minimal resources for individuals that basically impose a method of a take away approach.)

Present a few more situations and ask the students to represent them by open sentences, and then ask them to determine the missing number. With each problem, encourage the students to explain or show how they determined the missing subtrahend.

Toward the end, ask questions such as:

What strategies can you use to figure out what number is missing: 13 – ☐ = 9?

Why can you subtract 7 from 12 to solve 12 – ☐ = 7?

Karma has 15 pebbles. He has 8 more than Dorji. How many does Dorji have?

How can addition facts be helpful with solving 16 – ☐ = 8?

Assessment for Learning

See that the students can represent the simple situations with appropriate open sentences, and use reasonable strategies to determine the missing subtrahend in each case.

Extension

Provide adequate practice to solve open sentences in which the students determine the missing subtrahends, with simple stories or without the stories such as:

12 – ☐ = 6	☐ – 7 = 4	15 – ☐ = 5
☐ – 6 = 6	☐ – 5 = 6	14 – ☐ = 8

Have the students complete the relevant activities in their Student Activity Book.

Lesson 13 Missing Addends and Subtrahends

Objectives

Solve equations of the various forms that have been encountered in Lessons 11 and 12.

Materials

Counters and snap cubes

Begin with a story or a pictorial representation. For example, you may begin by saying that you have a total of 12 counters in your two hands. The number of counters in the open hand is clearly 4. How many counters are in the closed hand? Have the students generate number sentences that could be used to represent the situation. Each sentence should have a missing addend or a missing subtrahend, for the purpose of this lesson.

Some may see this as an addition problem with a missing addend, as with 12 = 4 + ☐; others may see it as a subtraction problem, as with 12 – ☐ = 4. Other sentences are plausible also.

Now suggest to the students that they place some counters (cubes) in front of them to develop a story of their own. Then have the number sentences generated. Some of these can be shared with the class. When you are confident that the students can generate the sentences, shift the attention to solving for the missing numbers.

Provide the students with various open sentences such as the following to solve:

☐ – 8 = 4	13 – ☐ = 8	☐ + 10 = 16
☐ + 3 = 11	9 + ☐ = 14	☐ – 1 = 7

Maths Note

Models with counters or cubes, along with verbal stories can be used as starting points. The goal is to develop number sentences that correspond to the situations. Then various strategies can be applied to solve the equations. The core of this lesson is to dedicate time to working with the ideas of the preceding two lessons, as the ideas are both important and challenging. The connections between addition and subtraction ought to become apparent.

Extension

Provide some more open sentence for the students to solve. Extend the addition examples to three numbers, such as 2 + 5 + ☐ = 13, or 12 = ☐ + ☐ + ☐. In the latter example, encourage them to come up with multiple answers by distributing 12 counters into three piles, not necessarily equal. This is helpful in freeing the thinking later for more complicated sums.

Have the students complete the relevant activities in their Student Activity Books.

Assessment for Learning

See that the students can represent the simple situations with appropriate open sentences, and use reasonable strategies to determine the missing values in each case.

Lesson 14 Fact Families

Objectives

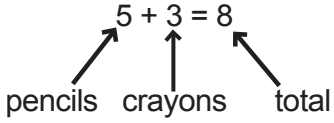
Write all the related addition and subtraction sentences for a given addition or subtraction sentence.

Materials

Pencils
Crayons

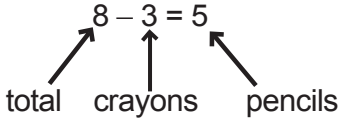
> **Maths Note**
>
> Addition and subtraction are intrinsically related. In any situation involving an addition, there is an equivalent subtraction situation and vice versa. Note that the order of numbers does not matter in addition. Students have been already exposed to these facts in earlier lessons. However, this lesson will review and consolidate these facts for the students.

Present a part-part-whole situation to the students. This could be done by showing a set consisting of 5 pencils and 3 crayons. Say: **I have a set of pencils and crayons. How many pencils are there? How many crayons are there? How many items are there altogether? Can you describe this set with an addition sentence?** Encourage and probe the students to come up with an addition sentence such as: 5 + 3 = 8. Write the sentence on the board. Discuss what each number and symbol means in this sentence. You could label them as shown below.



Ask the students if they could write the above addition differently (as: 3 + 5 = 8).

Then, ask them to write a related subtraction sentence for the addition. **Can you write a subtraction sentence for this set?** Ask probing questions such as: **There are 8 items in the set. Three of them are crayons. How many of the items are not crayons? How can you write this in a number sentence?** Once you write the sentence, 8 – 3 = 5, discuss what each number means in it. You could label them as below:



Then, have the students come up with another related subtraction sentence (as: 8 – 5 = 3)

Write all the 4 sentences together, and tell that they are all related and are called a Fact Family.

3 + 5 = 8
5 + 3 = 8
8 – 5 = 3
8 – 3 = 5
} *Fact Family*

Provide another addition sentence, for example, 6 + 4 = 10, and have the students tell and write the fact family for it. Provide a few more situations.

Students should observe that there are usually 4 sentences in a fact family. You could help them do that by asking: **How many sentences are there in each fact family above? How many addition sentences are there? How many subtraction sentences are there?** However, not all fact families will have 4 sentences. When a situation involves a double fact, there will be only 2 sentences. For example, have the students write all the sentences for the addition sentence, 5 + 5 = 10. Have the students observe and realize this too. Have the students complete the fact family for a few more situations involving double facts.

Toward the end, ask questions such as:

Why is it helpful to know that 8 + 5 = 13 if you have to solve 13 – ☐ = 5?
If you know that 8 + 5 = 13, what subtraction sentences can you solve easily?

Assessment for Learning

See that the students can come up with the fact family for a given addition sentence.

Extension

Make the fact families for some larger numbers using an example involving tens, or others where the starting fact could be done mentally like 40 + 20 = 60 or 10 + 20 = 30. Try some subtraction sentences as starting points like 100 – 10 = 90 or a double fact like 50 – 25 = 25.

Have the students complete the relevant activities in their Student Activity Book.

Lesson 15 Addition Table Patterns

Objectives

Explore patterns in the addition table to help solidify their knowledge of the addition facts.

Materials

Chart paper
Marker pens in two different colours

Prepare an 11 by 11 table for the addition facts as shown here.

+	0	1	2	3	4	5	6	7	8	9
0										
1										
2										
3										
4										
5										
6										
7										
8										
9										

Display the table, and tell the students that it is called an addition table. Then, with the help of the students complete the table. Encourage the use of patterns as this process is being carried out, so as not to think of this as a painful task of doing 100 separate sums.

Once the table is completed, discuss how to locate the sum or addition fact for two numbers. For example, to locate the sum for 8 + 5, you read the number in the row that begins with 8 and that is under the 5.

Have the students look or explore and discuss a variety of patterns in the table. For example, the numbers increase by one going to the right (which shows that, for example, 8 + 5 is one more than 8 + 4); the rows are the same as the columns (which means the order of adding does not matter), etc. Some of this may have arisen in the completing phase of the table. Also, draw attention to the double facts and the significance of 0 as two key ideas. A good activity is to cover up some of the numbers and ask students to use patterns to figure out what numbers are missing.

Toward the end, ask questions such as:

What patterns do you see in each row of the table?
Where are all the 9s in the table? Why does that pattern make sense?
Where are the 10s? Observe the connection to the facts for 10.
Why is the number below any number one more than itself?

Maths Note

The addition table is simply a way to record all of the addition facts possible. Really every addition that students will ever do involves adding digits from 0 through 9 to one another. The table can also be used for finding the subtraction facts. For 13 – 8 = □, the student looks in the 8 row for the number 13 and finds the difference as the number at the top of the column.

Assessment for Learning

See that the students can tell the addition facts for the numbers including the double facts.

Extension

Have the students complete the addition table in their Student Activity Books. You may want to refer to the addition table as they gradually begin to memorize their facts over the rest of the year. If time permits, you may wish to have them use the table to aid with subtraction. Here are some examples: 13 – 6; 11 – 5; 14 – 8; and 12 – 3. Note that with 13 – 6, for example, that we need to find the 13 in the row (or column) with 6 and find the corresponding number. The table is telling us that 13 = 6 + 7, and from our work with fact families it follows that 13 – 6 = 7.

Chapter Assessment

Formative Assessment

Formative assessment ideas, tips and reminders are provided within each lesson under the heading called Assessment for Learning. In addition, you should use a formative assessment tool called the Chapter Checklist. Prepare the Formative Assessment Recording Sheet for the chapter as shown below. You should look for evidence in each student, throughout the teaching of the chapter, that he or she has understood the key concepts and can perform the key mathematical skills by ways of observing, listening and asking probing questions. Accordingly, keep the records for each student by putting a mark, such as a tick mark, for each of the chapter goals once you are convinced that the student has achieved them. You could also keep relevant anecdotal records.

Using the Chapter Checklist purposefully will give you the benefit of ensuring that each student's learning progress is assessed in a systematic manner. What is even more important is the opportunity it will provide you to help each student along in achieving the chapter goals. Since this is meant as a formative assessment tool, you will not be giving any mark to the students by using it. However, investing time in carrying out this assessment technique will contribute positively in the students being able to do well in the summative assessments, including the examinations. You can also refer back to these records as you look for progress during the year and/or seek to address areas of concern.

Formative Assessment Recording Sheet
CHAPTER 2 ADDITION AND SUBTRACTION STRATEGIES

Chapter Checklist (Look for evidence throughout the chapter that the student has understood the key concepts and can perform the key skills.)

Student Name		Chapter Goals (The student is able to):							
		Use Counting On and Counting Back to solve addition and subtraction problems respectively.	Use Double facts to solve addition and subtraction problems.	Use Facts for 10 to solve addition and subtraction problems.	Determine the missing addends in an addition sentence.	Determine missing subtrahend in a subtraction sentence.	Determine the missing total in a subtraction sentence	Write the fact family for an addition sentence or a subtraction sentence	Recall addition and subtraction facts to 18.
1									
2									
3									
4									
5									
6									
7									
8									

Summative Assessment

As explained in the Introduction to the Teacher's Guide, the student's learning in each chapter will be measured primarily through the use of an assessment method called the Interview-based Performance Task. The primary purpose of this assessment is to thoroughly assess the level of understanding of the students in terms of the key concepts and skills as required in the chapter. It provides an opportunity for the students to display their understanding by ways of telling, describing, showing, and demonstrating in a non-threatening environment.

One of the beauties of this assessment method is that it allows you to teach and clarify things even as you are assessing the students. The fact that you have to provide marks to the students through the use of Interview-based Performance Tasks should be considered a secondary purpose. The Summative Assessment Recording Sheet (shown on the next page) is included in the Student Activity Book for your use with each student. Please refer to the Introduction to the Guide for the details on the marking scheme.

Summative Assessment Recording Sheet

Student Name: _____ Roll no.: ____ Section: ____

CHAPTER 2 ADDITION AND SUBTRACTION STRATEGIES

Interview-based Performance Task (Please refer to the Introduction to the Teacher's Guide for Class 2 for the marking scheme while using the Interview-based Performance Task.)

Task and Interview prompts	Key concepts and skills to look for
Provide the student with a set of snap cubes in two colours (e.g., 5 red cubes and 6 blue cubes), and a blank paper. And, ask: **Can you write an addition sentence for this set of cubes?** Use appropriate probing questions, if required. Have the student describe what each of the numbers in the sentence means. Have the student write the related addition and subtraction sentences, by asking questions such as: **Can you write this addition sentence in another way? How are these two addition sentences different? Why is the sum the same? Can you write a related subtraction sentence for this addition sentence? How do you know that 11 – 5 = 6? What is another subtraction sentence for this situation?** Have the student write an addition sentence using two different numbers, other than 5 and 6, for which the sum is 11. Ask him/her to tell how he/she determined the sum. Have the student write a subtraction sentence using two different numbers, other than 11 and 5, for which the difference is 6. Ask him/her to tell how he/she determined the sum.	The student is able to: - Represent a part-part-whole situation with an addition sentence. - Describe what each number in an addition sentence means. - Use the commutative property of addition. - Write the related addition and subtraction sentences for an addition sentence. - Write more than one addition fact for the same sum. - Use an appropriate strategy to add two numbers. - Write more than one subtraction fact for the same difference. - Use an appropriate strategy to find the difference of two numbers.

Comments and Marks

Strengths:

Areas of Need:

Follow up Steps:

Teacher's Signature and Date:

Summary of the Summative Assessment for Chapter 2

CA marks from Chapter 2 (Marks out of 10): _____

CHAPTER 3 MEASURING LENGTH AND AREA

Chapter Overview

The length of an object is the measure of how long it is from one end to the other. In other words, length is the same as distance. Measurements such as height, width, depth and distance around objects are all measurements of length.

Area is the amount of surface a shape covers. It is a two-dimensional measure, whereas length is a one-dimensional measure.

The students have had some experiences with the idea and measurement of length in classes PP and 1, such as comparing, estimating and measuring lengths using non-standard units. The students will review these concepts in this chapter. In addition, the students will be introduced to the concept of perimeter. Further, they will be introduced to standard units like centimetre and metre, and use these to measure length, including perimeter.

The students have also had some experiences with the idea of area in Class 1, such as comparing areas and measuring areas with non-standard units. The students will review these concepts and experiences with area in this chapter.

Length and area are two measurement concepts. Measurement is really about comparison – comparison of how much one feature of an object is as compared to the same feature of another thing. So in measurement, whether it is length, area, mass or capacity, we usually make use of numbers. This way, a chapter like this has the power of consolidating and furthering the students' concept of numbers.

This chapter has 10 lessons as detailed in the Table of Contents.

Basic Principles About Measuring Length and Area

- The length of an object is the measure of how long it is.
- Height is simply length considered vertically from a plane rather than horizontally on a plane.
- Area of a shape is the amount of surface it covers.
- Any individual item might have more of a measure than a second item, but less of a measure than a third item (e.g., A might be longer than B but shorter than C).
- Any measurement comparison can be stated in two different ways (e.g., A is more than B or B is less than A).
- Lengths and areas can be compared both directly and indirectly, using a third item.
- Tools or units of measuring length or area should be appropriate to the contexts.

Chapter Goals

- Estimate lengths reasonably in terms of non-standard units.
- Measure lengths using non-standard units.
- Describe the approximate size of a centimetre.
- Measure lengths in centimetres.
- Describe the approximate size of a metre and measure lengths in metres.
- Measure the perimeters of shapes.
- Compare area directly and use terms like larger/bigger than and smaller than.
- Measure areas using non-standard units.

Maths Words

Length, distance, distance around, height, measure, unit, centimetre, metre, perimeter, area, surface

Lesson 1 Measuring Length in Non-standard Units

Objectives

Use non-standard units to estimate, measure and record lengths (including heights and distances).

Materials

Sticks, pencils, plastic bottles, and strings of various lengths
Snap cubes, toothpicks, straws, paper clips, or other long thin items that come in uniform sizes

Review the concept of length and height. This could be done by asking the students to compare various lengths which can be compared directly such as pieces of sticks, pencils, strings, bottles, and heights of some students. In doing so, create situations for the students to use comparative terms like longer than, shorter than, taller than, about the same length, about the same height, tallest and shortest. Have the students also compare the lengths of objects which cannot be compared directly such as the heights of a door with the heights of windows.

Show the students a stick and some paper clips, and ask: **If we measure the length of this stick with these paper clips, how long do you think the stick is?** Encourage the students to tell their estimates. You could record the numbers they tell on the board. Suggest a few numbers which are not reasonable, such as: **Could the stick be 2 paper clips long? Why could not it be? Could the stick be 50 paper clips long? Why not?** Then, model how to measure the stick with the paper clips. Make a mistake by leaving obvious spaces in between some clips, and see if the students can realize the mistakes. Ask: **How long is the stick? Here, we have used the paper clips to measure the length of the stick.**

Distribute some paper clips, snap cubes, toothpicks, and other appropriate non-standard units of length measurement to the students in groups. Tell them that they will measure the lengths of their pencils, books, edge of the table using the units they have. Tell them that they should first estimate the lengths before measuring. As the students work, circulate to support. See that the students can make reasonable estimates, measure the lengths appropriately using the units, and express their estimates and measurements appropriately. Ask questions such as: **How long do you think is the table along this edge in terms of the toothpick? Is the edge exactly 11 toothpicks long? Or is it a little more than 10 toothpicks long? How should you line up the cubes to measure this length?**

Have the students exchange the units once they have finished using them. For example, a group which got snap cubes could exchange them with a group that got paper clips.

Maths Note

Students have already met the concept of a non-standard unit of length in Class 1. The students review the concept and skills of measuring lengths with non-standard units. It is important to reinforce the following concepts: that the choice of the units should be appropriate for what is being measured - not too large or too small; the non-standard units should be of uniform size; that the units should be properly aligned leaving no space in between; and that the students should always estimate the length in terms of units before actually measuring it. In cases where the number of units is not exact with the length being measured, students should learn to express the length as, for example, 'between 5 and 6 cubes long', or 'a little more than 5', or 'a little less than 6'.

Extension

The activity suggested below will set up the basis for the next lesson.

Explain to the students what a palm width is. It is the width of one's palm. You could ask the students to compare each other's palm widths.

Tell the students how many palm widths long an item is. For example, "**the length of a table I have at my home is 12 palm widths. How many toothpicks long do you think the table is?**" The students should at least be able to reason that it would take more toothpicks than palm widths because the palm is a larger unit. You could also ask the students to estimate the length of your table in terms of other units such as snap cubes and hand spans. (It is possible that the students would use early proportional reasoning but that should not be expected.)

Have the students complete the related activities in their Student Activity Books.

Assessment for Learning

See that the students align the beginning of the first non-standard unit with the beginning of the object to be measured, that the students touch the units end-to-end, that the students read the number of units correctly and express the measurements appropriately such as "the length of (my pencil) is a little over 5 cubes or between 5 and 6 cubes or a little less than 6 cubes or about 6 cubes".

Lesson 2 Making a Non-standard Measuring Tool

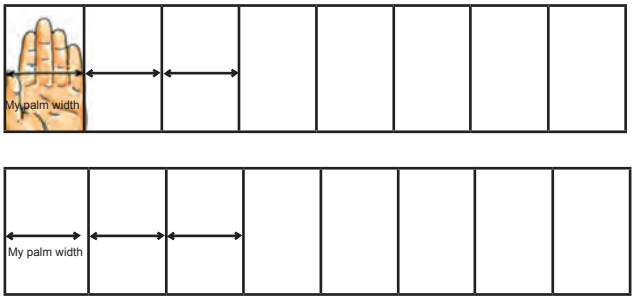
Objectives

Make a non-standard length measuring tool, and measure various lengths using it.

Materials

Duplicating papers
Stapler

Fold and cut into halves duplicating papers along the longer edge. Distribute a paper each to the students. Demonstrate and have the students trace the outline of their palm on the paper at its one end. Then, mark and label the width of the palm as 'My palm width'. Explain the meaning of the 'palm' and 'width' to the students. Then have the students fold the paper into multiple copies of their palm width. Distribute some more such papers (4 to 5), and have the students make multiple copies of their palm width. Join the papers, by either stapling or using tapes.



Tell the students that what they have made is a measuring tool, and that the unit of measurement is their palm width. Then, have the students measure various lengths using their measuring tool, such as the heights of tables, windows, doors, each other heights, edges of tables, edges of a chalk board, lengths of books, distance around containers and distance around their legs.

As they go about measuring the lengths of various objects, ask questions such as: **What do you think will be the distance from the floor to the door knob in terms of your palm width? How will you find out? What lengths are more than 10 palm widths? What lengths did you find were less than 2 palm widths? What lengths are between 5 and 6 palm widths? What length or height do you think will be more than 20 palm widths?**

Maths Note

One of the difficulties students face with measuring length is to ensure that the units they use are carefully placed so that no spaces are left between them. One way to do this is to make a "non-standard ruler" where a non-standard unit is used repeatedly on a long piece of paper to make a flexible ruler.

Assessment for Learning

See that the students can measure and express various lengths appropriately using their measuring tools. This would include checking whether the students align the beginning of the tool with the beginning of the object to be measured and asking the students to express the measurements in terms of the units.

Lesson 3 Value of a Standard Unit

Objectives

Gain a sense of why standard units are useful.

Materials

The measuring tools that the students made during the last lesson
Strings
Scissors

Tell a story, for example: **I want to install a curtain to the door of my house. For that, I have to first install a curtain rod across the top of the door.** (Explain what a curtain and a curtain rod are to the students.) **I have measured to see how long the rod should be. It should be exactly 8 palm widths long. Now, I cannot make the rod myself because I don't have the materials such as a knife and wood. So, I come to you for your help. Could you tell me how long the rod should be with paper or strings?** Have the students work in pairs or small groups to show you how long the rod would be. Provide strings, papers and scissors if the students need them.

Then, have the students compare and observe that the lengths of the rod provided by them are not exactly the same. Ask them why it was not possible to have the length for the rod the same, even when they know it is 8 palm widths for all. Students should realise that the palm width of one person would be different from the palm width of another person. Use this to motivate the need for a standard unit.

Toward the end ask questions such as:

> **Suppose every one of you used your own pencils to measure the height of the classroom door, would you all get the same measurement? Why, or why not?**
>
> **Suppose every one of you used the same pencil to measure the height of the classroom door, would you all get the same measurement? Why, or why not?**
>
> **Suppose you are told that someone is 12 staplers tall. Can you be sure whether or not he is taller than you? Why not?**

Maths Note

The primary purpose for using standard units is to improve communication. It is only because we want another person to understand what we mean that we all measure with the same units. Soon the students will be exposed to two standard units for measuring length – the centimetre and the metre. To motivate their use, it is desirable for students to see the value of standard units.

Assessment for Learning

See that the students can reason out why the measurements or lengths would be different when the non-standard units are used for them.

Lesson 4 Introducing the Centimetre

Objectives

Gain a sense of the centimetre.
Begin to use a ruler to properly draw and measure lines in centimetres.

Materials

Rulers (at least one ruler for two students)

Relate with the last lesson, and tell the students that since units like palm width, hand span, paper clips and pencils are different from person to person they are not very reliable to use as units of measurement. Tell the students that they will be using a unit of measuring length called centimetre.

Provide rulers to the students, if possible one each. Some students might already have personal rulers in their geometrical boxes. Show them how long a centimetre is on their rulers. Model drawing a line that is 1 cm on a paper using a ruler and a pencil. Have all the students draw a line that is 1 cm in their notebooks. Then have them draw lines which are all 1 cm in a variety of orientations, such as horizontally, vertically and slanting.

1 centimetre

Ask the students to observe and tell how long a centimetre is. Can you tell how long a centimetre is? What part of your body is about 1 centimetre long? How about the width of a finger? Model how to show a gap of 1 centimetre with your index finger and thumb. Then increase the gap to show about 2 centimetres. Have the students do the same.

Then, have the students draw straight lines that are all 2 centimetres using rulers in their notebooks.

2 centimetre

Then, ask the students to show things which are about 5 centimetres long, or indicate with their hands how long 5 centimetres would be.

Toward the end, ask questions such as:

Other than the width of your finger, what might be one centimetre long?
About how long would 5 centimetres be?
About how long would 20 centimetres be?

Maths Note

The first length unit that is usually introduced is the centimetre since it is a manageable size. Students should use rulers where only centimetres (not inches or millimetres) are shown, if at all possible. Students should be able to relate and describe about how long a centimetre is. They might see it as about the width of their finger. Students need to be shown how to use the ruler, i.e. lining up one end of a length or distance with the 0 and reading the mark at the other end.

Assessment for Learning

See that the students can describe or show how long 1 centimetre is. This could be checked during the lesson while the students work on drawing their lines using rulers and pencils, as suggested in the lesson.

Extension

Have the students complete the relevant activities in their Student Activity Books.

Lesson 5 Measuring Lengths in Centimetres

Objectives

Estimate, measure and record a variety of lengths in centimetres.

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Materials

Rulers

Have the students estimate the length of a variety of items in centimetres and then measure the lengths with rulers. For example, show a pencil and ask: **How many centimetres long do you think is this pencil? How do you know that it will be about (7) centimetres long? How will you measure the length of this pencil in centimetres?**

Provide rulers to the students individually (if possible) or in pairs or small groups. Ask a student to measure the length of the pencil with a ruler. Make sure that the students align the beginning of the pencil with the 0 mark on the ruler and to read the measurement appropriately.

Ask the student to measure the lengths of various objects. Encourage them to always estimate the lengths in terms of centimetre before they actually measure. The objects could be their pencils, crayons, edges of books, edges of tables, and even their palm widths and hand spans.

Extension

Challenge the students to estimate and measure the lengths around objects. For example, ask: **About how many centimetres would the length around your wrist be? How will you measure the length of your wrist in centimetres?** Students might have to first wrap strings around the round objects, which would then be stretched out to align with their rulers to measure the lengths.

Have the students complete the relevant activities in their Student Activity Books.

Maths Note

Once the students have become familiar with the centimetre, they need a lot of practice measuring in centimetres. They should always be estimating first. This is a way to ensure that students can check whether their measurements are reasonable.

The students need to be shown how to use the ruler, i.e. lining up one end of a length or distance with the 0 and reading the mark at the other end

Assessment for Learning

See that the students can make reasonable estimates of the lengths before measuring them. This could be checked while they are measuring the lengths of the objects as suggested in the lesson.

Lesson 6 Measuring Perimeter in Centimetres

Objectives

Understand the meaning of the term Perimeter.
Estimate, measure, and record Perimeters of 2-D shapes in centimetres.

Materials

Rulers
Cut out 2-D shapes such as rectangles, triangles and trapezoids (one shape for each student)

Prepare cutout of 2-D shapes as mentioned above, such that the length of each edge (or side) of each shape is measurable in exact centimetres. In other words, the lengths of the edges should not involve fractions of a centimetre. Also, ensure that each student will get a shape.

Provide the cutout shapes and rulers to the students. Have them measure the lengths of the edges of their shapes one by one in centimetres and record them on the shape. As they work with their measurements, circulate to provide help where needed. See that the students use the rulers properly to measure the lengths.

After everyone has finished measuring the edges of their shapes, ask them to determine the total length around their shapes. Ask them how they might determine the total length or distance around their shapes. Tell them that the total length or distance around a shape is called Perimeter. Write the word Perimeter on the board, and have the students write it in the middle of their shapes. And then, ask them to record the perimeter of their shapes. Help them add the lengths of the individual edges.

After everyone has determined the perimeter of their shapes, ask the students to describe their shapes and perimeters to the class. For example, a student might say: My shape is a trapezoid. The perimeter of my shape is 16 centimetre.

Maths Note

Students think of length as a single distance. Perimeter is a new idea—the idea that we combine distances to get one total value. It is also interesting that to measure perimeter it is possible to start anywhere (there is no single defined end), as long as the measurer gets back to the initial location.

Assessment for Learning

See that the students can use rulers properly to measure the lengths of lines. See also that the students can describe their shapes and perimeters.

Extension

Have the students complete the relevant activities in their Student Activity Books.

Lesson 7 Measuring in Metres

Objectives

Estimate and measure lengths in metres.

Materials

Metre sticks, including improvised metre sticks (one for each group of students)
Strings
Scissors

Ask the students to estimate and measure a few long lengths in centimetres. Ask questions such as: **How many centimetres do you thinks is the height of this door? How will you find it out? How long will be the distance from this end of the room to that end near the wall? How can you measure it in centimetres?** The students will realize that they need a great number of centimetres to measure such lengths or distances.

Tell that in such cases, we could better use a longer unit called metre. Show how long a metre is with the help of a metre stick. Look around the classroom for things that are about 1 metre; align a meter stick with those things and describe that they are about 1 metre. The objects could be the distance from the floor to the doorknob, height of the teacher table, or the length of a table top.

Ask the students to estimate a variety of appropriate lengths or distance in metres: **About how many metres do you think it will be from this end of the wall to that end? How tall do you think is this wall in metres, from the floor to the ceilings? What would be the height of this window in metres? Will your height be more than 2 metres? How do you know?**

Distribute a metre stick to groups/pairs of students with the instruction to measure various things or distances in and around the classroom. Instruct the students that each group/pair will tell the class about what they measured. In particular, they should tell one thing that is less than 1 metre, one thing that is about 1 metre and one thing that is more than 5 metres. Give them adequate time to measure things. As they go about measuring, help them with suggestions and the proper technique of using the mearsuring sticks to measure the distances.

Extension

A fun activity would be to have the students try walking/running in a way that each step is 1 metre in length, and then try to use this gait (way of stepping) to estimate the length of some long things (like a wall or the edge of a field). The purpose of this is to help them get a more physical sense of 1 metre. If they can't do 1 metre strides, they can try half metre strides – so two strides make a metre.

Maths Note

The metre is introduced to help students because it is useful to use a longer unit when measuring longer lengths or distances. They should relate a metre to objects that are about one metre in length or height, such as, the height from the floor to a door knob.

It is useful for students to create their own measuring tools, so it makes sense to have them build a 1 metre string or stick that they can use as a personal measure.

Assessment for Learning

See that the students can use the metre sticks correctly to measure such that they start reiterating the stick at the end point of the previous placement of the stick. And also see that the students can express a measurement appropriately such as "a little more than 3 metres", "between 2 and 3 metres", a little less than 3 metres", "about 1 metre" etc.

Lesson 8 Making a Metre Scale

Objectives

Recognize that 1 metre is 100 centimetres.

Materials

Duplicating papers (Four A4 papers for each pair of students)
Stapler
Metre sticks
Rulers

Maths Note

One metre is 100 centimetres.

Show a metre stick. Start lining up rulers against the stick to show that it is many centimetres. Tell students that the metre stick is 100 centimetres long, and that 1 metre has 100 centimetres. Tell the students that they will be making 1 metre with papers.

Distribute four A4 duplicating papers to each pair or group of students. Have each student fold a paper into halves along the longer edge, and then into quarters as you demonstrate the folding. See that everyone has done the folding properly. Have all the 4 papers in the pairs/groups folded in similar manner. Once that is done, have the students join the folded papers end to end by stapling them, so that each pair/group now has a long strip of paper. Distribute rulers. Then, ask the students to mark the paper along an edge at every 10 centimetre with the help of ruler and pencil. As the students work, go around ensuring that they are doing it correctly. Once the markings are done, have the student label the markings from one end to the other serially as 10 cm, 20 cm, 30 cm, …100 cm. They could then cut off the extra paper at the 100 cm marking. Their 1 metre stick is now ready.

Have the students align their paper metre with the metre sticks to confirm that 1 metre is 100 centimetres. Tell that with their paper metre, they could measure the lengths or distance around objects, which is not directly possible with metre sticks. Have the students measure a variety of lengths around items with their paper measuring tool, such as around their arms, legs, heads, chests, water bottles, bag etc, and have them describe these distances appropriately such as "**the distance around my head is a little less than 50 centimetres**".

Assessment for Learning

See that the students can relate centimetres to metre, such as that there are 100 centimetre in 1 metre, 200 centimetres in 2 metres, 50 centimetres in half a metre.

Toward the end ask questions such as:

Something is 120 centimetre long. Is it longer or shorter than 1 metre?

A dog's tail is 70 centimetres long. Is the dog's tail longer or shorter than 1 metre?

How many centimetres are the same as 1metres?

How many centimetres are the same as 2 metre?

How many centimetres are there in half a metre?

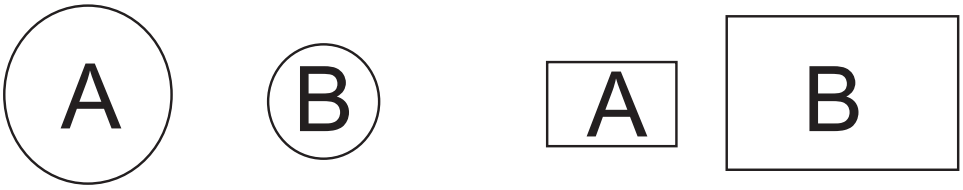
Lesson 9 Comparing Areas

Objectives

Understand the idea of area (as an amount of surface, or how much something covers).
Determine which of two items takes more space, or less space, by covering one with the other.

Materials

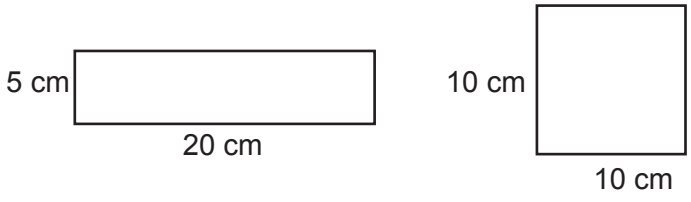
Two cut out circles, marked A and B with A bigger than B
Two cut out rectangles – marked A and B with B bigger than A
Two rectangles – marked C and D
Duplicating papers
Scissors



Tell the students: **Today we will be comparing areas.** Say and show that the area of the table top is bigger than the area of a book; the area of the floor is greater or bigger than that of the chalk board. The area of the assembly ground is bigger than the area of the classroom floor. Explain that the area is how large a surface is. Show the cutout circles, and ask: **What is the name of this shape? Can you see this letter A here? Let us call this Circle A. I have another circle here. What shall we call this circle? Which circle is bigger? Which circle has a bigger area? How can we show that circle A has a bigger area than circle B.** Encourage the students to make suggestions. Following up with their suggestions, put one circle on top of the other to compare their areas, where circle B will be shown to be clearly smaller in area.

Repeat the above procedure with the rectangles marked A and B; ask the students to predict which rectangle will have a bigger area, and compare the areas by placing one rectangle over the other. You could ask a student to do the direct comparison.

Then, show the rectangles marked C and D. The two rectangles should look different but have the same area. You could use the following dimension, without actually writing the dimensions for the students.



Maths Note

This is a review of Class 1 materials. Area is the measure of 2-dimensional expanse of an object—the space on a flat surface that a shape covers. Students can measure area using direct comparison if one shape fits right on top of another. Sometimes, if a shape is made of paper, it can be cut into pieces that can be rearranged to fit on top of a second shape. Some students will not have confidence that this does not change the area. This is something that will make more sense to those students with more experience.

Ask: **Which rectangle do you think has more area? How many of you think rectangle C has more area than D? How many of you think the rectangle D has more area than C? How will we know?** It will be quite difficult to know which is bigger simply by placing one on top of the other. You could then fold the longer rectangle in halves, the fold line being at the middle of the longer edge; cut it along the fold line and then superimpose the two halves on the square rectangle. The students should see this being done. Ask: **Did I change the area of the long rectangle?** Explain that you have changed the shape of the long rectangle, but the total area is the same. So the two rectangles have the same area.

Assessment for Learning

See that the students can appreciate that changing the shape of a 2-D shape does not change its area, as long as the cut pieces are joined without overlaps or gaps.

Prepare and cut out a variety of rectangles. Provide pairs/groups of students with a rectangle each. Ask the pairs/groups to make three rectangles, or other shapes, such that one shape has a smaller area than the rectangle they got, the second shape has a greater area than the rectangle they got, and the third shape has the same area as the rectangle they got. Make papers and scissors accessible for the students.

As they work, go around and ask:

> **How will you show that this shape has the same area as this rectangle?**
>
> **How do you know that this shape has a smaller area than the rectangle?**
>
> **How did you make the shape which has the same area as this rectangle?**

Extension

Have the students complete the relevant activities in their Student Activity Book.

Lesson 10 Measuring Area with Non-standard Units

Objectives

Measure areas with non-standard equal-size units.

Materials

Pattern blocks
Cut out of 2-D shapes on which some pattern blocks would fit exactly
Playing cards or used mobile phone vouchers

Tell the students: **Today we will be learning how to measure areas using smaller shapes.** Choose an appropriate area to measure using the Student Activity Books as the unit. The area to be measured should be such that it will be covered nicely with a whole number of the books. It would be nice if a table fit this rule. Then you could demonstrate covering the table top with the books, and say: The area of this table top is 8 books because 8 books cover it completely. If none of the tables in the classroom fulfills this rule, you could have a chart paper measured, ensuring in advance that a whole number of books cover it nicely. Tell that the book is called the unit of area measurement in this case. Then have the students predict how many books will cover a tabletop that you indicate. Then cover the table top with books, and express its area using appropriate language, such as: The area of this table top is a little more than 8 books (if the case is so). Tell that the book is called the unit of area measurement in this case too.

Show a playing card or mobile phone voucher, and ask: **How many cards do you think will cover this book?** After the students have guessed, cover the book with the cards, and count the number of cards. Say: **The area of this book is (12) cards.** Explain that the card is the unit of area measurement in this case.

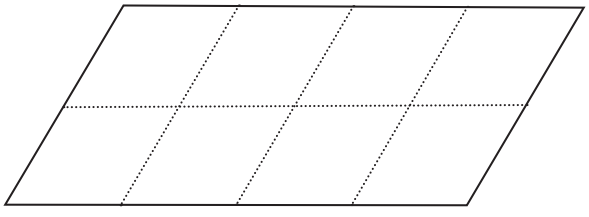
Show the pattern blocks to the students. The individual pattern blocks are the hexagon, the trapezoid, the rhombus, the triangle and the rectangle. See if the students can recall the names of the blocks. Tell that they will be using these pattern blocks as units to measure the areas of some shapes in their Activity Books.

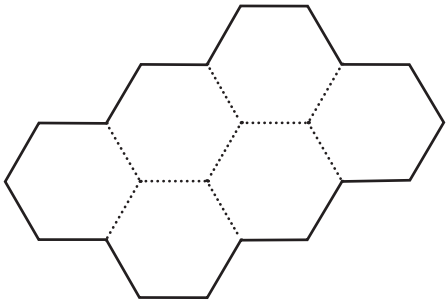
Distribute a shape each to groups or pairs of students on which some pattern block will fit exactly. The shapes should have been prepared in advance. Some of the shapes could be designed as shown below on papers, and cut out without showing the dashed lines, so that the pattern blocks would fit

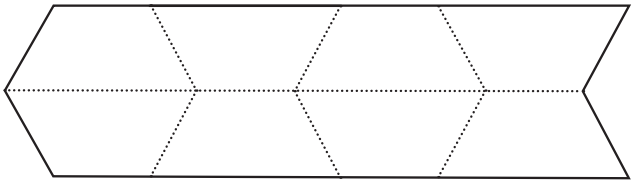
Maths Note

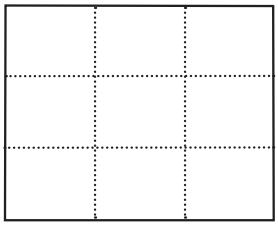
Because it is often difficult to compare area directly and because cutting up one shape to fit on top of another is both cumbersome and sometimes not even possible, students are motivated to use non-standard units to measure area.

The units students use should be standard simple shapes like squares, equilateral triangles, regular hexagons, or rectangles, all of uniform size and all shapes that fit together with no gaps. They should be neither too big nor too small for the items being measured. Students, after a few experiences with a unit, should be predicting how many units it will take to measure the area of a new item.









properly on them. Students should first think of what pattern blocks they can use to cover their shapes, and then cover the shapes with the chosen pattern blocks. Distribute or make the pattern blocks accessible to the students.

As the students work on measuring the areas of their shapes in groups, go around to help. Ask questions such as: **What is the name of the pattern block that you are using to cover your shape? How many (trapezoids) are needed to cover your shape? So, what is the area of your shape? Could you use any other pattern block to cover your shape? Will the number for your area of the shape increase or decrease if you used these triangles instead of the trapezoids as you unit of area measurement?**

Assessment for Learning

See that the students can describe measure and describe the area of their shapes in terms of the units used.

Encourage the students to share and describe the area of their shapes with others.

Extension

Provide the students with pattern blocks and blank papers. Challenge them to create one or more shapes with a given number of units. For example, tell a student who is given hexagonal blocks: **Create a shape whose area is 5 hexagons. Could you create another shape whose area is also 5 hexagons?**

Have the students complete the relevant activities in their Student Activity Books.

Chapter Assessment

Formative Assessment

Formative assessment ideas, tips and reminders are provided within each lesson under the heading called Assessment for Learning. In addition, you should use a formative assessment tool called the Chapter Checklist. Prepare the Formative Assessment Recording Sheet for the chapter as shown below. You should look for evidence in each student, throughout the teaching of the chapter, that he or she has understood the key concepts and can perform the key mathematical skills by ways of observing, listening and asking probing questions. Accordingly, keep the records for each student by putting a mark, such as a tick mark, for each of the chapter goals once you are convinced that the student has achieved them. You could also keep relevant anecdotal records.

Using the Chapter Checklist purposefully will give you the benefit of ensuring that each student's learning progress is assessed in a systematic manner. What is even more important is the opportunity it will provide you to help each student along in achieving the chapter goals. Since this is meant as a formative assessment tool, you will not be giving any mark to the students by using it. However, investing time in carrying out this assessment technique will contribute positively in the students being able to do well in the summative assessments, including the examinations. You can also refer back to these records as you look for progress during the year and/or seek to address areas of concern.

Formative Assessment Recording Sheet
CHAPTER 3 MEASURING LENGTH AND AREA

Chapter Checklist (Look for evidence throughout the chapter that the student has understood the key concepts and can perform the key skills.)

Student Name		Chapter Goals (The student is able to):					
		Measure lengths using non-standard units	Describe how long a centimetre is, and measure lengths in centimetres.	Measure perimeters of given 2-D shapes.	Describe how long a metre is, and measure lengths in centimetres.	Compare areas of shapes directly.	Measure areas of simple 2-D shapes with non-standard units.
1							
2							
3							
4							
5							
6							
7							
8							

Summative Assessment

As explained in the Introduction to the Teacher's Guide, the student's learning in each chapter will be measured primarily through the use of an assessment method called the Interview-based Performance Task. The primary purpose of this assessment is to thoroughly assess the level of understanding of the students in terms of the key concepts and skills as required in the chapter. It provides an opportunity for the students to display their understanding by ways of telling, describing, showing, and demonstrating in a non-threatening environment.

One of the beauties of this assessment method is that it allows you to teach and clarify things even as you are assessing the students. The fact that you have to provide marks to the students through the use of Interview-based Performance Tasks should be considered a secondary purpose. The Summative Assessment Recording Sheet (shown on the next page) is included in the Student Activity Book for your use with each student. Please refer to the Introduction to the Guide for the details on the marking scheme.

Summative Assessment Recording Sheet

Student Name: _____ Roll no.: ____ Section: ____

CHAPTER 3 MEASURING LENGTH AND AREA

Interview-based Performance Task (Please refer the Introduction to the Teacher's Guide for Class 2 for the marking scheme while using the Interview-based Performance Task.)

Task and Interview prompts	Key concepts and skills to look for
Have a 2-D shape drawn on a piece of paper, as shown below, some trapezoidal, rhomboidal and triangular pattern blocks ready. The shape should be such that it can fit 2 trapezoids, or 3 rhombuses, or 6 triangles on it.  Trapezoid rhombus triangle Ask the student: **Can you measure the area of this shape with one of these pattern blocks? So what is the area of this shape? Can you now measure the area with another of these blocks? What is the area using this unit? Has the area of the shape changed when you measured it with different units? Why has the number changed?** Present the student with a rectangle that is 2 cm by 3 cm, and a ruler. Ask: **How many centimetres long do you think is this side of the rectangle** (indicating to one of the sides of the rectangle)**? Measure the side n centimetres using the ruler. So, how lon is the side? Can you measure and write the perimeter of this shape in centimetres?** Ask the student to draw a line that is 5 centimetres with the help of the ruler.	The student is able to: - Measure the area of a shape with non-standard units. - Describe the area of a shape in non-standard units. - Understand and tell that the area of a shape does not change even if we use different units to measure it. - Measure an area in more than one non-standard unit. - Make reasonable estimate of the length of a line in centimtres. - Measure the lenthg of a line using a ruler correctly and express the lenght in centimetres. - Measure and record the perimeter of a shape in centimetres. - Draw a straight line for a given length in centimetres.

Comments and Marks

Strengths:

Areas of Need:

Follow up Steps:

Teacher's Signature and Date:

Summary of the Summative Assessment for Chapter 3

CA marks from Chapter 3 (Marks out of 10): _____

CHAPTER 4 PLACE VALUE

Chapter Overview

The idea of place value is essentially about understanding how our number system works. The number system that we use is a base ten system. That means we count quantities in groups of ten. For example, ten single items are counted as one ten, or one group of ten; fifteen items are counted as one ten and five more; twenty items are counted as two tens; what ninety-nine really means is nine tens (or nine groups of tens) and nine more; then, ten groups of tens is counted as one hundred, ten groups of hundreds is counted as one thousand, ten groups of thousands is counted as one ten-thousand; ten groups of ten-thousands is counted as a hundred-thousand; ten groups of hundred-thousands is counted as a million, and so on.

Even though children, and adults, may be looking at and counting numbers in a linear fashion such as counting and saying the number names in a continuous sequence as one, two, three, … eight, nine, ten, eleven, twelve, ….and so on, the base ten system is imbedded in that. This fact becomes apparent from twenty onwards – twenty (as two tens), twenty-one (as two tens and one), twenty-two (as two tens and two) and so on. It is not so apparent for the teen numbers and especially for the number names right after ten, as eleven and twelve are not wordily indicative of being ten and one more and ten and two more respectively. But the written numerals for these numbers take that fact into account. That is to say that we have a different symbol for each of the numbers from one to nine, such as 1, 2, 3, … 9, but the symbol we use for ten is 10, which is a combination of 1 and 0, which means to tell that it is group of ten with nothing more. For eleven, the symbol is 11, which means to tell that it is one group of ten and one more; for twenty three, the symbol is 23, which means to tell that it is two groups of ten and three more, and so on. In fact, any number or quantity can be efficiently expressed and written using the ten symbols – 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0. This is found to be an efficient system of representing quantities and writing them with numbers. And, it relies on the idea of place value of numbers. Place value means that in a number the position, or place, of a digit tells us its value. In 38, the position of the 3 tells us that it is 3 tens and the position of the 8 tells us that it is 8 ones. In 83, the position of the 8 tells us that it is 8 tens.

Children need to be exposed to the idea of place value, because this is how the number system works. This also enhances their number sense. In fact, we have already exposed the students to the idea of place value in Class PP very informally in looking at the teen numbers as ten and some more with the help of modeling the numbers with counters and ten-frames. Now that the students have worked with numbers up to 100, they will look at 2-digit numbers as groups of tens and ones all the way up to 99. The treatment will still be quite informal, in that it may not even be necessary to be using the term ‘place value’ with the students. However, it will be crucial to use concrete models that are proportional to represent the numbers for the students to really appreciate the place value concepts along with the place value charts. The proportional models means that the model for 10 is ten times as much or as big as the model for 1. You might start with models like 10 sticks bundled together to make 1 ten or 10 small buttons (or bean seeds) put in a bag to represent a 10. The lessons in this guide, however, describe using the base ten blocks. This is based on the assumption that all the schools in the country would have these materials in place as they are included in the supply list.

The base ten blocks consist of small cubes, rods, flats and big cubes. The small cubes represent ones, the rods represent tens, the flats represent hundreds, and big cubes represent thousands. These are all proportional blocks. However, you will need only the small cubes (or ones blocks) and the rods (or tens blocks) in this lesson. The rod is called tens block as it is the same as 10 ones block lined up together. This should be made known to the students.

This chapter has 5 lessons as detailed in the Table of Contents. The place value concepts will be continued and built on further in Chapter 8 (Numbers Greater Than 100).

Basic Principles about Place Value

- Students need opportunities to recognize and create many different types of number representations. Different representations highlight different number relationships.
- We write numbers using a place value system not only to be efficient (we need only 10 symbols to represent all whole numbers), but also to provide benchmarks against which to compare numbers to (e.g., a 2-digit number is more than 9 but less than 100).
- Tools such as 10-frames, number lines, and 100-charts help us highlight patterns in the number sequence and compare numbers to familiar benchmarks.
- Students could face a conceptual challenge at first at making connections between counting discrete objects (as with 10-frames or other ways of using manipulatives) and the number line (which sees numbers as a position or a measurement).

Chapter Goals

• Describe 2-digit numbers as tens and ones.
• Represent 2-digit numbers with models of tens and ones.
• Represent numbers with models on a place value chart.
• Write numbers on a place value chart.
• Determine the sum when 10 is added to a number.

Maths Words

Tens, ones, cubes, rods, place value chart, sum, group

Lesson 1 Describing 2-digit Numbers as Tens and Ones

Objectives

Describe and represent 2-digit numbers as tens and ones.

Materials

100-chart on a chart paper

Put up the 100-chart, and explain it to the students. Have the students read aloud the numbers as you point from 1 to 10 on the first row, and then continue from 11 to 20 on the second row, and so on in similar fashion to 100. Tell and show that each row in the chart has 10 numbers, or that each row is a ten. So, there are 10 tens in the chart.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Maths Note

Students have used the 100-chart before. The focus now is to help them see a number as tens and ones.

Explain with the help of the chart that the number 10 represents 1 ten as it appears at the completion of one row of ten, 20 represents 2 tens as it appears at the completion of the second row of tens, 30 represents 3 tens as it appears at the completion of the third row of tens, 40 represents 4 tens, and so on. Going beyond a row, but not completing the next row means there are tens and ones. For example, to get to 34, you fill in 3 rows of tens and 4 more. Ask: **What does 43 represent? How many tens do you have to cross before you get to 43? And, and how many ones do you have to count after 4 tens to get to 43?** Ask several similar questions for other numbers.

Then, ask: **What number is 6 tens and 2 ones? Where is it on the chart?** Ask several similar questions for other numbers.

For a challenge, you could ask the students to locate where a number (like 62) is on the chart, but they have to do it blindfolded. They can touch the chart. They should explain what they are doing to locate where the number should be. When they are satisfied with their identified position, the blindfold can be revealed. The purpose of this would be to get the students talking more about the arrangement of the numbers on the chart. Closing off one sense (sight) brings other things to attention. They will not be able to identify the exact location of a number but they should be close … their reasoning is what counts.

Assessment for Learning

See that all the students can express or describe a number in terms of tens and ones, and also describe why it is so.

Extension

Have the students practise describing a number in terms of tens and ones with reference to the 100-chart on the wall, by asking questions such as: **Can you tell what 34 is in terms of tens and ones?** Students should be saying something like: 34 is 3 tens and 4 ones. After all the students are able to describe a number in terms of tens and ones comfortably, begin writing them down. Write on the board the following, and have the students complete the sentences.

34 is 3 tens and 4 ones

43 is 4 tens and 3 ones

46 is ___ tens and ____ ones

62 is ___ tens and ____ ones

55 is ___ tens and ____ ones

Have, and help the students complete the related activities in their Student Activity Books.

Lesson 2 Representing 2-digit Numbers as Tens and Ones

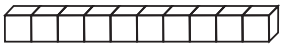
Objectives

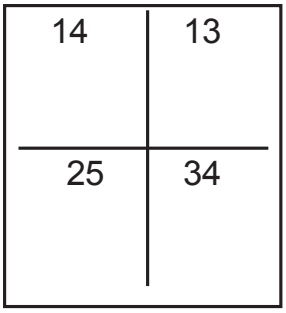
Represent 2-digit numbers with models for tens and ones.

Materials

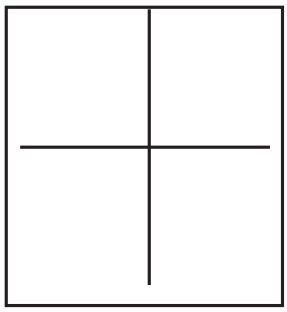
Base ten blocks (Small cubes, or ones) – about 50 for each group/pair
Base ten blocks (rods or tens) – about 50 for each group/pair
A4 sized duplicating papers divided into 4 parts as shown here – one for each group/pair

One 

Ten 



Front side


Back side (write different numbers for different groups)

In advance, prepare and have ready the above materials. The base ten blocks should be in separate containers or plastic bags for each group/pair of students, and distribute them. Referring to the small cubes, ask: **What do you think this is? What is the name of this shape?** Tell that they will call these cubes ones, and that they will use these to represent numbers. **Everyone, pick up and show 1 one. Show 2 ones. Show 3 ones. Now, in your group, show or represent number 7 with ones.** See that they can do that. Now, represent number 14 with ones.

Then, introduce the rod as ten. **I want everyone to pick up long block. It is a rod. What can you say about this shape? What is the name of this shape? In the group, I want you to line up the ones along this rod, like this** (You might need to do it too). **How many ones are the same length as this rod? Explain that they will call this a ten, since 10 ones is the same as it. Everyone, pick up and show 1 ten. Show 2 tens. Show 3 tens.**

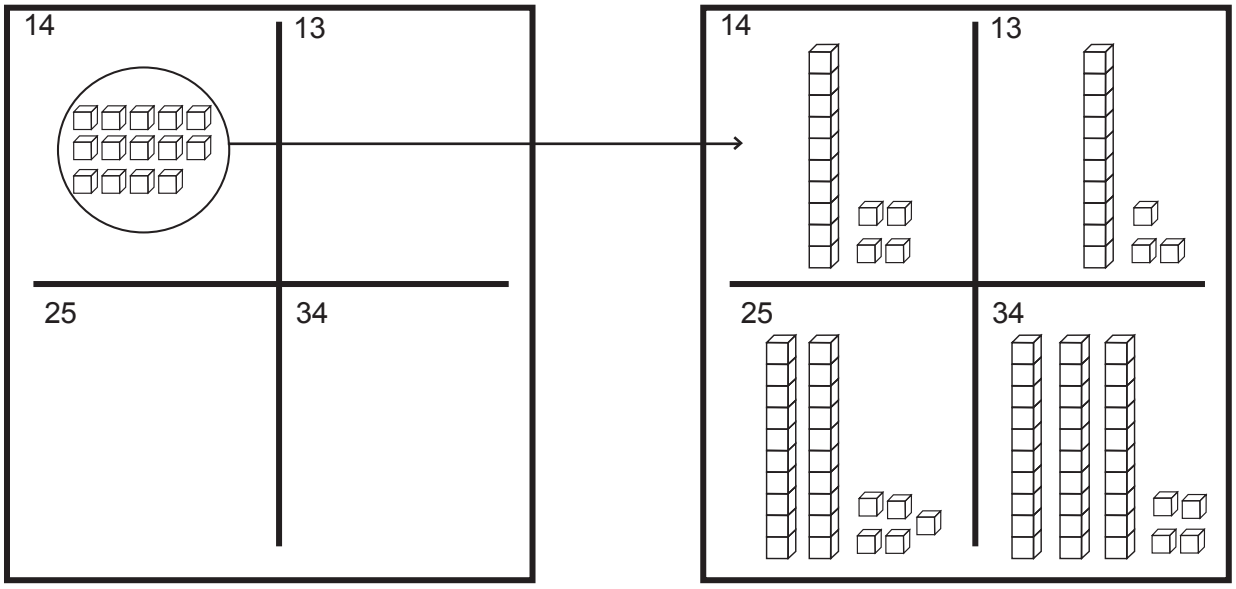
Distribute the A4 sized papers with the numbers (14, 13, 25 and 34) written in the 4 quadrants as shown above, one for each group/pair. Have all the groups display the page with these common numbers facing up. The numbers on the back side of the page should be different for different groups. Some of the numbers should have 0 ones such as 30, 40, or 50, while some should be single-digit numbers such as 8, 9 or 5.

First, have all the groups show or represent the number in the first quadrant, 14, with ones blocks. Once all have done that, have them trade 10 ones with 1 ten. Then, have the groups represent the other three numbers on the page with tens and ones blocks. As they work, circulate to see and help them. It is

Maths Note

Students should use models that are proportional; that means that the model for 10 is ten times as much or as big as the model for 1. This lesson is designed around using two of the blocks from the set of base ten blocks. These are the small cubes, which are called ones, and the rods, which are called tens. A rod is called a ten because it is the same as 10 ones (or small cubes) lined up together. This should be explained to the students.

This lesson uses base ten blocks because they are effective tools in the teaching of place value and number concepts, and it is assumed that all the schools will have these materials. But, the concept of teaching numbers and place value need not necessarily depend on these materials. In fact, we should use other proportional materials also: You might improvise models like 10 sticks (or toothpicks) bundled together or 10 small buttons (or bean seeds) put in a plastic bag to represent a ten. These ideas are strongly suggested to be used as alternative (in the absence of base ten blocks) or extended activities for the lesson.



important that the students model tens to the left of the ones since that is how the digits are written for a number.

Have the groups then reverse the page and represent the numbers written there with the base ten blocks. Invite them to see that the digit on the left shows the tens and the digit on the right shows the ones in the number. Encourage the students to visit and see the number representation of other groups, as the numbers are different from theirs.

Toward the end, ask questions such as: **How many tens are there in 25? How many ones are there in 25? Write the number 25 on the board, and ask: What does 2 mean in 25? Where is 2 written in 25 – to the right or to the left? What does 5 mean in 25? Is it on the left or right of 2?** Similarly, repeat the questions for other 2-digit numbers.

Assessment for Learning

See that the students can represent the 2-digit numbers with the base ten blocks and describe the numbers in terms of tens and ones. This should be done during the lesson by observing and asking the students relevant questions during the lesson.

Extension

As describe in the Math Note for the lesson above, the teaching of the concept of place value need does not depend on the use of base ten blocks alone. As such, it should also be taught using other equally effective models. The following materials would be required.

Uniform sized sticks (toothpick or match sticks without the match box would be nice)
Rubber bands
A4 sized papers as used in the lesson above

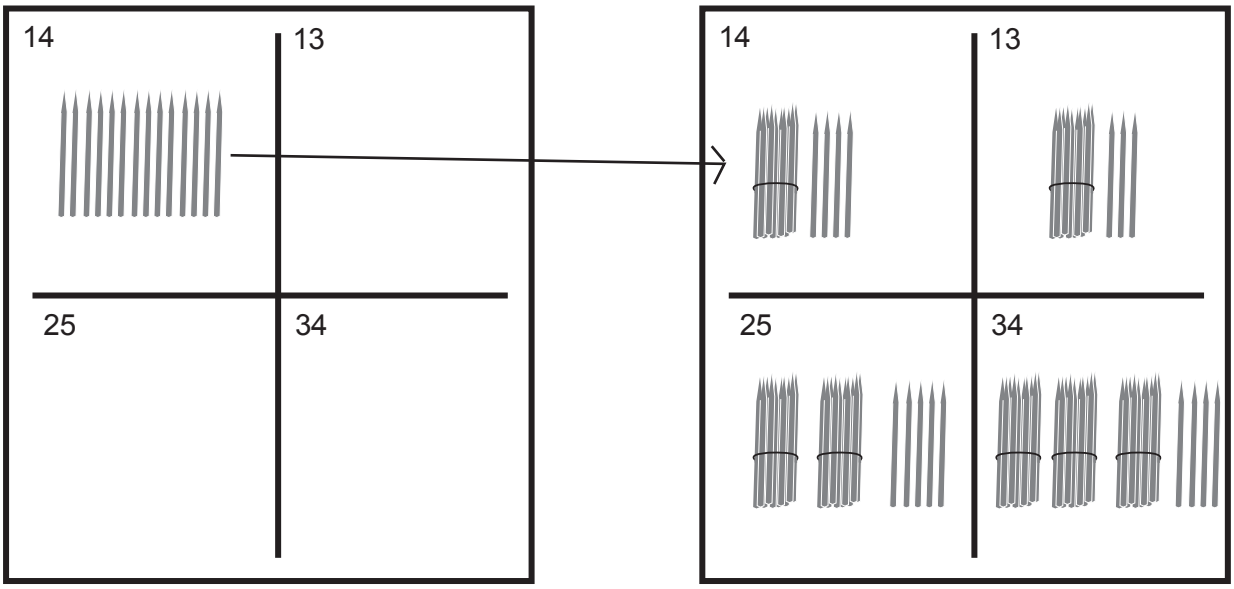
Ten

One

Prepare the materials in advance. You would need enough of the sticks. Bundle up 10 sticks with rubber bands. Make enough of such bundles, such that each group will have 10 bundles if possible. Then each group should also have about 20 loose sticks.

Distribute the loose sticks and bundles of sticks to the groups. Have the students count the number of stick in the bundles. Tell that they will call the loose sticks as ones, and the bundles as tens.

Distribute the A4 sized papers with the number written in the quadrants to the groups, as in the lesson above. Have the students represent each number with the tens (bundle) and ones (loose sticks). It is still important that the students model tens to the left of the ones since that is how the digits are written for a number.



Encourage the students to describe the similarities and difference between using the sticks and base ten blocks.

Have the students complete the relevant activities in their Student Activity Book.

Lesson 3 Measuring with Base Ten Blocks

Objectives

Measure lengths with base ten blocks and express them in tens and ones.

Materials

Base ten blocks (Small cubes, or ones)
Base ten blocks (rods or tens)

Distribute the above base ten blocks to the students in pairs or groups. Tell them that they will be measuring lengths with the tens and the ones.

First, ask the students to measure the longest pencil the students have in their group with the blocks. **Who has the longest pencil in your group? Can you together measure how long that pencil is with the ones?** As they work on it, circulate to see the measuring being done properly. Have the students express the length of the pencil appropriately such as like: **The pencil is about 15 ones long; or, the pencil is 1 ten and 5 ones long**; or, t**he pencil is about 8 ones long,** etc depending on the cases.

Ask the students to measure specific lengths. For example, lengths which are about 4 tens long, close to 50 ones long, between 5 and 6 tens long, etc. Suggest the lengths such as various books in the classroom, the shorter edge of a table, an edge of a shelf, lower edge of a calendar, etc. The students should use the tens as far as possible and use the ones to finish if another ten would be too long. With each measurement, ask the students to express the length. **How long is this length? How many tens and how many ones long is it? If you did not use the tens, and used only the ones, how many ones long would it be? Why would that be?**

Toward the end, ask questions such as:

> **An object is 43 ones long. How many tens would be required to measure it? Will 4 tens cover it completely? How many ones will be required after the 4 tens to cover the length?**
>
> **A distance is 3 rods and 2 ones long. How many ones long is it?**

Maths Note

In this lesson, the students will use the ones and tens of the base ten blocks to measure lengths, and express the lengths as tens and ones. Although generally base ten blocks are 1 cm or 10 cm long, there is no need to mention the standard unit. They could be considered as non-standard units as well. Students should continue to call the small cubes as ones and the rod as tens. They use rods as far as possible and use small cubes to finish if another rod would be too long.

Assessment for Learning

See that the students can express each length measurement appropriately in terms of tens and ones.

Extension

Have the students carry out the length measurements in groups or pairs and complete the relevant activity in their Student Activity Book.

Lesson 4 Writing Numbers on a Place Value Chart

Objectives

Place the digits of a 2-digit number on a place value chart.
Tell the value of a digit in a 2-digit number according its place or position in the number.

Materials

Base ten blocks (tens) – about 10 each for each group/pair
Base ten blocks (ones) – about 20 for each group/pair
Place value chart made on A4 sized papers – one for each group/pair

Tens	Ones

Distribute the above base ten blocks to the students. Write a 2-digit number on the board, for e.g., 35, and ask the students to represent it with the blocks. Have the students explain each group of the blocks. **What are these 3 long rods for? What are these 5 small cubes for? How many tens are there in 35? And, how many ones are there? Where should the tens be placed – on the right or on the left of the ones? Why is that?**

Now, introduce a place value chart to the students. Explain the columns. Distribute the charts to the groups. Ask the students to now place the tens and ones blocks in the chart for the number 35. Make sure that the students place the appropriate blocks in the appropriate columns.

Provide a few more 2-digit numbers for the students to represent with the blocks in the charts. Write the numbers on the board such as, 42, 24, 56, 78, 78, 50, and 20. Then draw a place value chart on the board, and demonstrate how to write a number in it, for e.g., 35.

Tens	Ones
3	5

Draw some more place value charts on the board, and ask some students to come forward to write the other number already written on the board in the charts.

At the end, ask questions such as: **In the number 35, which represents more, the 3 or the 5? Explain why you say this.** Repeat with other numbers (not always having the tens digit smaller than the ones). Then, ask: **Someone told me that the number in the tens place always represents more than a number in the ones place. Can you think of any number where this is not true? Or can you explain why it must always be so?"**

Maths Note

A place value chart is simply a chart with columns for ones, tens, hundred, thousands etc. However, the place value chart at this point is limited to only ones and tens columns, since they are dealing with 2-digits numbers. Students should first represent a 2-digit number with proportional models (base ten blocks or bundles and loose sticks) on the place value charts, before writing the numbers in the charts.

Assessment for Learning

See that the students can explain why the number on the left is placed in the tens column and the number on the right is placed in the ones column.

Extension

Have the students complete the relevant activities in their Student Activity Books.

Lesson 5 Adding 10s to a Number

Objectives

Recognize that adding 10s to a number affects only the 10s digit.

Materials

Base ten blocks (ones and tens)

Distribute the above base ten blocks to the students in groups or pairs. Write a 2-digit number on the board (e.g, 38) and ask the students to represent it with the blocks. Make sure that the students represent it correctly with 3 tens blocks and 8 ones blocks, with the tens on the left of the ones. Then, tell that you want to add 10 to 38, and write the following expression on the board: 38 + 10. Ask: **What would be the sum for 38 and 10?** Encourage them to tell the sum as well as to tell how and why. Then, ask the students to add 1 ten (1 tens block) to their model of 38. **I want you to add 1 ten (a tens block) to your model of 38? Now, how many tens are there? How many ones are there? What has increased? What has remained the same? So, what number do your blocks show now?** Then, write the sum as: 38 + 10 = 48. Students should realize that when you add a 10 to a number, it is only the tens digit that changes with the ones digit remaining the same. Tell that 38 is 3 tens and 8 ones, and that if we add 1 ten, we have 4 tens and 8 ones.

Maths Note

Although adding 10 might be thought of as an addition issue rather than a place value issue, adding using place value concepts makes more sense.

Students should have opportunities to add a single 10 and then several 10s using mental maths and place value concepts rather than thinking of these as typical addition questions.

Similarly, have the students add 38 + 20 with the models. Then, discuss it as 38 is 3 tens and 8 ones, and that if we add 2 tens, we have 5 tens and 8 ones. Again, discuss that it is only the tens digit that has changed when you added tens.

Ask the students to determine the sums and discuss them for several problems involving adding 10 to 2-digit numbers, such as the following. Ask the students to explain how they determine their sums for such problems.

24 + 20
53 + 30
15 + 10
82 + 10

Toward the end, in order to make sure that this understanding is in place, you could start mixing the addition of tens and one, as shown below.

24 + 30	33 + 5
31 + 20	10 + 71
42 + 3	30 + 14
17 + 10	3 + 52

Assessment for Learning

See that the students can describe how when they add 10s to a number only the tens digit changes and not the ones digit.

The students need to show that they know how to add tens by distinguishing between the addition of tens and the addition of ones.

Extension

Have the students complete the relevant activities in their Student Activity Books.

Chapter Assessment

Formative Assessment

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Formative Assessment Recording Sheet
CHAPTER 4 PLACE VALUE

Chapter Checklist (Look for evidence throughout the chapter that the student has understood the key concepts and can perform the key skills.)

Student Name		Chapter Goals (The student is able to):				
		Describe 2-digit numbers as tens and ones.	Repre-sent 2-digit numbers with models of tens and ones	Represent 2-digit numbers with the models on place value charts.	Write 2-digit numbers on place value charts	Determine the sum when 10s are added to a 2-digit number
1						
2						
3						
4						
5						
6						
7						
8						

Summative Assessment

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Summative Assessment Recording Sheet

Student Name: _____ Roll no.: ____ Section: ____

CHAPTER 4 PLACE VALUE

Interview-based Performance Task (Please refer to the Introduction to the Teacher's Guide for Class 2 for the marking scheme while using the Interview-based Performance Task.)

Task and Interview prompts	Key concepts and skills to look for
Have a place value chart with the columns for tens and ones, base ten blocks (tens and ones) ready. Provide the student with a 2-digt number, say 64, by writing it down on a paper, and ask: **What is this number?** **Can you say this number in terms of tens and ones?** **Can you show this number with these blocks?** **Why is the tens on the left of the ones?** **Now, please put these block in this place value chart.** **If we add 20, or 2 tens to 64, what will be the sum?** **Write here 64 + 20 = 84.** **What number in 64 has changed when you added 20? Why did that happen?** **Why did 4 not change when adding 20 to 64?**	The student is able to: - Describe a number in terms of tens and ones. - Represent a number with base ten materials correctly. - Tell why the tens blocks are shown on the left of the ones blocks. - Place models for a number correctly on the place value chart. - Find the sum for adding 10s to a number correctly. - Explain why only the tens digit change when 10s are added to a number.

Comments and Marks

Strengths:

Areas of Need:

Follow up Steps:

Teacher's Signature and Date:

Summary of the Summative Assessment for Chapter 4

CA marks from Chapter 4 (Marks out of 10): _____

CHAPTER 5 FRACTIONS

Chapter Overview

Fractions are basically found to be useful in two contexts. Either fractions are used to represent parts of a whole or alternatively, to represent parts of a set or group.

In representing parts of a whole by a fraction, it is important to know that the parts, which make the whole, are equal in size. The denominator of the fraction tells the total number of the equal parts into which the whole is divided, and the numerator of the fraction tells the number of these equal parts that is being considered. For example, in the fraction $\frac{2}{3}$ the denominator is 3 telling us that the whole is divided into 3 equal parts. The numerator of 2 indicates the number of these parts that are the focus of our attention in the particular situation. For example, a rectangle is divided into three equal parts and two of these are shaded. Hence, we could say that $\frac{2}{3}$ of the circle is shaded.

It is also important to know that a fraction always has a complementary fraction. A fraction and its complement make up the whole. For example, the fraction $\frac{2}{3}$ has a complementary fraction of $\frac{1}{3}$. That is, if $\frac{2}{3}$of a shape is shaded, then,$\frac{1}{3}$ of the shape is not shaded.

In representing parts of a set using a fraction, it is not necessary that the individual items that make up a set be identical or equal in size. For example, we might say that $\frac{2}{5}$ of a group is boys if there are 2 boys and 3 girls in the group. The denominator tells the total number in the set, and the numerator tells how many in the set are being considered. The reason that the fraction is still used even though the sizes might be different is that the individual members of the set are the things that are considered equal in size. Note that any time we are representing a part of a set with a particular characteristic, we are also saying that the remainder of the whole does not share that characteristic. For example, for the fraction $\frac{3}{5}$, its complementary fraction is $\frac{2}{5}$. For the instance above, knowing that $\frac{3}{5}$ of a set are boys is based on the fact that $\frac{2}{5}$ of the set are not boys.

In Classes PP and 1, the students were exposed to the concept of fraction halves in connection with their meaning as part of a whole. In this chapter the students will review this concept of fraction halves and then extend to the fractions known as thirds, fourths, fifths, and sixths, both in the contexts of parts of a whole and parts of a set. It will be important for the students to understand the meaning of fractions as well as to communicate in fraction languages, such as saying two fifths, for $\frac{2}{5}$, or one third for $\frac{1}{3}$, along with using the symbols for fractions.

This chapter has 5 lessons as detailed in the Table of Contents.

Basic Principles about Fractions

- A fraction represents a comparison of a part to a whole. The whole can be a single whole, for example a shape, or it can be a set.
- The denominator indicates the total number of parts in the whole and the numerator the number of these parts that are being given attention.
- The parts of a whole must be equal in size in the case of a single whole to be represented by a fraction.
- The parts need not be equal in size in the case of a set to be represented by a fraction.
- A fraction always has a complementary fraction. The two fractions make up the whole.

Chapter Goals

- Identify and say halves, thirds, fourths, fifths and sixths of shapes.
- Label a given (or indicated) part of a whole with a fraction symbol or number.
- Identify halves, thirds, fourths, fifths and sixths of a set.

- Label a given (or indicated) part of a set with an appropriate fraction symbol or number.
- Describe what the numerator and the denominator in a fraction mean in relation to a given situation including sets.

Maths Words

Fraction, whole, half, halves, third, thirds, fourth, fourths, quarter, quarters, fifth, fifths, sixth, sixths, set, numerator, denominator, complementary fraction

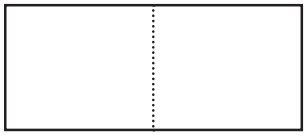
Lesson 1 Interpreting Fractions of a Whole

Objectives

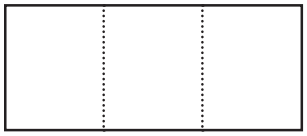
Identify halves, thirds, fourths and sixths of shapes.
Divide shapes into halves, thirds, fourths and sixths.

Materials

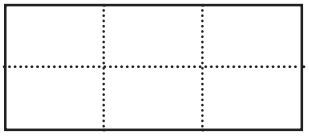
Cutouts of a variety of rectangles and circles in plain papers – at least one shape for each student
Crayons
Rulers



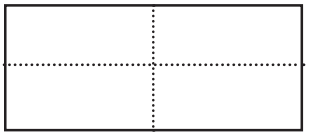
Have the cutout shapes ready. Show a rectangle to the students and tell them that it is a rectangle. Fold the rectangle into two equal parts and unfold it so that the students can see it. Explain that you have divided the shape into 2 equal parts with the fold line. Ask: **What have I done to this shape? How do we know that the 2 parts are the same in size or area? What is each part called?** Explain that if we divide a shape into 2 equal parts, each part is called one half. Have the students say the word one half as you point to one of the equal parts of the shape. Emphasize that the two parts are equal in area.



Take up another rectangle, and fold it into 3 equal parts, and unfold it. Tell the students what you just did with the shape. Ask: **How many equal parts is the rectangle divided into now? Is each part one half? Why not?** Explain that when a shape is divided into three equal parts, each part is called one third. Have the students say in unison after you the fraction name one third as you point to one of the equal parts. Emphasize that the three parts should be the same in area.



Then fold the current shape once such that it is now divided into six equal parts, and ask: **How many parts is this shape divided into now? Is each of the 6 parts the same in area? How can we check that they all have the same area? Now that this shape is divided into 6 equal parts, what can we call each of these parts?** Encourage the students to suggest the fraction name. Have all the students say in unison the name one sixth.



Then, take up the original shape already divided into two equal parts, and ask: **How many equal parts is this shape divided into? What is the name for each part when we have two equal parts?** Fold the shape in such a way that it is now divided into 4 equal parts. Encourage the students to suggest the name for a part now. Have the students then say in unison the fraction name one fourth.
Explain that when a shape is divided into equal parts, each part is called a fraction, and that one half, one third, one fourth, and one sixth are all fractions.

Keep the cutout rectangles and circles on a table. Ask the students to come

Maths Note

This is the students' introduction to fractions other than one half. They need to know that, if a shape is divided into equal parts, each part is called a fraction. The name of the fraction depends upon how many equal parts into which the shape is divided. If a shape is divided into 2 equal parts, each part is one half; if it is divided into 3 equal parts, each part is one third; if it is divided into 4 equal parts, each part is one fourth, and so on.

The focus of this lesson is on the students being able to identify and say correctly the fraction names such as one half, one third, one fourth, and one sixth with the help of some simple shapes. This will extend to students creating representations of these fractions with shapes.

forth to take a shape each of their choice. Tell them to divide their shapes into two, three, four, or six equal parts as per their choice. As they work, circulate to ensure that they are doing alright. Ask questions such as: **How many parts have you divided your shape into? How do you know that the parts are all equal? What is the name of one of the equal parts? Why can you call (one fourth) and not (one third) for this part?**

Assessment for Learning

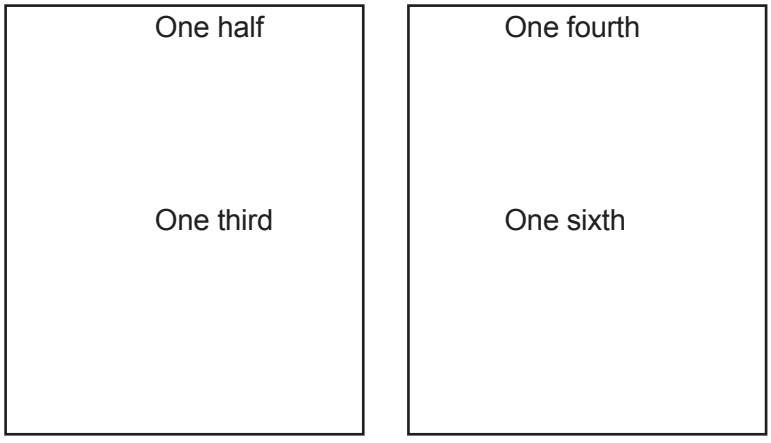
See that the students can identify and say the fraction names appropriately.

Ask the students to colour one of the equal parts of their shapes. You might also have them draw straight lines along the fold lines with pencils and rulers. You might want the students to tell to the class how they divided their shapes and say the names of their fractions.

Extension

Put up chart papers on the wall with a title Our Fractions and subtitles: one-half, one third, one fourth, and one sixth, as shown below.

Our Fractions



Then, have the students post their fractions at the appropriate places on chart papers. After everyone has posted his or her fraction, have the students observe and describe them. **How many shapes show one third on the chart? Can someone point to a picture that shows one sixth on the chart?** etc.

Lesson 2 Writing the Fraction Numbers

Objectives

Identify the fractions of a whole shape and label them with fraction numbers.
Describe what the numbers in a fraction represent.

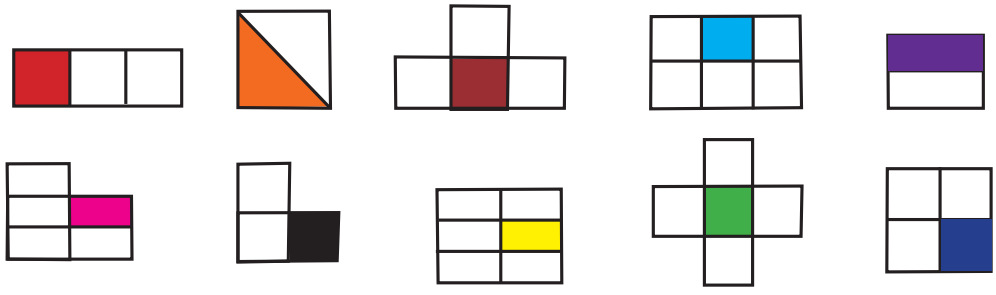
Materials

Pictures of some simple shapes divided into equal parts with one part coloured in each shape.

Review the concept of fractions in connection with the previous lesson. Tell that when a shape is divided into equal parts, each part is called a fraction of the shape. If a shape is divided into 2 equal parts, the fraction name for each part is called one half; if a shape is divided equally into 3 equal parts, the fraction name for each part is one third; if the shape is divided into 4 equal parts, the fraction name for each part is called one fourth, and so on. Tell that we can write the fraction names with numbers.

Draw the students' attention to the chart put up during the previous lesson, and write the fraction numbers alongside the fraction names on the chart such as $\frac{1}{2}$ beside the words one half, $\frac{1}{3}$ beside one third, $\frac{1}{4}$ beside one fourth and $\frac{1}{6}$ beside one sixth. Explain what the numerator and the denominator in each fraction tell in connection with the parts the students have coloured.

Put up the following shape, made in advance, one by one, and discuss what parts are coloured. Have the students say aloud the fraction names represented by the coloured parts. Write the fraction number for each. Discuss what each of the numbers in each fraction tells or represents in connection with the diagrams. Remember to also discuss what fractions would represent the parts not coloured in each case.



Draw a few simple shapes on the board and shade some parts of them. Ask some students to come to the front and write an appropriate fraction number for the shapes. Ask the students to describe what each number in their fraction tells in connection with the pictures.

Maths Note

Students should always remember that the parts that make up a whole must be equal to be represented by a fraction. The denominator, or the number at the bottom, of a fraction tells how many equal parts the whole is divided into. The numerator, or the number at the top, of a fraction tells how many of the equal parts are being considered. For example, $\frac{1}{3}$ could mean that a whole is divided into 3 equal parts, and that one of these parts is being discussed. That one part could be the shaded part. Students should also be made aware that, if $\frac{1}{3}$ is shaded, there is another fraction for the parts not shaded, which in this case is $\frac{2}{3}$.

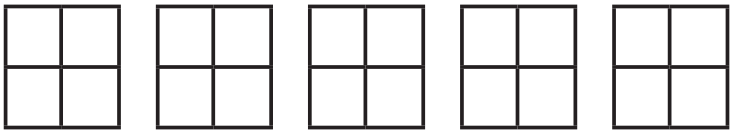
Assessment for Learning

See that the students can write the fraction number properly, and that they can describe what the numbers in the fractions represent.

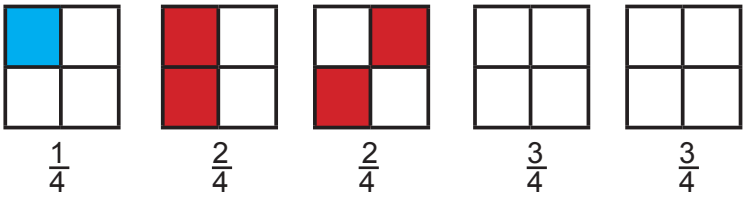
Extension

Name a simple fraction and have the students draw a simple shape with appropriate colouring to represent the fraction. For example, if you name $\frac{1}{3}$ or one third, then students can draw a picture of that. The fractions you name at this stage should all be unit fractions like $\frac{1}{4}, \frac{1}{2}, \frac{1}{5}$ and $\frac{1}{6}$.

Draw or put up 4 identical shapes which are all divided into 4 equal parts likes the one shown below. Tell the students that each shape is divided into 4 equal parts.



Colour 1 of the equal parts in the first shape, and ask: **What fraction of this shape is coloured? Write the fraction $\frac{1}{4}$ below the shape. What fraction of the shape is not coloured?** Colour 2 parts of the second shape, and ask: **What fraction of this shape is coloured?** Write the fractions $\frac{2}{4}$ below the shape. Colour 2 parts of the third shape in a different way than the second shape, and ask: **What fraction of this shape is coloured? Is this the same fraction as the fraction for the second shape? Why?** Write the fraction $\frac{2}{4}$ below the shape. Ask a student to come forth and colour three fourths of the fourth shape. Ask another student to come forth and write the fraction $\frac{3}{4}$ under the fourth shape. Ask a third student to come forth and colour three fourths of the fifth shape in a different way. Write the fraction $\frac{3}{4}$ below the shape.



Put up various shapes as shown below and have the students discuss, tell and write the appropriate fractions for the coloured parts under each shape. Make sure to ask the students to describe the complimentary fraction for each of the fractions that represent the coloured parts (i.e. the fractions representing the part of the shapes that is not coloured).

Have the students complete the relevant activities in their Student Activity Books.

Lesson 3 Creating Fractions of a Whole

Objectives

Identify shapes as relevant fractions of a whole shape.

Materials

Snap cubes in different colours

Have the students make models of rectangles using two colours of cubes. The shape of the rectangle (long and skinny, or short and wide) does not matter. It is the number of cubes used that will be the focus. Begin by having students (in groups) make a rectangle with each of 2, 3, 4, and 6 cubes. In each case, there should be one cube in the rectangle that is a particular colour. The remaining cubes should be one other colour. For example, the rectangle with 4 cubes may include 1 red and 3 blue cubes.

Then ensure that students can name and provide the fraction numbers for one half, one third, one fourth and one sixth. Have the students state a sentence about each picture. For example, one fourth of the rectangle is red. When the idea is clear to all, shift attention to the idea of a complementary fraction. Keeping the rectangular models intact, ask the students to use fractions to state something about the rest of the rectangle. For the above example, the student could say three fourths of the rectangle is not red, or three fourths of the rectangle is blue.

Maths Note

In this lesson, students explore the relationships between a bigger shape and a smaller shape. They would identify a smaller shape as a fraction of the bigger shape. It is critical for the students to use concrete shapes. For convenience and effectiveness, the lesson is built around using snap cubes. Counters that could be used to form rectangles could be substituted, if necessary.

Extension

In connection with the lesson above, have the students make an additional rectangle, with some number of their choice that involves more than six cubes. Revisit the core principles of the lesson with these amounts. Hence, all students would be introduced to more fractions such as one seventh, one eighth, one ninth, one tenth, etc.

Assessment for Learning

See that the students can describe and show how a smaller shape is a particular fraction of a larger one.

Lesson 4 Further Work with Fractions of a Whole

Objectives

Identify shapes as relevant fractions of a whole shape.

Maths Note

The students will continue to explore the relationships between a bigger shape and a smaller as a continuation of the last lesson using fractions. It is critical for the students to use concrete shapes or cutouts of paper shapes. For convenience and effectiveness, the lesson is built around using pattern blocks. But other cutout shapes such as circles with semi-circles and quarter-circles, heart shape with half of it, and rectangles and their halves could also be used.
The focus here is on the relationships with areas and hence, the pattern blocks are appropriate. However, the relationships are more complicated than with rectangular models using snap cubes. Hence, if necessary, use the snap cubes for additional time as an opening for this lesson. The description of the lesson involves pattern blocks.

The set of pattern blocks consists of hexagons, trapezoids, rhombuses and small triangles. They are made in such a way that 2 trapezoids fit exactly on a hexagon, 3 triangles fit exactly on a trapezoid, 2 triangles fit exactly on a rhombus, 3 rhombi fit exactly on a hexagon.
Since the emphasis is on the relationships rather than the naming of shapes, you could have the students refer to the shapes by their colours if recalling their names proves to be a hindrance to their describing the relationships. For example, you could say that a green piece (which is the colour of the triangle) is one sixth of the yellow piece (which is the colour of the hexagon).

Materials

Set of pattern blocks, or paper cutouts of them
Snap cubes (optional for reinforcement, as mentioned in the Math Note)

Show a hexagon to the students, and ask: **What shape is this? Let us say this a 1 whole shape.** Show a trapezoid, and place it on the hexagon. **Does this trapezoid cover the hexagon completely?** Place another trapezoid so that the students can see that the two trapezoids cover or fit on the hexagon exactly. Explain that it is like when you divide a hexagon into two equal parts, you get two trapezoids. So, we can say that if the hexagon is 1 whole shape, the two trapezoids are like its halves. Each of the trapezoids is one half. So the trapezoid is a fraction of the hexagon and the name of the fraction is one half.

Next, place three rhombi on the hexagon. Explain that it is like dividing the hexagon into three equal parts to get three rhombi. So, a rhombus is a fraction of the hexagon, and the name of this fraction is one third, because it takes 3 rhombi to make one hexagon. Tell, as you demonstrate appropriately, that if the hexagon is 1 whole, the rhombus is one third, because it takes 3 rhombi to make one hexagon; if the hexagon is 1 whole, then, the trapezoid is one half, because it takes 2 trapezoids to make one hexagon. Repeat saying these, and have the students say them after you.

Next, place 6 triangles on top of a hexagon, and ask the students: **What fraction of the hexagon is a triangle? Why?**

Distribute the sets of pattern blocks to the students in groups. Encourage them to show how many of a smaller block fit exactly on a larger block. As they work,

circulate and ask questions in groups: **What have you found out?** For shapes and representations made, they can be asked appropriate questions. Also, the students can be asked to find other ways of representing common fractions like one half or one third. (It is fine if they pull out three blue pieces and show that one blue piece is one third in that case. This will lead nicely into the next lesson if it arises.)

Encourage the students to ask and respond to one another with questions in their groups. Model some examples, if needed. For example, a student could ask another student questions like: **Which shape is one third of which shape? How many green triangles would you need to cover a trapezoid? So what fraction of the trapezoid is the triangle?**

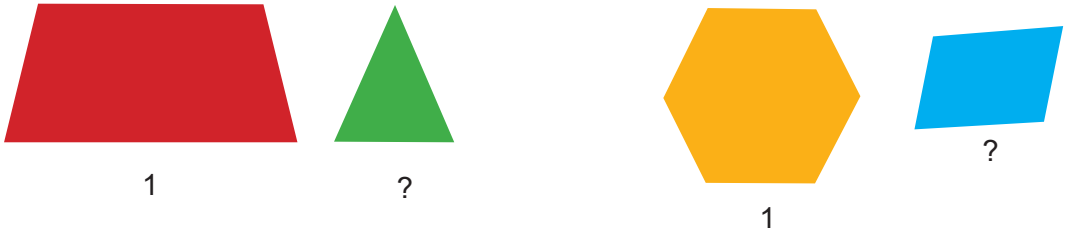
Assessment for Learning

See that the students can describe and show how a smaller shape is a particular fraction of a larger one.

Extension

In connection with the lesson above, draw the pictures of the pattern blocks in pairs and represent the smaller blocks as a fraction of the larger block. For example, draw a hexagon and a trapezoid and tell: **The hexagon is 1 whole shape and the trapezoid is a fraction of it. What fraction is the trapezoid?** Following their suggestions, write the fraction for the trapezoid.

Draw a few more pairs of shapes and repeat the questions:



Have and help the students complete the relevant activities in their Student Activity Books.

Lesson 5 Fractions of a Set

Objectives

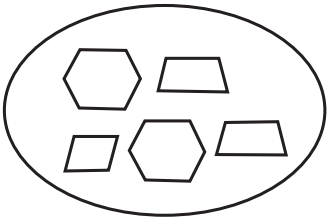
Recognize that fractions can be used to describe part of a whole that is made up of separate items.

Materials

Pattern blocks
Diagrams of sets of pattern blocks
Snap cubes in different colours

Present the students with a set of pattern blocks in an open and shallow container such as a bangchung or a tray-like container. The set could consist of 5 blocks such as 2 hexagons, 2 trapezoids and 1 rhombus. Tell and ask: **This is a set of blocks. How many of the blocks are rhombus shapes? How many blocks are there in the set? Explain that we can also use fractions to represent parts of a set: One fifth of this set is rhombus. What fraction of this set is not rhombus? How many hexagons are there in the set? What fraction of the set is hexagon? What fraction of the set is not hexagon?**

Put up a diagram, made in advance, representing the situation above and write the fractions. Discuss what each of the numbers in the fractions represents.



Rhombus: $\frac{1}{5}$

Hexagon: $\frac{2}{5}$

Trapezoid: $\frac{2}{5}$

Call 2 boys and 3 girls to the front. Tell that it is a set of students. Ask: **How many boys are there in this set? How many students are there in total? What fraction of the set is boys? How will you write the fraction? What fraction of the set are not boys? What fraction of the set are girls?**

Present the students with a set of snap cubes. For example, the set could consist of 2 blue cubes and 4 red cubes. Ask: **Name a fraction for this set of cubes. Can you tell another fraction for this set of cubes?** Encourage the students to tell and write down the fraction. Have them describe the fractions they tell. For example; **What does 2 mean? What does 6 mean?**

Present other similar sets, either with concrete objects or with diagrams and discuss the related fractions.

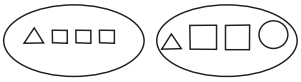
Extension

Use three or more colours of cubes and have students identify fractions for different colours. For example, a group may have 1 red, 2 green, and 4 blue cubes. Students may identify that one seventh of the cubes are red and that six sevenths of the cubes are not red. (Note: It is a good idea to use 5 or 7 cubes in total as then there is no need to deal with issues of equivalent fractions as would be the case with 4 out of 8 being one half, for example.)

Have, and help, the students complete the relevant activities in their Student Activity Books.

Maths Note

Fractions are often used to describe parts of a set. For example, we might say that $\frac{2}{5}$ of a group is boys if there are 2 boys and 3 girls. The denominator tells how many are in the set and the numerator tells how many in the set are being considered. It is important to note that the items in the set do not have to be identical. For example, the triangles are $\frac{1}{4}$ of each set below even though they are much smaller than the other shapes in the second set.



The reason that the fraction is still used even though the sizes are different is that the number of objects is being considered rather than the size of these objects.

Assessment for Learning

See that the students can describe what the numerator and the denominator in each fraction mean with respect to the sets.

Chapter Assessment

Formative Assessment

Formative assessment ideas, tips and reminders are provided within each lesson under the heading called Assessment for Learning. In addition, you should use a formative assessment tool called the Chapter Checklist. Prepare the Formative Assessment Recording Sheet for the chapter as shown below. You should look for evidence in each student, throughout the teaching of the chapter, that he or she has understood the key concepts and can perform the key mathematical skills by ways of observing, listening and asking probing questions. Accordingly, keep the records for each student by putting a mark, such as a tick mark, for each of the chapter goals once you are convinced that the student has achieved them. You could also keep relevant anecdotal records.

Using the Chapter Checklist purposefully will give you the benefit of ensuring that each student's learning progress is assessed in a systematic manner. What is even more important is the opportunity it will provide you to help each student along in achieving the chapter goals. Since this is meant as a formative assessment tool, you will not be giving any mark to the students by using it. However, investing time in carrying out this assessment technique will contribute positively in the students being able to do well in the summative assessments, including the examinations. You can also refer back to these records as you look for progress during the year and/or seek to address areas of concern.

Formative Assessment Recording Sheet
CHAPTER 5 FRACTIONS

Chapter Checklist (Look for evidence throughout the chapter that the student has understood the key concepts and can perform the key skills.)

Student Name		Chapter Goals (The student is able to):				
		Identify and say halves, thirds, fourths, fifths and sixths of shapes.	Label a given (or indicated) part of a whole with a fraction symbol or number.	Identify halves, thirds, fourths, fifths and sixths of a set.	Label a given (or indicated) part of a set with an appro-priate fraction symbol or number.	Describe what the numerator and the denominator in a fraction mean in relation to a given situation inclusing sets.
1						
2						
3						
4						
5						
6						
7						
8						

Summative Assessment

As explained in the Introduction to the Teacher's Guide, the student's learning in each chapter will be measured primarily through the use of an assessment method called the Interview-based Performance Task. The primary purpose of this assessment is to thoroughly assess the level of understanding of the students in terms of the key concepts and skills as required in the chapter. It provides an opportunity for the students to display their understanding by ways of telling, describing, showing, and demonstrating in a non-threatening environment.

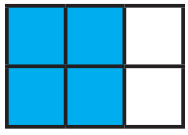
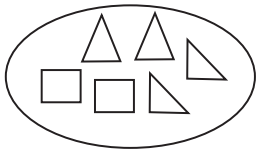
One of the beauties of this assessment method is that it allows you to teach and clarify things even as you are assessing the students. The fact that you have to provide marks to the students through the use of Interview-based Performance Tasks should be considered a secondary purpose. The Summative Assessment Recording Sheet (shown on the next page) is included in the Student Activity Book for your use with each student. Please refer to the Introduction to the Guide for the details on the marking scheme.

Summative Assessment Recording Sheet

Student Name: _____ Roll no.: ____ Section: ____

CHAPTER 5 FRACTIONS

Interview-based Performance Task (Please refer to the Introduction to the Teacher's Guide for Class 2 for the marking scheme while using the Interview-based Performance Task.)

Task and Interview prompts	Key concepts and skills to look for
Present the student with a diagram as shown here. Present a blank paper as well. Say: **Tell me a fraction related to this picture? Write your fraction on this blank paper. What does (4) mean in your fraction? What does 6 mean? What fraction of the shape is (not shaded)?** 	The student is able to: - Identify an appropriate fraction for a shape divided into equal parts. - Say the fraction name correctly. - Write a fraction number correctly. - Describe what the numerator and the denominator in a fraction mean related to a shape divided into equal parts. - Represent a part of a set with an appropriate fraction. - Describe what the numerator and the denominator of a fraction mean in connection with a set. - Describe the similarities between a set and a shape.
Present the student with a diagram of a set of shapes as shown here. Ask: **Can you write a fraction for this set of shapes? What does the (2) mean? What does 6 mean? What is the same about this set and the shape above? What is different about this set and the shape above?** 	

Comments and Marks

Strengths:

Areas of Need:

Follow up Steps:

Teacher's Signature and Date:

Summary of the Summative Assessment for Chapter 5

CA marks from Chapter 5 (Marks out of 10): _____

CHAPTER 6 GEOMETRY

Chapter Overview

Geometry is the study of shapes, both 2-Dimensional and 3-Dimensional – their features like sizes, positions, orientations; relationships among the various features of a shape; effects on the position and orientation of shapes due to certain transformations applied to them. 2-D shapes are flat and can be drawn on paper. 3-D shapes are solid shapes and occupy space. You can draw diagrams of 3-D shapes on paper, but these diagrams only show the view from one perspective.

The students have had some experience exploring basic 2-D shapes and 3-D shapes in Classes PP and 1. This chapter will engage the students in a similar experience in reviewing and furthering their understanding of 2-D shapes and 3-D shapes. The students will continue to study and describe the features and properties of these shapes, compare and describe the similarities and difference between them, and create models of the shapes.

The students will be introduced to two new shapes – square and pentagon, in addition to circle, triangle, rectangle, rhombus and hexagon which they already dealt with in Class 1, as far as the 2-D shapes are concerned. The students will explore the concept of parallelism for the first time and explore lines of symmetry for a shape in more than one way.

The students will consolidate their understanding of cylinders, prisms, cones and pyramids for the 3-D shapes. The students will be introduced to the nets of 3-D shapes, and they will identify and make models of 3-D shapes from the nets.

This chapter has 9 lessons as detailed in the Table of Contents.

Basic Principles About Shapes

- To distinguish between shapes, students must focus on attributes of the shapes whether it is for the purpose of identifying them, sorting them, or building with them.
- Some attributes of a 2-D object relate to the object as a whole, but some focus on parts of them.
- It is often useful to think of shapes in terms of their component parts.
- By making the shapes, properties of those shapes become more readily apparent.

Chapter Goals

- Describe parallel lines as lines that do not and will not meet in either direction.
- Identify and name 2-D shapes such as circle, triangle, rectangle, pentagon and hexagon.
- Describe the 2-D shapes in terms of their features.
- Know squares are special rectangles.
- Identify and describe the lines of symmetry for shapes.
- Identify and name 3-D shapes such as cylinders, prisms, cones and pyramids.
- Describe the 3-D shapes in terms of their features.
- Identify and make pyramids and prisms from their nets.

Maths Words

2-D shapes, circle, triangle, rectangle, square, pentagon, hexagon, parallel lines, intersecting lines, symmetry, lines of symmetry, cylinder, prism, cone, pyramid, net.

Lesson 1 Exploring Parallel Lines

Objectives

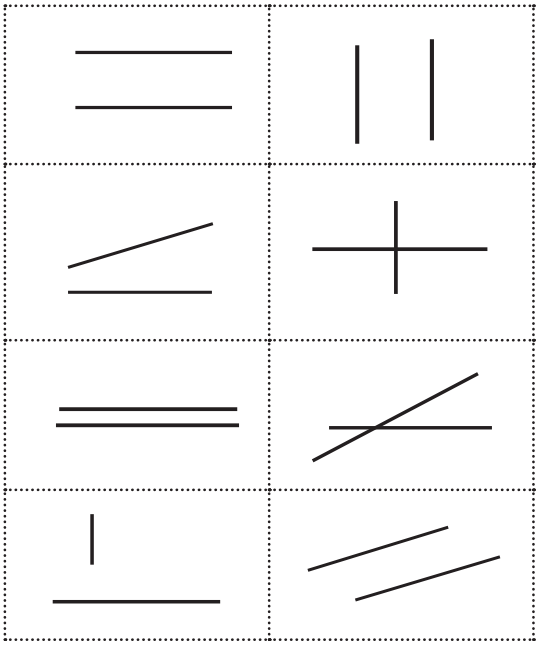
Describe the meaning of parallel lines.

Materials

Student Activity Books
Scissors

Ask the students to cut out the pairs of lines from their Student Activity Book on page __. Provide scissors for that. You could also model how to tear off the sections from page using rulers or other stiff straight edges. Then, ask the students to sort the pairs of lines into two sets. As they work, circulate and ask questions such as: **How did you sort your pairs of lines? What is the same about all the pairs of lines in this set? What is different about the pairs of lines in this set from those in that set?** The students might sort the pairs of lines in ways different from what you expected (i.e. set of parallel lines and set of non-parallel lines). That should be alright at this stage as long as the students can provide a reason for their sorting.

Once you have visited and seen everyone's sorting, draw the students' attention to how you would sort the pairs of lines. You could start by placing the lines which are non-parallel in one set: **I am putting these two pairs of line together since the lines cross each other here. I would also place this pair of lines with them, since the lines will cross if they are extended or made a bit longer** (referring to another pair of non-parallel lines. **Similarly, this pair of lines will also cross each other if the lines are made longer, so, I am going to put it here as well. Now we are left with these other pairs of lines, which I am going to make into another set.** Display the pairs of lines in each set clearly so that all the pairs are visible to the students. Encourage the students to describe what is the same about all pairs of lines in the second set (i.e., the set of parallel lines).



Maths Note

Two lines are parallel if they travel in the same direction; the lines will never meet even if they are extended in either direction indefinitely. Another way to look at parallel lines is that they maintain the same distance between them.

It may be easier for the students to understand parallel lines in the light of the second definition, since we normally see short line and can visually and physically test if the distance is the same at different points between the lines.

The former definition involves applying the logic of extending the lines indefinitely. Though it is easier to use only one definition, students should learn to reason about and understand all these definitions. At this stage, students are just beginning to think about parallel lines so that they can use it to recognize sides of particular types of shapes, e.g. that the opposite sides of rectangles are parallel. A formal definition is not needed at this point.

Explain that the pairs of lines in the second set do not cross each other; the lines also do not seem to cross each other even if they are longer or extended; and that the pairs of lines looks equally apart at all the points along the lines. Tell that such pairs of lines are called parallel lines. Have the students repeat the word “parallel lines” after you. Write the word on the board. Explain that the lines which cross each other, or which will cross each other if they are made longer are called non-parallel lines. Have the students say the word “non-parallel lines” after you.

Ask the student to sort their pairs of lines in the same way as set of parallel lines and set of non-parallel lines. Encourage the students to check the distance between the pairs of lines which are parallel with their rulers. As they work on this, go around and ask: **What is the distance between this pair of lines at this point? What is the distance at this point?** etc.

Toward the end, ask questions such as:

> **What makes this pair of lines different from this pair of lines** (showing up a pair of parallel line against a pair of non-parallel lines)?
>
> **How could you tell that these lines are parallel** (showing a pair of parallel lines)**?**
>
> **What do you think parallel means?**
>
> **Suppose (Kezang) and (Choden) are asked to walk on a pair of parallel lines which they cannot actually see. What should they keep in mind as they walk along the parallel lines?**

Assessment for Learning

See that the students can describe or tell in their own words what parallel lines means, and what non-parallel lines means.

Extension

You might ask the students to post their pairs of lines on the wall where you have put up chart papers with the headings “Parallel lines” and “Non-parallel lines”.

Have the students look around for things that look like parallel lines such as the opposite edges of tables, the iron rods in the windows that go in the same direction, or lines in paintings and diagrams that may be on the walls.

Have help the students complete the related activities in their Student Activity Books.

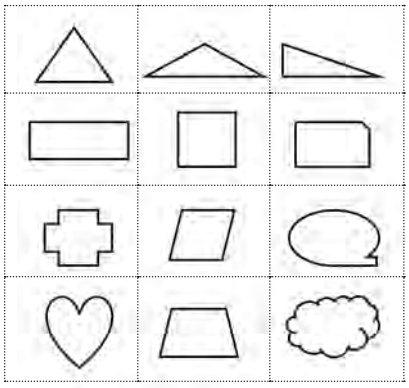
Lesson 2 Exploring Symmetry

Objectives

Recognise the lines of symmetry in simple 2-D shapes and relate symmetry to the notion that each half shape is a mirror image of the other.

Materials

Shapes from the Student Activity Book on page __
Scissors



Ask the students to cut out the shapes from their Student Activity Book on page __. Provide scissors for that.

After everyone is finished with cutting their shapes along the shape boundaries, take up one shape that is symmetrical (e.g. a triangle which is symmetrical), and fold it along the middle such that the two halves fit exactly on each other. Say: **This shape is symmetrical, because when I fold it in the middle, this half of it fits exactly onto the other half. The two halves are equal and exactly the same.** Explain that the fold line for the symmetrical shape is called the line of symmetry. **Now I want you to try folding each shape to see if they are symmetrical or not. Put all your shapes which are symmetrical in one set and the others which are not symmetrical in another set. You can also discuss with your neighbours.**

As the students work on that, go around and help them. Ask questions such as: **Which is your set of symmetrical shapes? How do you know that this shape is symmetrical? Show me the line of symmetry for this shape. How do you know that this shape in not symmetrical?** Referring to a shape which is symmetrical, ask: **Can you fold this shape in a different way so that the two halves created will still fit exactly on each other? In other word, ask: Can you find another line of symmetry for this shape?**

Toward the end, ask: **How many of your shapes are symmetrical? How many of your shapes are not symmetrical? How many shapes are there altogether? Can you make an addition sentence for that?** Encourage the students to tell an addition sentence, and write it on the board. Encourage the students to tell what each of the numbers in the addition sentence means. **Now, can you tell a related subtraction sentence?** Encourage the students to describe what each of the numbers in the subtraction sentence means. Have the students tell another related subtraction sentence, and the meaning of each number in that sentence.

Ask the students to take care of the shapes for the next activity, mentioned in the Extension on the next page.

Maths Note

Symmetry is one of the most important geometric attributes we observe in shapes around us. Humans seem to appreciate shapes that show symmetry.

The students have met the idea of symmetry in Class 1. They will look at a broader variety of shapes in this lesson. They will also see shapes involving more than one line of symmetry including diagonal symmetry; previously they looked at shapes having only one line of symmetry, which were mostly either horizontal or vertical.

Assessment for Learning

See that the students can describe how a shape is symmetrical. See also that they can identify more than one line of symmetry for some of the shapes.

Extension

Ask the students to have their set of symmetrical shapes made during the lesson above. Ask them to find out if these shapes could have more than 1 line of symmetry by folding in different ways. Have them draw the lines of symmetry along the fold lines.

Have the student then sort the symmetrical shapes into sets depending on how many lines of symmetry the shapes have.

You might ask the students to post their shape on the wall where you could have put up chart papers with the headings as shown below. You might want to draw the attention of the students on the number of lines of symmetry between the two rectangles in the set. The rectangle which is not a square has 2 lines of symmetry while the rectangle which is a square has 4 lines of symmetry. You could ask: **What makes these two rectangles have different numbers of lines of symmetry?** (At this point you would not have introduced the word square yet)

Symmetrical Shapes	**Non-symmetrical shapes**
With 1 line of symmetry	
With 2 lines of symmetry	
With 4 lines of symmetry	

Discuss how the lines of symmetry run in the shapes. Show them that some lines are horizontal (line which go left-right), some are vertical (lines which go top-bottom), and some are diagonal (lines which are slanting). Have them practise saying these three words – horizontal, vertical, and diagonal with appropriate action of the hands.

(Note: Be aware that what is vertical, horizontal, and diagonal is a matter of perspective. For example, if a shape is on the floor, the line of symmetry may seem vertical for someone on one side and horizontal for someone else looking from a different side. You should discuss this with the students. Also, you might want to note that the idea of “vertical” is a little strange. It assumes that the drawing is on the wall. Otherwise all lines of symmetry on paper on a desk go horizontal because they are all lying flat.)

Discuss with the students that in nature many things are symmetrical: Our human body is symmetrical with the line of symmetry passing vertically through the middle of the nose; similarly the bodies of animals are also symmetrical; fruits such as apples and mangoes are also symmetrical; things which are made by humans such as bottles, cars, and pairs of shoes are also symmetrical.

Ask the students to identify symmetrical items in the classroom or outside the classroom.

Lesson 3 Identifying and Describing 2-D Shapes

Objectives

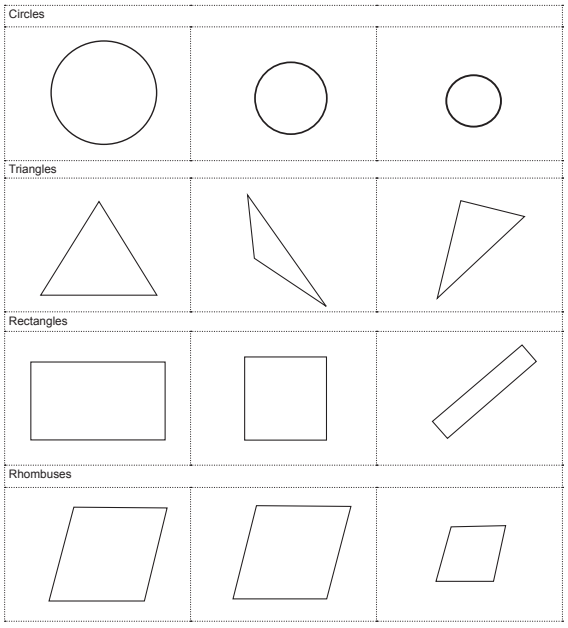
Identify and name 2-D shapes (such as circle, triangle, rectangle, rhombus, trapezoid, hexagon and pentagon).
Describe the 2-D shapes in terms of their shape features (such as number of corners, edges, lines of symmetry, and presence of parallel lines in them).

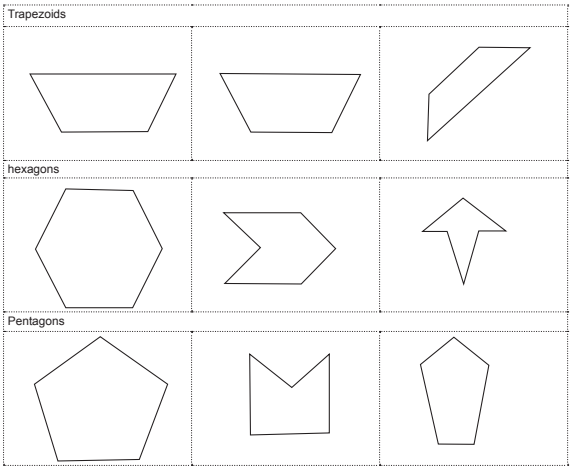
Materials

Chart papers and marker pens
Cutout of 2-D shapes (with each of the shapes in at least 3 different sizes and forms)
Glue stick

You could draw the shapes similar to the ones provided here and cut them out, or if possible, photocopy and cut them out. Some relevant descriptions are provided for each type of shape.

Have the cutouts of the shapes ready. All the above shapes, except pentagon, should be familiar to the students from their experience with them in the earlier classes. Pick up a familiar shape (e.g. a triangle) and ask the students if they can name it and describe it. **What is this shape called? Can you tell something about this shape?** Ask probing questions such as: **How many edges does a triangle have?** (Explain the meaning of edge. An edge is also called a side.). **How many corners does it have?** (Explain the meaning of corner. A corner is also called a vertex.) **Does a triangle have any pair of parallel sides? Do you think this triangle is symmetrical? If it is symmetrical, where would the line of symmetry be?**

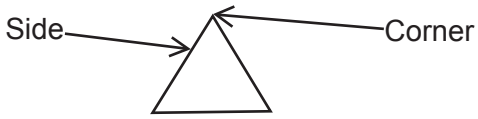




Maths Note

Students have worked with identifying and describing many of the 2-D shapes mentioned above in Classes PP and 1. This lesson will add one more shape – pentagon, to their repertoire of 2-D shapes. Now that they have been exposed to the idea of parallel lines and finding more than one line of symmetry in shapes, they will also describe these shapes in terms of these two concepts.
It is still important to present to the students a variety of each of these 2-D shapes, in terms of their sizes, shapes, and orientations, so that the students develop their perceptual constancy. Perceptual constancy is the ability to identify a shape as that shape even though it is presented in different forms and ways. For example, the students should be able to identify a rectangle even if a rectangle is presented with different dimensions and orientations, which might be different from how it is normally presented. Some relevant information on each type of shape is provided with the samples of the shapes for your understanding.

Draw a triangle and show the sides and corners for it, by labelling them.



Then draw a rectangle and do the same.

Repeat the above process with each of the familiar shapes. Introduce pentagons and hexagon as shapes having 5 sides and 6 sides respectively. Ask the students to describe a pentagon and a hexagon as you show the shapes one by one.

Put up a chart paper with the names of the shapes written on it in such a way that there are adequate spaces to paste the cut out shapes under each shape name, as shown below.

Tell the students that you have different kinds of triangles, rectangles, rhombuses, trapezoids, circles, hexagons and pentagons. Mix up the shapes stack them up in a pile. Ask a student to come to the front, pick up a shape, and describe it. Then ask the class where it should be pasted on the chart paper. Help the student in posting it at a proper place on the chart. Repeat this process with other students until all the shapes have been posted.

Triangles	Trapezoids
Cirlces	Pentagons
Rectangles	Hexagons
Rhombuses	

At the end, tell the students that they have just sorted the shapes into 7 sets. Ask: **What is the same about all the hexagons? What is the same about all the triangles? How do all the rhombuses look? What is the same about the rectangles and rhombuses? What is different about rectangles and rhombuses? What other shapes have 4 sides besides rectangles? What is the name of the shape which has 5 sides? Where do you see hexagons? Where can you see pentagons?** (Standard footballs have pentagons and hexagons on it. The cells of the honey bee comb have hexagon shapes. It would be nice if you can get these materials, or picture of them, and bring them to the class for this lesson.)

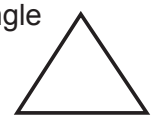
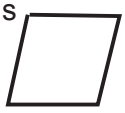
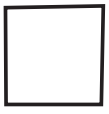
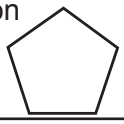
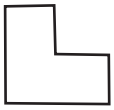
Assessment for Learning

See that the students can name and describe each of the shapes adequately.

Extension

Prepare the following on a chart paper in advance. Put it up on the wall. With the help of the students, fill up the chart with information on each shape. The required information for each type of shape should be based on the given diagram in the table.

The shape circle has been left out, as asking for how many sides, corners and lines of symmetry with it would create some complication for the students at this stage. For example, a circle has countless number of lines of symmetry.

Shapes	Number of sides	Number of corners	Number of pairs of parallel lines	Number of lines of symmetry
This triangle 				
This triangle 				
This rhombus 				
This rectangle 				
This rectangle (all sides same) 				
This trapezoid 				
This pentagon 				
This hexagon 				
This pentagon 				
This hexagon 				

Lesson 4 Exploring Squares

Objectives

Identify and describe squares as special rectangles for which all the 4 sides are the same.

Materials

Sets of about 6 rectangles in various sizes, 2 of which should be square, 2 almost squares, and 2 clearly not squares – one set for each group of students
Rulers

Have a set of rectangle as mentioned above, preferably in cutout forms. The dimensions of the rectangles should be in whole numbers of centimetres. This would facilitate measuring and communicating measurements in centimetres since the students have learnt measuring in centimetres earlier in the Chapter 3.

Distribute a set each to the groups of students. Tell them that some of the rectangles have all the sides equal in length, and ask them to sort the rectangle into two sets – a set of rectangles having the same sides and a set which in the sides are not all the same. As they work, go around and ask how they determined the rectangles which have all the sides the same. Ask: **Which rectangles have all their 4 sides equal in length? How did you find that out? Did you use ruler to measure the sides? How long is each side of this rectangle if you have measured with rulers?** If the students are measuring the sides with rulers, see that they know how to measure and read the measurements correctly.

Tell the students that there is a special name for the rectangles that have all the 4 sides the same, and introduce the name square. Emphasise that a square is still a rectangle. A square is still a rectangle because it has 4 sides and the opposite sides are parallel as is the case with all the other rectangles.

A method you could teach the students to see if a rectangle is a square is this: Fold the rectangle along a diagonal. If one half fits exactly onto the other half, then the rectangle is a square. If the two halves do not fit exactly onto each other, then it is not a square.

Toward the end, ask questions such as: **What is different about rectangles which are squares and rectangles which are not squares? How many lines of symmetry are there for squares? How many lines of symmetry are there for rectangles which are not squares?**

Maths Note

Squares are rectangles for which all the 4 sides are equal in length. Up till now, we have not introduced squares to the students in terms of using the word as such. But, they did work with squares in dealing with rectangles. Students should still continue to recognize squares as rectangles. With discussion of the special properties of squares, students should continue to think of them as rectangles, and not as a something that as something different from a rectangle.

Assessment for Learning

See that the students can describe what a square is.

Extension

Have the students complete the relevant activities in their Student Activity Books

Lesson 5 Identifying and Describing 3-D Shapes

Objectives

Identify and describe 3-D Shapes (spheres, prisms, pyramids, cones and cylinders)

Materials

Models of geometric 3-D geometric shapes (such as spheres, prisms, pyramids, cones, and cylinders)
Common objects in the forms of the above shapes (such as blocks and containers)

Have a collection of the above mentioned models ready. Show the models one by one and see if students can name them. You might help them with the names. However, the focus should be on describing shapes.

Pick up a shape (e.g. a prism) and ask the students to describe it. Encourage them to tell as many things as they can about it. Ask probing questions about what colour it is, what is made up of, whether it will roll or slide, what it is like etc. Ask them also to describe it in terms of its shape features, by asking probing questions such as: **How many faces does it have? What shape is this face? Are there many corners for this shape? Shall we count the number of corners for this shape? How many edges are there?**

Repeat the above process with a few more shapes.

Divide the class into groups and distribute a shape each to the groups. Within the groups, ask the students to describe their shape. A group member will show up the shape and say one thing about it in full sentence, and pass it on to the next group member, who will do similarly, but without repeating what has already been said. This will continue until all the group members have said. The group member should then decide at the end if the group left anything out about the shape. The groups should then report back to the whole class, saying the properties they noticed (so the groups work is like a rehearsal time for them to speak confidently to the whole class). Then, the classmates can identify properties that the groups perhaps missed.

Then, provide each group with an additional shape which is different from the shape they already have. Ask them to compare and talk about what is the same and what is different between the two shapes in their groups. As they work, go around and engage in discussion with them and ask questions like: **How are there two shapes the same? What is different about these two shapes?**

Maths Note

Students have had some experiences in identifying and describing 3-D Shapes in Classes PP and 1. This lesson will review them. In this lesson, the students could describe the shapes in terms of their critical features (features which make a prism a prism), as well as non-critical features (such as colours and materials; a prism is still a prism whether it is green or red, or whether it is made of wood, rubber, stone or glass. They should also focus on how shapes are alike and how they are different. But, students should begin to realize it is the presence of the critical features that make a shape a shape. The next two lessons focus on the critical features for cones, cylinders, prisms and pyramids.
It is essential to have the materials mentioned for the students to be able to identify and describe the shapes.

Assessment for Learning

See that every student can describe a shape in at least a few ways.

Extension

Ask the students to trace each face of a 3-D shape in their notebooks, and have them identify or name the resulting 2-D shape. Ask questions such as: **When you trace the faces of a cylinder, what 2-D shape will you get? Are the two circles the same? How many circles will you get when you trace the face of a cone? What shape do you get when you trace the faces of a rectangular prism? When you trace the faces of the cube, what will you see?**

Students may wonder how to trace the curved surface of a cylinder or cone. You can tell them that they do not have to do this yet, but if they want to try they can do this: 1) Stand the cylinder or cone on its base. 2) Mark a vertical line on the face. 3) Lay the cylinder/cube on that line. 4) Roll the shape until it returns to that line. 5) While rolling, note the shape it sweeps (e.g. follow the edge with a pencil to see what shape is left showing).

Lesson 6 Cylinders and Cones

Objectives

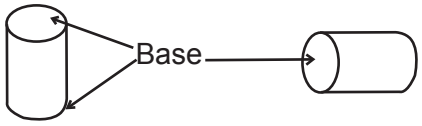
Define a cylinder.
Define a cone.

Materials

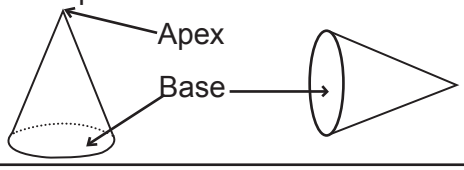
Models of cylinders and cones (if possible in a variety of materials such as wood, plastics, paper)
Chart paper containing the definitions with illustrations of cylinder and cone

Show up a model of cylinder and describe it along with appropriate gestures and pointing to the shape : **This is a cylinder. A cylinder has two identical circular bases. It has a curved side surface.** Explain the meanings of 'base' and 'identical bases'. Explain the meaning of curved surface as not being flat like the faces. Pass the cylinder to a student, and have him or her describe it as: **A cylinder has two identical circular bases.** Have the student pass the cylinder to the next student, who will repeat the description. Continue this until all the students have done the same.

Cylinder
A cylinder is a 3-D shape that has 2 identical circular bases.



Cone
A cone is a 3-D shape that has one circular base and an apex.



Put up the chart paper containing the definitions of the two shapes. Read and have the students read the definition of cylinder after you.

Then, show up a cone and describe it as: **This is a cone. A cone has one circular base and one apex. It has a curved surface for its side.** Explain the meanings of base, apex and curved surface as you point to them appropriately.

As in the case with the cylinder, pass around the cone and have the students describe it. Then, read and have the students read the definition of the cone from the chart.

Toward the end, have the students compare the cylinder with cone. **What is the same about a cylinder and a cone? What is different about a cylinder and a cone?**

Maths Note

While it may not be necessary to provide th e definitions in formal ways, the student should now begin to describe cylinders and cones in terms of their critical features.

Extension

Draw a cylinder on the board. Show how to draw it. Have the students draw and practise drawing it in their notebooks. As they do, go around and help them. Do the similarly with drawing a cone. Encourage the students to practise drawing cylinders and cones in various ways over the next several days.

Have the students complete the relevant activities in their Student Activity Books.

Assessment for Learning

See that every student can describe the two shapes as mentioned above.

Lesson 7 Prisms and Pyramids

Objectives

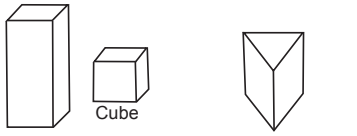
Define a prism.
Define a pyramid.
Name the prisms and the pyramids according to the shapes of their bases.

Materials

Models of a variety of prisms and pyramids (if possible in a variety of materials such as wood, plastics and paper)
Chart paper containing the definitions with illustrations of prisms and pyramids

Show up a model of a prism (e.g. a rectangle-based prism) and describe it along with appropriate gestures and pointing to the parts of the shape: **This is a prism. A prism has two identical bases, which are not circles. The side faces are all rectangles.** Explain the meanings of 'bases' and 'identical bases'. Explain the meaning of the side faces.
Show up another prism (e.g. triangle-based prism) and describe it along with appropriate gestures and pointing to the parts of the shape: **This is also a prism. A prism has two identical bases, which are not circles. The side faces are all rectangles.** Show up the above two prisms to the students and ask them: **These two are both called prisms. Why are they called prisms? What is different about these two prisms? What is the same about these two prisms?** Then explain that the prisms are named according to the shapes of their bases.

Prism
A prism is a 3-D shape that has 2 identical bases, which are not circles.



Pyramid
A pyramid is a 3-D shape that has one base, which is not a circle, and an apex.

Pass around the rectangle-based prism to about half of the students and have them say, one by one, as: **A prism is a shape with 2 identical bases, which are not circles. This is a rectangle-based prism, because it has rectangular bases.** Then, pass around a triangle-based prism to rest of the class and have them say, one by one, as: **A prism is a shape with 2 identical bases, which are not circles. This is a triangle-based prism, because it has triangular bases.**

Then, show up a pyramid (e.g. a triangle-based one) and describe it as: **This is pyramid. A pyramid has one base, which is not a circle, and one apex. It side faces are all triangles.** Explain the meanings of base, apex and side faces. Show up another pyramid (e.g. rectangle-based prism) and describe it. **This is also a pyramid. A pyramid has one base, which is not a circle, and one apex. The side faces are all triangles.** Explain the meanings of base, apex and side faces. Show up the above two pyramids to the students and ask them: **These two are both called pyramids. Why are they called pyramids? What is different about these two pyramids? What is the same about these two pyramids?** Then explain that the pyramids are named according to the shapes of their bases.

You might pass around the pyramids and have the students say the definition

Maths Note

While it may not be necessary to provide the definitions in formal ways, the student should now begin to describe prisms and pyramids in terms of their critical features.

Prisms and pyramids are named according to the shape of their bases. A prism with rectangular bases could be called either as 'rectangular prism' or 'rectangle-based prism'. Similarly, it is either triangular prism or triangle-based prism, or 'hexagonal prism' or 'hexagon-based prism'. The pyramids are named in the similar manners.

and names of the pyramids as in the case of prism above.

Put up the chart paper containing the definitions of the two shapes. Read and have the students read the definitions of prisms and pyramids after you.

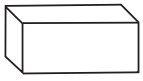
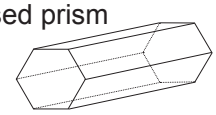
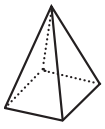
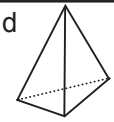
Toward the end, have the students compare a prism with a pyramid. **What is the same about a rectangle-based prism and a rectangle-based pyramid? What is different about these two shapes?**

Assessment for Learning

See that every student can describe prisms and pyramids as mentioned above.

Extension

Have the students observe and record the number of corners, edges and faces for various prisms and pyramids in a table as shown below. Distribute ach shape to the students in groups, have them explore, and tell the required information. Put up the table on a wall to fill it up together.

Shapes	**Number of corners**	**Number of edges**	**Number of rectangular side faces**	**Number of triangular side faces**
Rectangle-based prism 				
Triangle-based prism 				
Cube (Rectangle-base prism) 				
Hexagon-based prism 				
Rectangle-based pyramid 				
Triangle-based pyramid 				

You could let the students predict the results for a pentagon-based prism and a pentagon-based pyramid. (Note: This would be a good chance to draw out reasoning from the students, but it is not necessary that the students should know this.)

Draw rectangular prism on the board. Show how to draw it. Have the students draw it in their notebooks. As they do, go around and help them. Do the same as above with triangular prism, rectangular pyramid and triangular pyramid. Encourage the students to practise drawing cylinders and cones in various ways over the next several days.

Have the students complete the relevant activities in their Student Activity Books.

Lesson 8 Making Models of 3-D Shapes

Objectives

Make solid models of various 3-D Shapes such as spheres, cones, cylinders, prisms and pyramids.

Materials

Modeling clay
Dough (You could prepare adequate amount of play dough in case clay is not available. You could make the dough by adding some amount of salt and cooking oil to the flour in the process of kneading the dough)
Some planks or empty tables
Models of 3-D shapes (Prisms, pyramids, cylinders, cones, cubes, spheres)

Take the students to a proper place: it could be in the classroom if the class size is small, or outside in a ground. Each student should have access to adequate space of a table or some planks. Have the student make various 3-D shapes with clay or dough. They should have the model in front of them to look at and refer to. You should engage yourself also in making the shapes along with the students. As the students work or are completing their models, engage them with questions like: **What shape is this? What makes your shape a (pyramid)?**

In asking the students the above questions, it would be good to ask students to share their strategies to make shapes. It is very likely that different students will have different strategies. Encourage students to try following their classmates' strategies even if they liked the strategy they used first. The point is more than learning better strategies: When telling their strategies they will be referring to characteristics of the shape, especially if you ask for clarification while referring to those aspects of the shape. Also the strategies they use are likely to relate to the characteristics. For example, students may describe how they tapered their cones and pyramids by making their hands form a smaller and smaller shape. Or they may describe how they keep their hand in the same position as they move up and down the prism or cylinder.
You could ask each student to make at least 3 different shapes. You could prepare some index cards with the names of the shapes. Have the students label their shapes with the index cards. They could write and attach their own names on the shapes they made. The shapes could be allowed to dry and stored at a proper place for future use.

You could congratulate the students for their beautiful creations, although perfection of the shapes they made should not be the emphasis. When you congratulate them, refer to the way their shapes exhibit the key properties of the shapes.

Maths Note

The intent of this lesson is to provide practice in making models of 3-D shapes. The expectation is not that the shapes will look perfect, but that they will exhibit the required characteristics of the shape. For example, a prism should show two bases that are close to identical, joined by faces that appear to be rectangles. A pyramid should have an apex, a base, and the side faces should appear to be triangles. A sphere should look like a ball. Students should have appropriate materials, such as modeling clay or dough, to allow them to build the required shapes.

Assessment for Learning

See that the students can name and describe their shapes in terms of their shape features.

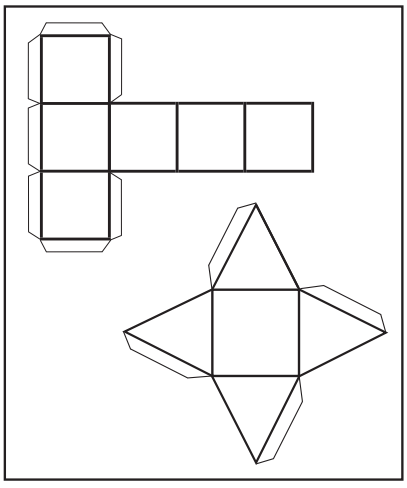
Lesson 9 Nets of Prisms and Pyramids

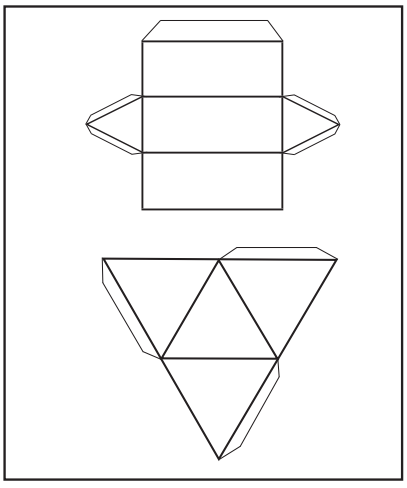
Objectives

Fold the given nets of prisms and pyramids into those shapes.

Materials

Nets from the Student Activity Book on pages __ and __
Scissors
Glue sticks





Maths Note

There are many nets for shapes, but only the simplest or most obvious nets should be used for the students at this stage. Students should be given the nets, made out of paper (stiff paper if possible). You could collect discarded file folders throughout the year to be used for the nets. Before students fold the nets, they should be provided with an opportunity to predict what the shape might be.

Show a page containing the nets from the Student Activity Book. Explain that these are called nets and that if we fold along the lines we will get a 3-D shape. Demonstrate cutting off a shape along the out lines and then folding it into a 3-D shape.

Ask the students to cut off the two pages from their Student Activity Book containing the nets of shapes. Ask them to predict what shape each of the nets will produce. Then, have them cut off the nets one by one and fold them into the shapes. Provide scissors and glues for this. As they work, circulate and help them with the task. Ask questions such as: **What shape did you think this will fold into? Why? What clues did you use to predict what shape this will be? Which parts of the net will be the bases of the shape? How do you know?**

Assessment for Learning

See that the students can predict what shape each net will give rise to.

Extension

Have the students complete the relevant activities in their Student Activity Books.

Chapter Assessment

Formative Assessment

Formative assessment ideas, tips and reminders are provided within each lesson under the heading called Assessment for Learning. In addition, you should use a formative assessment tool called the Chapter Checklist. Prepare the Formative Assessment Recording Sheet for the chapter as shown below. You should look for evidence in each student, throughout the teaching of the chapter, that he or she has understood the key concepts and can perform the key mathematical skills by ways of observing, listening and asking probing questions. Accordingly, keep the records for each student by putting a mark, such as a tick mark, for each of the chapter goals once you are convinced that the student has achieved them. You could also keep relevant anecdotal records.

Using the Chapter Checklist purposefully will give you the benefit of ensuring that each student's learning progress is assessed in a systematic manner. What is even more important is the opportunity it will provide you to help each student along in achieving the chapter goals. Since this is meant as a formative assessment tool, you will not be giving any mark to the students by using it. However, investing time in carrying out this assessment technique will contribute positively in the students being able to do well in the summative assessments, including the examinations. You can also refer back to these records as you look for progress during the year and/or seek to address areas of concern.

Formative Assessment Recording Sheet
CHAPTER 6 GEOMETRY

Chapter Checklist (Look for evidence throughout the chapter that the student has understood the key concepts and can perform the key skills.)

Student Name		Chapter Goals (The student is able to):					
		Describe what parallel lines are	Identify symmetrical shapes.	Determine the number of lines of symmetry in a simple shape	Identify and describe familiar 2-D shapes.	Identify and describe familiar 3-D shapes	Say the definitions of prisms and pyramids in their own words.
1							
2							
3							
4							
5							
6							
7							
8							

Summative Assessment

As explained in the Introduction to the Teacher's Guide, the student's learning in each chapter will be measured primarily through the use of an assessment method called the Interview-based Performance Task. The primary purpose of this assessment is to thoroughly assess the level of understanding of the students in terms of the key concepts and skills as required in the chapter. It provides an opportunity for the students to display their understanding by ways of telling, describing, showing, and demonstrating in a non-threatening environment.

One of the beauties of this assessment method is that it allows you to teach and clarify things even as you are assessing the students. The fact that you have to provide marks to the students through the use of Interview-based Performance Tasks should be considered a secondary purpose. The Summative Assessment Recording Sheet (shown on the next page) is included in the Student Activity Book for your use with each student. Please refer to the Introduction to the Guide for the details on the marking scheme.

Summative Assessment Recording Sheet

Student Name: _____ Roll no.: ____ Section: ____

CHAPTER 6 GEOMETRY

Interview-based Performance Task (Please refer to the Introduction to the Teacher's Guide for Class 2 for the marking scheme while using the Interview-based Performance Task.)

Task and Interview prompts	Key concepts and skills to look for
Provide the student with models of a prism and a pyramid. Ask questions such as: **Which one of these is a prism? Which one is a pyramid? What is different about a prism and a pyramid? Show me the apex of this pyramid. How many edges can you count on this pyramid? What is the shape of the base of this pyramid? So, what is the name of this pyramid? What is the name of this prism?** Provide the students a cylinder, and ask: **What is the same about this cylinder and this prism? What is different about the cylinder and the prism?** Provide the student with cutouts of a rectangle which is not a square and a square. Tell: **These are both rectangles. Can you tell me what is different about these two rectangles? What do you call a rectangle that has all its 4 sides the same in length? This long rectangle has 2 lines of symmetry. Can you show me the lines of symmetry in it by folding the shape? Now how many lines of symmetry are there in this square? How many pairs of parallel lines are there in a rectangle? Can you show them?**	The student is able to: - Identify prisms and pyramids. - Name prisms and pyramids according to the shape of their bases. - Tell the difference between a prism and a pyramid. - Describe the similarities between a prism and a pyramid. - Count the number of corners and edges in a 3-D shape. - Compare and describe the similarities and difference between a prism and a cylinder. - Recognise a square as a rectangle that has all the 4 sides equal in length. - Tell the difference between a square and a rectangle which is not a square. - Determine the lines of symmetry in a simple shape. - Recognise the pair of parallel lines in a rectangle.

Comments and Marks

Strengths:

Areas of Need:

Follow up Steps:

Teacher's Signature and Date:

Summary of the Summative Assessment for Chapter 6

CA marks from Chapter 6 (Marks out of 10): _____

CHAPTER 7 TWO-DIGIT ADDITION AND SUBTRACTION

Chapter Overview

There are basically two situations where addition is involved. One is called active addition, in which some objects join a set and, as a result, the number of objects in the set is increased, and we determine the total number of objects in the set. The other is called static addition, in which a whole is made up of two or more parts, and we determine the number in each part. The sum is then made up of the various quantities being added together, or collected into one total. Similarly, there are basically two situations where subtraction is involved, active subtraction and static subtraction. In active subtraction, some objects from a set are removed, or separated, or taken away, and as a result, the number of objects in the set is decreased, and we determine how many are left in the set. In the static subtraction, we compare two sets, and determine which set has more items and by how many more. This is based on the idea of a subtraction result representing a difference identified through comparison, unlike the active form which conceptualizes the result as a leftover following a removal process. Yet, another situation where subtraction is involved is in finding a missing addend.

The students have learnt various strategies of addition and subtraction in chapter 2. For the sake of refreshing, the strategies were “Counting Forward and Counting Backward”, “Using Double Facts” and “Facts for 10”, although the numbers used were single digits and teen numbers. The students have learnt to look at and describe two-digit numbers as groups of tens and ones in chapter 4, in which, they also learnt to determine the sums of numbers in adding 10s. Here in chapter 7 the students should be applying and reinforcing previously learned knowledge and skills to add and subtract two-digit numbers. As such, it would be beneficial to invest some time to refresh the students by revisiting addition and subtraction strategies with single digit and teen numbers at the beginning of this chapter.

A thorough understanding of addition and subtraction concepts, with proficiency in adding and subtracting numbers using various strategies, helps the students in gaining a good sense of numbers. Such proficiency and skills with numbers are also useful outside of school, even as adults.

This chapter has 8 lessons as detailed in the Table of Contents.

Basic Principles about Addition and Subtraction

- Addition and subtraction both involve changes in quantity.
- Addition involves combining. The combining can be active, where some objects join other objects, or static where a whole is made of two or more parts.
- Subtraction involves removal or taking-away or separation, comparison, or finding a missing addend.
- An equation is a statement of balance. It simply indicates that the quantity on one side balances, or is an alternate representation for, the quantity on the other side.
- Addition and subtraction are intrinsically related. In any situation involving an addition, there is an equivalent subtraction situation and vice versa.
- There are many strategies that can be effectively used to solve any addition or subtraction problem.
- Using principles of addition and subtraction, strategies used to add 1-digit numbers can be extended to adding and subtracting 2-digit numbers.

Chapter Goals

- Add multiples of ten mentally.
- Use and describe a variety of strategies to add two 2-digit numbers.
- Record addition of 2-digit numbers on a place value table.
- Subtract tens or multiples of ten from a number mentally.
- Use and describe a variety of strategies to subtract a 2-digit number from another 2-digit number.
- Record subtraction of 2-digit numbers on a place value table.

Maths Words

Addition, subtraction, addition sentence, subtraction sentence, plus, minus, add, subtract, sum, difference, equals, strategy

Lesson 1 Adding Tens

Objectives

Add multiples of ten mentally.
Write addition sentences for the addition of multiples of ten.

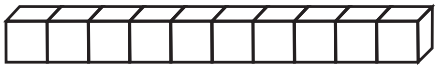
Materials

Base ten blocks
Snap cubes

Have the students recall some of the double facts and facts for 10, by asking questions such as: How much is 5 + 5? 6 + 6? 7 + 7? 8 + 8? 9 + 9? 10 + 10? 6 + 4? 7 + 3? 8 + 2?

Ask: **How many cubes are 2 cubes plus 3 cubes together?** After hearing the responses from the students, write on the board the sentence: 2 cubes + 3 cubes = 5 cubes. **Can you show this addition situation with cubes?** Have a student represent the situation with snap cubes, by putting together a set of 2 cubes with another set of 3 cubes to count 5 cubes altogether.

Show a tens block and a ones block to the students and remind them that they are called tens and ones respectively.

Ten  One 

Ask: **How many tens is 2 tens plus 3 tens?** Represent it by putting together a set of 2 tens and a set of 3 tens to count 5 tens altogether. Then, write on the board the corresponding sentence: 2 tens + 3 tens = 5 tens. Remind students that 2 tens mean 20 and 3 tens mean 30. Write the sentence 20 + 30 = 50 below the above sentence.

Then, ask the students to tell the sums for various combinations of tens. Ask the students also to represent and describe the situations concretely with the tens blocks. Then, ask the students to complete the sentences such as the ones below.

4 tens + 3 tens = ___ tens 40 + 30 = ___	6 tens + 4 tens = ___ tens 60 + 40 = ____
5 tens + 2 tens = ___ tens 50 + 20 = ___	5 tens + 5 tens = ___ tens 50 + 50 = ____
7 tens + 2 tens = ___ tens 70 + 20 = ___	4 tens + 4 tens = ___ tens 40 + 40 = ____

The additions should be done mentally. Students should see that since they know their addition facts, they can mentally figure out how many tens there are and record the appropriate calculation.

Maths Note

This lesson really reviews what students have learned previously in chapter 4. Students need to understand that adding tens is no different from adding any other units. 2 tens + 3 tens = 5 tens just like 2 trucks + 3 trucks = 5 trucks. This is a critical prerequisite to adding 2-digit numbers. It is best to focus on sums that are less than 100, although there might be some situations where the sum is greater than 100.

Students should represent the addition situations with concrete materials before they get into writing the situations symbolically. The design of the lessons assumes the availability of base ten blocks in the schools. However, in the cases where base ten blocks are not available, other proportional models for numbers such as 10 sticks bundled together for tens and loose sticks for ones should be improvised and used for this chapter, as was also suggested in chapter 4 on place values concepts.

Toward the end, ask questions such as:

How is adding 3 + 7 like adding 30 + 70? Why are they related?

How much is 40 + 40? How do you know?

What allows us to add 30 + 50 in our heads?

Assessment for Learning

See that the students can relate the addition facts for 1-digit numbers with the addition of corresponding multiples of ten in finding the sums for the latter.

Extension

Have the students determine the sums of adding multiples of 10 to any one digit or 2-digit number. For example, ask: What is the sum of 24 + 10? Ask the students to represent and describe this situation with base ten blocks. Encourage them to think of 24 as 2 tens and 4 ones. Adding 1 ten to 2 tens and 4 ones make 3 tens and 4 ones. 3 tens and 4 ones is 34. Similarly, ask the students to solve several problems such as those given below.

32 + 10 = _____	40 + 30 = ___
32 + 20 = _____	41 + 30 = ___
32 + 30 + _____	43 + 20 = ___
50 + 30 = _____	77 + 20 = ___
56 + 30 + _____	86 + 10 = ___

Have the students complete the relevant activities in their Student Activity Book.

Lesson 2 Adding 2-digit Numbers

Objectives

Add 2-digit numbers using a variety of strategies.
Explain or describe the strategies used for adding 2-digit numbers.

Materials

Base ten blocks (tens and ones)

Ask the students to find the sum for 34 + 23, and ask them to explain how they added. Encourage them to think of each number in terms of tens and ones. Encourage them to use the base ten blocks to help them add and explain how they added. The students might solve this addition using any of the following strategies, or you might have to model thinking and adding in those ways.

- Adding the tens to get 50 (3 tens and 2 tens is 5 tens) and the ones to get 7 (4 ones and 3 ones is 7 ones); so the sum is 57.

- Adding, first, 20 to 34 to get 54, and, then, 3 to 54 to get 57.

You might ask the students to write the addition sentence 34 + 23 = 57.

Similarly, ask the students to solve two-digit additions which do not require regrouping such as the ones provided below. For each addition, ask the students to explain the strategies they used to determine the sum. **How did you add 28 and 51?** Encourage the students to add in more than one way. How else could you add them?

34 + 25	28 + 51
62 + 24	15 + 44
43 + 35	55 + 44

Extension

Ask the students to add two 2-digit numbers requiring regrouping, for example, 36 + 39. Ask them to explain how they added. Encourage them to use base ten blocks to help them in their addition. The students might add this using any of the following strategies, or you might have to model thinking and adding in those ways.

- Adding the tens to get 60 and the ones to get 15; 60 + 10 is 70 and 5 more is 75 (since 15 is 10 + 5).

- Adding 30 to 36 to get 66, and then adding 9 by adding 10 to get 76 and subtracting 1 to get 75 (since 39 is 30 + 9 and 9 is 10 – 1).

- Adding 36 and 40 to get 76 and then subtracting 1 to get 75 (since 39 is 40 – 1)

You might ask the students to write the addition sentence 36 + 39 = 75.

Maths Note

Students need opportunities to explore a variety of strategies for adding 2-digit numbers before they record the additions symbolically. They should learn to use these strategies mentally and be able to explain them. They might use concrete material to help them with their thinking in the beginning. These strategies would basically involve adding the tens together and the ones together. When the total number of ones becomes ten or more, ten ones are regrouped to make a ten, thus, increasing the number of tens by one. It would be best to expose the students to only the situations which do not require regrouping initially. Perhaps one day is spent on situations involving no regrouping, another day on situations involving regrouping, and another day involving both.

Assessment for Learning

See that the students can describe the numbers in terms of tens and ones, and then explain how they add the numbers.

Similarly, ask the students to solve the following additions, all of which involve regrouping. For each addition, ask the students to explain the strategies they used to determine the sum.

24 + 36	46 + 38
65 + 28	66 + 27

Ask questions like:

How would you represent 24 + 36 with tens and ones blocks?

How did you add 46 and 38? How else could you have added?

How does it help to think of 38 as 40 – 2?

How do you know that 46 + 38 is 2 less than 46 + 40?

Does anyone know the value of 66 + 27 using the fact that 65 + 28 = 93?

Have the student do the relevant activities in their Student Activity Book

Lesson 3 Adding on a 100-Chart

Objectives

Use a 100-chart to efficiently add 2-digit numbers where the sum is less than 100.

Materials

100-chart on a chart paper (This could be the same chart made and used in chapter 4.)

> **Maths Note**
>
> Students associate adding 10 with moving down 1 step on a 100-chart. They associate adding 1 with moving to the right 1 step on a 100-chart. They think of adding a number as separately adding the tens part and then the ones part.

Put up the 100-chart on the wall. Explain to the students that each row in a 100-chart is like a 10, and that the rows are like stacks of tens. Explain, and demonstrate that when you add 10 to a number you go down 1 step below the number. For example, 23 + 10 would involve going down 1 step from 23 to land on 33. This is because there is one more group of 10 and no change in the ones. Similarly, 23 + 20 would involve going down 2 steps, to land on 43, since 20 is 2 tens.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Then, explain and show that to 1 to a number, you go rightward the appropriate number of steps. For example, with 23 + 1, you would go 1 step to the right to land at 24. To add, 23 + 5, you would go 5 steps to the right from 23 to land at 28. Help them notice that if you get to the end of the row (e.g. to 30), adding 1 means going to the first space on the next row (e.g. to 31). To add numbers such as 37 + 21, start at 37, go down 2 and go 1 to the right. Some students will notice that to add, for example 29, they might add 30 by going down 3 steps and back (leftward) 1 to subtract the extra 1 that they added.

> **Assessment for Learning**
>
> See that the students add and describe the procedures of adding two two-digit numbers on the 100-chart.

Ask a student to come to the front to solve an addition problem (e.g. 52 + 34) using the chart. Ask the other students to observe and confirm it. Repeat the process with some more students.

Toward the end, ask questions such as:

How could you add 47 to 35? Where would you start? What would you do? Why do you go down 3 steps to add 30?
Could you add 47 + 35 by starting at 35?
In what row is the answer to 23 + 52? Why?

Extension

Integrate some mental mathematics by stating a starting number on the chart and then giving instructions as to the steps needed to get a result. Determine the final number. Then state or write the corresponding addition sentence. (For example, suppose we start at 31. The instructions are to move down 3 steps and go right 4 steps. What is the resulting number? The answer is 65. The addition sentence would be 31 + 34 = 65.)

Have the students do the relevant activities in their Student Activity Book.

Lesson 4 Recording 2-digit Addition

Objectives

Add 2-digit numbers symbolically in more than on way.
Explain or describe the steps involved in the additions.

Materials

Base ten blocks – tens and ones (If required for some students)

Explain the addition of (e.g. 36 + 24) in the following way.

36 + 24 = (30 + 20) + (6 + 4) = 50 + 10 = 60 (Separating the numbers into tens and ones, and adding the tens together and the ones together.)
Also, explain that they could record the same addition in the following way:

$$\begin{array}{r} 36 \\ +\ 24 \\ \hline 50 \\ +\ 10 \\ \hline 60 \end{array}$$

Ask the students to solve a few addition problems, such as those provided below, using both the ways.

46 + 34 = ___ + ___ = ___	46 +34 ____
46 + 36 = ___ + ___ = ___	46 +36 ____

Provide a few more similar problems. Ask the students to explain how each step in their addition process makes sense to them.

Extension

The students have used place value charts to represent 2-digit numbers in chapter 4. Explain that they could use place value charts to add numbers meaningfully. For example, for the addition of 36 + 24, they place the number in the place value chart, and add the tens and the ones separately. If the number of ones is 10 or more, then, they are regrouped appropriately.

Tens	Ones
3 + 2	6 4
5	10
6	0

Maths Note

In the previous lessons, students learnt to determine the sums for various additions using a variety of strategies. Other than writing the addition sentences, they did not use any step by step algorithm symbolically.

The steps involved in recording the addition symbolically should make sense to the students at each stage. There is more than one way to do this. Students should be exposed to all these.

The traditional algorithm of addition, for example, arranging the numbers in columns, and then, adding the ones first, with or without regrouping, followed by adding the tens is not introduced. Instead, the students will add the tens and the ones separately, with the addition of the tens taking place before the addition of ones. In this way, if it involves regrouping, it is clear to the students. It is important to continue to describe numbers in terms of tens and ones.

Assessment for Learning

See that the students can explain the addition of tens and ones separately in their additions.

Draw a few place value charts on the board, and ask some students to come to the front and solve similar addition problems, such as the ones provided below. While a student solves on the board, ask others to observe and confirm the steps.

Tens	Ones
4 + 3	6 4

Tens	Ones
4 + 3	6 6

Tens	Ones
6 + 2	5 8

Have the students complete the relevant activities in their Student Activity Book.

Lesson 5 Subtracting Tens

Objectives

Subtract multiples of ten mentally.
Write the subtraction sentences for the subtractions of multiples of ten.

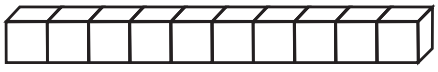
Materials

Base ten blocks
Snap cubes
Ten-frames and counters

Have the students recall some of the subtraction facts related to double facts and facts for 10, by asking questions such as: **What is 10 – 5? 12 – 6? 8 – 4? 14 – 7? 10 – 8? 10 – 6?** Encourage the students to explain how they obtain the differences for these subtractions. You might need to use counters or ten-frames and counters to show the subtraction facts for the benefit of those who might still need to see concretely and visually these subtraction facts.

Ask: **How many cubes are 5 cubes minus 3 cubes?** You might explain this by showing 5 cubes and then removing or taking away 3 cubes. After hearing the responses from the students, write on the board the sentence:
5 cubes – 3 cubes = 2 cubes.

Show tens blocks and ones blocks to the students and remind them that they are called tens and ones respectively.

Ten  One 

Ask: **How many tens is 5 tens minus 3 tens?** Distribute tens and ones blocks to the students in groups, and have them represent this situation. The students might show this in more than one way. For example, they might show it by first putting together a set of 5 tens and then removing 3 tens from the set to show 2 tens left. They might also show a set of 5 cubes and another set of 3 cubes, and compare them. Encourage them to model the situation using both of these methods for this subtraction problem.

Then write the situation as a subtraction sentence on the board:
5 tens – 3 tens = 2 tens. Remind the students that 5 tens means 50 and 3 tens means 30 and 2 tens means 20, and write the number sentence below the above sentence as:

5 tens – 3 tens = 2 tens
50 – 30 = 20

Then, ask the students to tell the differences for various subtractions of tens. Ask the students also to represent and describe the situations concretely with the tens blocks. Then, ask the students to complete the sentences such as the ones below.

Maths Note

Students need to understand that subtracting tens is no different from subtracting any other units. 5 tens – 3 tens = 2 tens just like 5 trucks – 3 trucks = 2 trucks. This is a critical prerequisite to subtracting 2-digit numbers.

Students should work on this outcome at concrete, pictorial and symbolic levels. At the concrete level, students work with base ten blocks (or other materials that represent tens such as ten sticks bundled together). At a pictorial level, they will draw pictures or interpret the subtraction situations represented by pictures. Symbolically, they will write both 7 tens – 3 tens = 4 tens and 70 – 30 = 40.

The subtraction should be done mentally. Students should see that since they know their addition and subtraction facts, they can mentally figure out how many tens there are and record the appropriate calculation.

4 tens – 3 tens = ___ tens 40 – 30 = ___	6 tens – 4 tens = ___ tens 60 – 40 = _____
5 tens – 2 tens = ___ tens 50 – 20 = ___	5 tens – 5 tens = ___ tens 50 – 50 = _____
7 tens – 2 tens = ___ tens 70 – 20 = ___	4 tens + 4 tens = ___ tens 40 + 40 = _____

The students should use their knowledge of subtraction facts to carry out these subtractions of tens mentally. However, some students might still need to carry out these subtractions with the help of concrete materials, which should be encouraged.

Toward the end, ask questions such as:

How is subtracting 7 – 5 like subtracting 70 – 50? Why are they related?

How much is 90 – 30? How do you know?

Why is it easy to subtract 60 – 20 in your head?

Assessment for Learning

See that the students can relate the addition facts for single digit numbers with the addition of corresponding multiples of ten in finding the sums for the later.

Extension

Have the students determine the differences of subtracting multiples of 10 from any 2-digit number. For example, ask: **What is the difference of 24 – 10?** Ask the students to represent and describe this situation with base ten blocks. Encourage them to think of 24 as 2 tens and 4 ones. Subtracting 1 ten from 2 tens and 4 ones leaves only 1 ten and 4 ones. 1 ten and 4 ones is 14. Similarly, ask the students to solve several such problems such as those given below.

32 – 10 = _____	40 – 30 = ___
32 – 20 = _____	41 – 30 = ___
32 – 20 = _____	43 – 20 = ___
50 – 30 = _____	77 – 20 = ___
56 – 30 = _____	86 – 10 = ___

Have the students complete the relevant activities in their Student Activity Book.

Lesson 6 Subtracting 2-digit Numbers

Objectives

Subtract 2-digit numbers using a variety of strategies.
Explain or describe the strategies used for the subtraction of 2-digit numbers.

Materials

Base ten blocks - tens and ones

Ask the students to find the difference for 34 – 23, and ask the students to explain how they subtracted. Encourage them to think of each number in terms of tens and ones. Encourage them to use the base ten blocks to help them subtract and explain how they subtracted. The students might subtract this using any of the following strategies, or you might have to model thinking and subtracting in those ways.

- Subtracting the tens and ones separately (taking away 2 tens from 3 tens to give 1 ten, and taking away 3 ones from 4 ones to give 1 one); the difference is 1 ten and 1 one = 11. (With base ten blocks, this difference can be found by removing what is common to 23 and 34.)

- Counting back 4 from 34 to 30 and then counting back a further 7 from 30 to 23; so a total of 11 steps of counting back from 34 to 23. The difference is 11.

- Counting on, or adding 7 to 23 to get to 30, and then adding on a further 4 from 30 to 34 to give a total of 11 to get to 34 from 23. So, the difference is 11.

- Thinking of 23 as 20, and taking away 20 from 34 to get 14; then taking away 3 for 23 to 20 gives a final difference of 11.

You might ask the students to write the addition sentence 34 – 23 = 11.

Similarly, ask the students to solve 2-digit subtractions which do not require regrouping such as the ones provided below. For each subtraction, ask the students to explain the strategies they used to determine the difference. **How did you subtract 27 from 49? Encourage the students to subtract in more than one way. How else could you subtract 27 from 49?**

Extension

Ask the students to subtract 2-digit numbers requiring regrouping, for example, 52 – 28. Ask them to explain how they subtracted. Encourage them to use base ten blocks to help them in their subtraction. The students might subtract this using any of the following strategies, or you might have to model thinking and subtracting in those ways.

Maths Note

Students need opportunities to explore a variety of strategies for subtracting 2-digit numbers before they record the subtractions symbolically. They should learn to use these strategies mentally and be able to explain them. They might use concrete materials to help them with their thinking initially. They might calculate a difference by taking away, by comparing the two values or by figuring out what to add to one number to get to the other.

These strategies would basically involve removing, or taking away, the tens and the ones of the smaller number from the tens and ones of the greater number. When there are not enough ones to take away, or remove, from the ones of the greater number, it would involve regrouping (or decomposing) one of its tens into 10 ones. It would be best to expose the students to only the situations which do not require regrouping initially. Perhaps one day is spent on situations involving no regrouping, another day on situations involving regrouping, and another day involving both. In any case, students should be provided with adequate time and practice to subtract one 2-digit number from another.

- Subtracting 2 tens from 5 tens to get 3 tens, and then realizing that they cannot take away 8 ones from 2 ones. This would necessitate regrouping or changing one of the tens from 52 to 10 ones to see 52 as 4 tens and 12 ones. Now, they can take away 2 tens from 4 tens to get 2 tens, and take away 8 ones from 12 ones to get 4 ones. 2 tens and 4 ones is 24. The use of base ten blocks to represent the subtraction concretely would be especially useful in such a case.

- Counting back 2 from 52 to get to 50, and then counting back 10 and 10 more to get to 30 from 50, and a further counting back of 2 to get to 28; so a total of 24 steps of counting back from 52 to 28 to give the difference of 24.

- Counting on, or adding 2 to 28 to get to 30, and then adding on further amounts of 10, 10 and 2 to get from 30 to 54 and give a total of 24 to get to 52 from 28. The difference is 24.

- Thinking of 28 as 30, and taking away 30 from 52 to get 22. Then, adding back 2 (because an excess of 2 was taken earlier by taking away 30 instead of 28), to get a difference of 24.

- Using base ten blocks, 5 tens and 2 ones can be placed down close together to represent 52. Then the 2 tens and 8 ones for 28 can be placed on top of the representation of 52. The uncovered blocks can be counted. This will be the difference of 24.

Assessment for Learning

SSee that the students can carry out the subtraction using at least one strategy, which they can also explain.

You might ask the students to write the addition sentence 52 – 28 = 24.

Similarly, ask the students to solve the following subtractions, all of which involve regrouping, using their own strategies. For each subtraction, ask the students to explain the strategies they used to determine the difference.

41 – 23	57 – 28
51 – 17	62 – 25

Ask questions like:

How would you represent 41 – 23 with base ten blocks?
How did you subtract 41 – 23?
How could it help to think of 28 as 30 – 2 to calculate 57 – 28?
How do you know that 51 – 17 is 3 more than 51 – 20?

Have the student do the relevant activities in their Student Activity Book.

Lesson 7 Recording 2-digit Subtraction

Objectives

Subtract 2-digit numbers symbolically in more than one way.
Explain or describe the steps involved in the subtractions.

Materials

Base ten blocks – tens and ones

Explain subtraction where regrouping is not involved, (for e.g. 36 – 24), in the following way.

36 – 24 = (30 – 20) + (6 – 4) = 10 + 2 = 12 (Subtracting the tens and the ones separately; explain that there are enough of both the tens and the ones to take away from.)

Also, explain that they could record the same subtraction in the following way:

$$\begin{array}{r} 36 \\ -\,24 \\ \hline 10 \\ +\;\;2 \\ \hline 12 \end{array}$$

Ask the students to solve a few similar subtraction problems, where regrouping is not involved, such as the ones provided below, using both these ways.

47 – 23 = (___ – ___) + (___ – ___) = ____	$\begin{array}{r} 47 \\ -\,23 \\ \hline \end{array}$
58 – 25 = (___ – ___) + (___ – ___) = ____	$\begin{array}{r} 58 \\ -25 \\ \hline \end{array}$

Provide a few more similar problems. Ask the students to explain how each step in their subtraction process makes sense to them.

Extension

Explain to the students that they could subtract 2-digit numbers on place value tables. The use of place value tables makes it clear to see the numbers as tens and ones, and also makes it clear to subtract the tens and ones separately. It is helpful to demonstrate this with the same subtraction problems used earlier in the lesson. For example, 36 – 24 would be done as:

Tens	Ones
3 – 2	6 4
1	2

Maths Note

In the previous lessons, students learnt to determine the differences for various subtractions using a variety of strategies. In all those, other than writing the horizontal subtraction sentences, they did not use any step by step algorithm symbolically.

The steps involved in recording the subtraction symbolically should make sense to the students at each stage. There is more than one way to do this. Students should be exposed to many such ways.

The traditional algorithm of subtraction, for example, arranging the numbers in columns, and then, subtracting the ones first, with or without regrouping, followed by subtracting the tens is not introduced. Instead, the students will subtract the tens and the ones separately.

In this lesson, the students will first focus on subtraction situations in which there is no regrouping. They will then extend recording subtractions which involve regrouping.

Similarly, ask the students to solve the following subtractions. You might ask the students to come forth and solve these on the board.

Tens	Ones
4	7
– 2	3

Tens	Ones
5	8
– 3	5

Assessment for Learning

Have the students explain the steps in the subtraction process.

Then, provide a problem which involves regrouping (e.g., 53 – 28). Put the numbers in a place value table.

Tens	Ones
5	3
– 2	8

Tens	Ones
4 ~~5~~ →	10 + 3
– 2	8
2	5

Ask the students if there are enough ones in 53 so that they can take away 8 ones. Make them realize that, as it is, they need to take away 8 ones, but there are only 3 ones at the moment. Ask for suggestions to solve this problem. Explain that this can be solved by regrouping or changing one of the tens in 53 to 10 ones. Hence, 53 is regrouped as 4 tens and 13 ones. Now they can proceed with the subtraction.

Ask the students to solve a few problems involving regrouping, such as those provided below.

Tens	Ones
6	2
– 2	9

Tens	Ones
7	3
– 1	8

Tens	Ones
8	2
– 3	6

Have the students complete the relevant activities in their Student Activity Book.

Lesson 8 Adding and Subtracting with Money

Objectives

Apply knowledge and skills of adding and subtracting 2-digit numbers to solving problems involving money.

Materials

A packet of crayons
A notebook

Tell the students that you will tell them a story, and that they will have to figure out whether to add or subtract for a question at the end. Tell a story, for example: **I bought a notebook and a packet of crayons from a shop last time.** Show a notebook and a packet of crayons to the students. **The cost of the notebook was Nu 36 and the cost of the packet of crayons was Nu 25.** You could draw the pictures of the items and their costs on the board. Ask the students: **How many ngultrums did I pay altogether for the notebook and the crayon? Should you subtract or add these two numbers? Why? How will you add 36 and 25?**

Let the students add the two numbers in their own ways. As they work on it, go around and ask questions like: **How did you add 36 with 25? What is the sum of 36 and 25? So, how many ngultrums did I pay altogether for these things?** Encourage the students to share and tell each other how they added the two numbers. Encourage the students to add using a variety of strategies as discussed in the preceding lessons including using place value tables.

Then, ask the students: **How many more ngultrums did the notebook cost than the crayons? Should you add or subtract the numbers? How will you subtract 25 from 36?** Repeat the process as in the case with the addition above.

Extension

Have the students complete the relevant activities in their Student Activity Books.

Maths Note

There is no new mathematics that students will learn in this lesson, but they will apply what they have learned about adding and subtracting 2-digit numbers in everyday situations involving money.

Students should first understand a problem or situation, and then choose to add or subtract appropriately the numbers involved in the problems.

Assessment for Learning

See that the students can add (36 + 25) and subtract (36 – 25) using a variety of strategies, and explain the addition and subtraction processes.

Chapter Assessment

Formative Assessment

Formative assessment ideas, tips and reminders are provided within each lesson under the heading called Assessment for Learning. In addition, you should use a formative assessment tool called the Chapter Checklist. Prepare the Formative Assessment Recording Sheet for the chapter as shown below. You should look for evidence in each student, throughout the teaching of the chapter, that he or she has understood the key concepts and can perform the key mathematical skills by ways of observing, listening and asking probing questions. Accordingly, keep the records for each student by putting a mark, such as a tick mark, for each of the chapter goals once you are convinced that the student has achieved them. You could also keep relevant anecdotal records.

Using the Chapter Checklist purposefully will give you the benefit of ensuring that each student's learning progress is assessed in a systematic manner. What is even more important is the opportunity it will provide you to help each student along in achieving the chapter goals. Since this is meant as a formative assessment tool, you will not be giving any mark to the students by using it. However, investing time in carrying out this assessment technique will contribute positively in the students being able to do well in the summative assessments, including the examinations. You can also refer back to these records as you look for progress during the year and/or seek to address areas of concern.

Formative Assessment Recording Sheet
CHAPTER 7 TWO-DIGIT ADDITION AND SUBTRACTION

Chapter Checklist (Look for evidence throughout the chapter that the student has understood the key concepts and can perform the key skills.)

Student Name		Chapter Goals (The student is able to):					
		Add multiples of 10 mentally.	Use and describe a variety of strategies to add 2-digit numbers.	Record addition of 2-digit numbers on a place value table.	Subtract tens or multiples of 10 from a number mentally.	Use and describe 2-digit subtractions using a variety of strategies.	Record 2-digit subtractions on place value tables
1							
2							
3							
4							
5							
6							
7							
8							

Summative Assessment

As explained in the Introduction to the Teacher's Guide, the student's learning in each chapter will be measured primarily through the use of an assessment method called the Interview-based Performance Task. The primary purpose of this assessment is to thoroughly assess the level of understanding of the students in terms of the key concepts and skills as required in the chapter. It provides an opportunity for the students to display their understanding by ways of telling, describing, showing, and demonstrating in a non-threatening environment.

One of the beauties of this assessment method is that it allows you to teach and clarify things even as you are assessing the students. The fact that you have to provide marks to the students through the use of Interview-based Performance Tasks should be considered a secondary purpose. The Summative Assessment Recording Sheet (shown on the next page) is included in the Student Activity Book for your use with each student. Please refer to the Introduction to the Guide for the details on the marking scheme.

Summative Assessment Recording Sheet

Student Name: _____ Roll no.: ____ Section: ____

CHAPTER 7 TWO-DIGIT ADDITION AND SUBTRACTION

Interview-based Performance Task (Please refer to the Introduction to the Teacher's Guide for Class 2 for the marking scheme while using the Interview-based Performance Task.)

Task and Interview prompts	Key concepts and skills to look for
Ask the students: **What is the sum of 50 and 20? How did you add 50 + 20? Can you write the addition sentence for 50 + 20 including their sum?** **How much more is 50 than 20? How do you know the difference? Write the subtraction sentence for 50 – 20 including their difference.** Provide the student with a 2-digit addition on a place value table to solve, such as the one shown here. Ask related questions. Tens | Ones 6 | 5 + 2 | 8 | Ask the student to solve a 2-digit subtraction on a place value table, such as the one provided here. Ask related questions. Tens | Ones 6 | 5 – 2 | 8 |	The student is able to: - Add multiples of 10 mentally. - Describe the strategy used in adding 2-digit numbers. - Subtract multiples of 10 mentally. - Explain the strategy used in subtracting multiples of 10. - Add 2-digit numbers with regrouping on a place value table. - Subtract 2-digit numbers with regrouping on a place value table.

Comments and Marks

Strengths:

Areas of Need:

Follow up Steps:

Teacher's Signature and Date:

Summary of the Summative Assessment for Chapter 7

CA marks from Chapter 7 (Marks out of 10): _____

CHAPTER 8 NUMBERS GREATER THAN 100

Chapter Overview

This chapter introduces students to 3-digit numbers greater than 100. They have already been exposed to 100, which is the least 3-digit number, as an extension of the 2-digit numbers they have dealt with so far. The main intention of the chapter is for the students to gain a good sense of these numbers, as was the case with the numbers that the students dealt with so far.

This intention can be achieved through the employment of a combination of various means and strategies. The use of a 100-chart to introduce the numbers beyond 100 has the benefit of showing to the students the pattern in the number system, as a repetition of groups of 10, besides allowing them to compare the numbers (for e.g., numbers further down the chart are greater than those up in the chart). The use of number lines is also helpful in comparing the numbers. The use of proportional models, such as the base ten blocks, to represent the 3-digit numbers provides the students with a sense of what the numbers represent and the sizes of the numbers. This sense of the size of numbers will also be enhanced by using 3-digit numbers to represent real life situations (for e.g., relating a 3-digit number, say 230, as the total number of students in the school).

It is important for the students to gain the flexibility of representing 3-digit numbers with base ten blocks in a variety of ways. For example, 325 can be represented with 3 hundred blocks, 2 ten blocks and 5 one blocks, or with 32 ten blocks and 5 one blocks, or with 325 one blocks. Correspondingly, the students should be able to describe a 3-digit number in more than one way. For example, 325 should be seen as 3 hundreds 2 tens and 5 ones, or 32 tens and 5 ones, or 325 ones. The students should begin to realize that a digit in a number indicates a value according to the place or position it occupies in the number. For example, the digit 3 in 325 tells 3 hundreds or 300 (it also tells 30 tens), the digit 2 tell 2 tens, and the digit 5 tells 5 ones.
This chapter has 7 lessons as detailed in the Table of Contents.

Basic Principles about Numbers

- Students need opportunities to recognize and create many different types of number representations. Different representations highlight different number relationships.
- We write numbers using a place-value system not only to be efficient (we need only 10 symbols to represent all whole numbers), but also to provide benchmarks against which to compare numbers to (e.g., a 2-digit number is more than 9 but less than 100).
- Tools such as 10-frames, number lines, and 100-charts help us highlight patterns in the number sequence and compare numbers to familiar benchmarks.
- Relating numbers to benchmarks like the tens (10, 20, …, 100) and hundreds (100, 200, 300,….) helps us interpret and compare them, and supports subsequent work in addition and subtraction.

Chapter Goals

- Represent 3-digit numbers with base ten blocks in a variety of ways.
- Describe a 3-digit number as groups of hundred, tens, and ones.
- Describe a 3-digit number as groups of tens and ones.
- Count numbers up to 900 by 100s, 25, and 10s.
- Write 3-digit numbers in numerals and words.
- Compare 2-digit and 3-digit numbers.

Maths Words

Tens, ones, hundreds, base ten blocks, more than, greater than, less than, digits, skip counting, 100-chart

Lesson 1 Introducing Numbers Beyond 100

Objectives

Say and write the numbers from 101 to 200.

Materials

100-chart, as shown here
Student Activity Books

> **Maths Note**
>
> Students have met the numbers from 1 to 100. It makes sense to introduce the numbers beyond 100 by appealing to what they would expect. They have learned that 100 is ten 10s, so it makes sense that 1 more than that is one hundred one. The pattern can be built up by extending the 100-chart. It only makes sense that below 91 is 101, below 92 is 102, etc. The only thing that needs to be done is to point out the patterns and help students read the numbers.

Prepare a chart as shown here in advance. Present it and ask the students to think about what numbers they might put in the row below the 9th row. They are likely to suggest 101 below 91 since all the numbers in that column end in 1 and the other digit goes up by 1. You will need to help them read the number as one hundred one and assure them that it is 1 more than 100. Similarly, the numbers 102 through 110 should be introduced. 110 might be difficult for the students initially, especially how to read it as one hundred ten, but, again, it follows the pattern in the right hand column. Be careful to read the number as one hundred ten and not one hundred and ten. Reinforce that this number is 10 more than 100.

Ask the students to open their Activity Book on the page which has this chart.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104						

Allow them to fill in the numbers from 101 to 200. As they work on it, go around to assess how the students are doing and to provide help . For example:

- if a student is writing the numbers consecutively, and is at 138, you might ask can ask what number comes next and why.

- Or you might ask a student what number will appear in a particular blank square. Maybe the square that should have 148. Or the one that should have 142. When the student says what the number should be, you can ask for the student's reasoning.

- Or instead you could ask the student where the number 143 would go, or where 148 would go?

As all the students are about to complete their writing, fill up the chart with the numbers yourself.

Have the students chant in unison the numbers from 101 to 200 by looking at the big chart in the class.

Toward the end, ask questions such as:

What number is below 94? Why?
What number is below 152? Why?
How do you read this number (point to 147 when saying this**)?**

Assessment for Learning

See that the students can write the numbers properly, and can describe the numbers to answer the questions as suggested above.

Extension

Review with the students writing number words for numbers to 100. Then, ask them to write the same for the numbers greater than 100 in their notebooks. You might have to have the students practise these over the next several days.

Numerals	Number words
100	one hundred
101	one hundred one
102	one hundred two
103	one hundred three
104	one hundred four
105	one hundred five
106	one hundred six
107	one hundred seven
108	one hundred eight
109	one hundred nine
110	one hundred ten
111	one hundred eleven

Have, and help the students complete the related activities in their Student Activity Books.

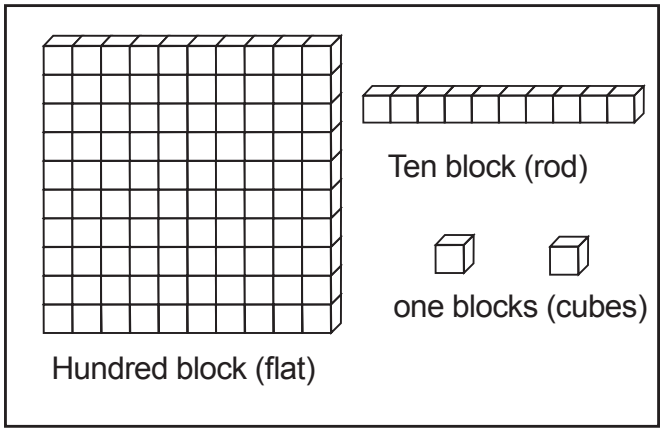
Lesson 2 Representing Numbers Greater than 100

Objectives

Use concrete materials to represent numbers greater than 100.

Materials

Base ten blocks (hundreds, tens, ones)



Maths Note

Because students know that 100 is 10 tens, they can build from that idea to represent numbers greater than 100. It is best to introduce a new concrete representation for 100. The base ten block for hundred is used in these lessons, along with other base ten blocks. And even if the base-10 blocks are available, it can be good to use these other proportional models such as a bundle of ten bundles of ten sticks for hundred, a bundle of ten sticks for ten, and loose sticks for ones.

Distribute enough of tens and ones blocks to the students in groups. Ask them to represent a few 2-digit numbers (e.g. 13, 27, 50 and 84) with them. See that they display the ten blocks on the left and the one blocks on the right, in the order that digits in the numbers are written.

Ask the students to show 100 with tens blocks. **How many rods (or tens) did you use to show 100? Why?** Ask the students to align the 10 rods so that they form a square. Introduce a hundred block, and tell that it is called a hundred (or flat informally) and that it is the same as 10 ten blocks.

Distribute the hundred blocks to the students. Ask the students to show 234 with the base ten blocks. See that the students display the hundred blocks, ten blocks and one blocks in the order from left to right in the manner the digits are written in numbers. Ask the students to show the models for a variety of 3-digit numbers, one after another, such as the ones provided here, by writing the numbers on the board: 372, 426, 515, 406, 601, 600, and 700.

Toward the end, ask questions such as:

How are the models for 203 and 303 alike? How are they different? You might want the students to model both these numbers, and have them compare them.

What is different about the two 3s in the number 303 when you model the number? You might have to write the number 303 on the board to refer to and talk about the 3s. **How many tens are there in 303?**

Give an example of a number that has 4 hundred blocks in its model. (Ask each student can answer the question, and you could write the numbers on the board, perhaps asking the student to say how

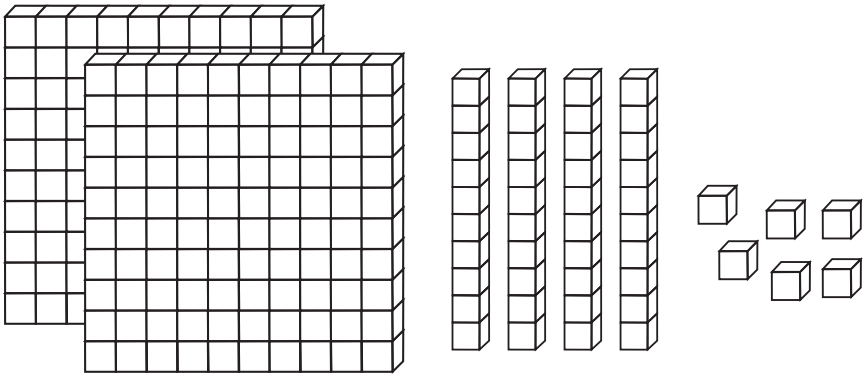
Assessment for Learning

See that the students can represent or model the 3-digit numbers with the base ten models correctly.

it should be written. Then ask the students: **What do you notice about all these numbers? Would that be true for all numbers that have 4 hundred blocks in their model?**

Extension

Present the model for a 3-digit number and ask the students to tell the number.



For example, show a model as shown below, and ask: **What number does this model show?** After the students tell the number, ask a student to come in the front and write the number on the board.

Repeat the process with models for several 3-digit numbers. Include the models for numbers with no tens and no ones. For example, represent the models for number like 302,109 and 500.

Ask the students to think of numbers which are more than 100, or provide such numbers, which are related to real life situations. Have the students then model these numbers. For example, you might ask or tell the number of students in the school, the number of people in the community, the number of days in a year, the amount of money you have in your purse, if they are all more than 100 but less than 1000.

Have, and help, the students complete the relevant activities in their Student Activity Book.

Lesson 3 Describing 3-digit Numbers as Hundreds, Tens and Ones

Objectives

Describe 3-digit numbers as groups of hundreds, tens and ones.

Materials

Base ten blocks

> **Maths Note**
>
> In this lesson, the students learn to describe and write how they describe a number in terms of groups of hundreds, tens and ones.

Write a 3-digit number on the board, and ask the students to read it aloud. For example, write the 526 on the board and ask: **What number is this? How many hundreds are there in this number? How many tens are there? How many ones are there?** Tell the students that they could write what they said about the groups of hundred, tens and ones in the number as:
526 = 5 hundreds 2 tens 6 ones

Repeat the process with some more numbers such as 532, 678, 914, 308 and 204. You might need to model the numbers with base ten blocks for some students to see the groupings in terms of hundreds, tens and ones clearly.

Have the students write the equations in their notebooks.

Write some numbers in terms of their groupings in hundreds, tens and ones, and ask the students to write the numbers. For example, write and read a number as provided below, and ask the student to write the numbers by also writing an equals sign at the end.

4 hundreds 6 tens 7 ones = _____
4 hundreds 0 tens 7 ones = _____
7 hundreds 7 tens 7 ones = _____
8 hundreds 8 tens 0 ones = _____

Then, write the following open sentences on the board, and ask the students to fill in the blanks. Ask the students to tell why they filled up the blanks as they did.

___ hundreds ___ tens ___ ones = 904
5 hundreds ___ tens 1 one = ___ 6 ___
0 hundreds 2 tens 8 ones = _____
7 hundreds 0 tens 0 ones = ____

> **Assessment for Learning**
>
> See that the students can describe a number in terms of hundreds, tens and ones verbally as well as writing them down.

Extension

Have the students do the relevant activities in their Student Activity Books

Lesson 4 Counting by 10s

Objectives

Skip count the numbers by 10s beyond 100.
Describe 3-digit numbers in groups of tens and ones.

Materials

The extended 100-chart made during Lesson 1
Base ten blocks

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130
131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190
191	192	193	194	195	196	197	198	199	200

Maths Note

Students learn to count by 10s by continuing to build on the patterns they noticed earlier. For example, after 100 comes 110, 120, 130, … as evidenced on the extended 100-chart. They also need to learn that 110 is 10 more than 100, 120 is 10 more than 110, etc. The skip counting should start only from the multiples of 10.

The students should also think of a number of the form [ ]0 as [ ] tens, no matter whether the number in the [ ] is one digit or two digits. For example, 320 is 32 tens. This can be modelled by trading 10 tens at a time for 100. There would be 32 tens.

Draw the students' attention to the numbers in the last column of the extended 100-chart, and have them say the numbers 10, 20, 30, …. 90, 100, 110, 120, … 190, 200 as you point to these numbers one by one.

Then, have them skip count by 10s starting at any multiple of 10. For example, you could begin: 50, 60, 70,… and ask the students to continue. Similarly, you could begin 170, 180, 190,… and the students should know that 200 comes next. Initially, you might refer to the chart for the numbers, but later, the students should be able to say the numbers without any visual reference.

Model and ask the students to say the multiples of 10 in terms of groups of tens. For example, referring to the numbers 10, 20, 30, …90, 100, 110, 120, … say 1 ten, 2 tens, 3 tens, … 9 tens, 10 tens, 11 tens, 12 tens, 13 tens, ….19 tens, 20 tens, 21 tens, ….etc. Make sure the students realize that every group of 10 tens is another 100.

Write a 3-digit multiple of 10 on the board, say 140, and ask the students: **What is this number? Can you say this number in terms of how many groups of hundreds, tens, and ones?** Model this with base ten blocks, using 1 hundred block and 4 ten blocks. Then, keeping this model, make an alternative model for 140 using 14 ten blocks. Explain how both the models show 140. Now describe this number in terms of groups of tens and ones. The intention of this activity is to have the students see and describe 140 both as 1 hundred 4 tens 0 ones and 14 tens and 0 ones. You could then write the following on the board:

140 = 1 hundred 4 tens 0 ones
140 = 14 tens 0 ones

Ask the students: **Why is 1 hundred 4 tens the same as 14 tens?**

Distribute the base ten blocks to the students in groups. Ask them to represent and describe some 3-digit numbers in terms of both the hundreds, tens and ones and in terms of only tens and ones. The numbers could be the same as these: 150, 170, 235, and 206. Ask the students to also write two equations for each of these numbers as shown above for 140.

Extension

Have the students complete the relevant activities in their Student Activity Book.

Assessment for Learning

See that the students can skip count by 10s starting at any multiple of 10. Also, see that they can describe a 3-digit number in terms of groups of hundreds, tens and ones as well as in terms of only groups of tens and ones.

Lesson 5 Counting by 100s and 25s

Objectives

Count numbers from to 900 in 100s and 25s.
Notice the pattern in numbers when counting by 100s or 25s.

Materials

None

Write the numbers from 100 to 900 on the board in sequence, as:

100 200 300 400 500 600 700 800 900

Have the students chant: **one hundred, two hundred, three hundred, … nine hundred,** as you initially point to the numbers written on the board. Tell that they are skip-counting the numbers by 100s. They should understand that each time there is one more hundred. Provide the students practice until they can comfortably say the skip-counting by 100s. Then, present the pattern below:

25 50 75 100 125 150 175 200

Ask the students what they notice about the numbers. Ask the students to say the numbers as you point to each of them in the above sequence. Explain that this is skip-counting by 25s, they only say every twenty-fifth number. Ask the students to predict what will come next. Help them see that they will always say … twenty five, … fifty, …. seventy five,… hundred, but that what will change are the words before they say these words. Then, challenge the students to continue the pattern by verbally skip-counting the numbers beyond 200 to as far as they could go but to stop at 900.

Provide some more practice to the students for skip-counting by 100s and 25s. Toward the end, ask questions such as:

What comes next: 300, 400, 500,…?
What comes next: 175, 200, 225, 250,….?
How many numbers will you say when you count by 25s to 225?

Extension

Have, and help, the students complete the relevant activities in their Student Activity Books.

Maths Note

The students know the sequence of numbers beyond 100. They should learn to skip count the numbers by 100s and 25s. They should use the patterns they have learned to help them count by 100s first and then 25s. They should only be starting from a multiple of 100 or 25, respectively.

Assessment for Learning

See that the students can skip-count by 100s and 25, and also describe the patterns they notice in the numbers while skip-counting by these two numbers.

Lesson 6 Placing Numbers Beyond 100 on a Number Line

Objectives

Place numbers appropriately on a number line that is marked in 100s or 10s.

Materials

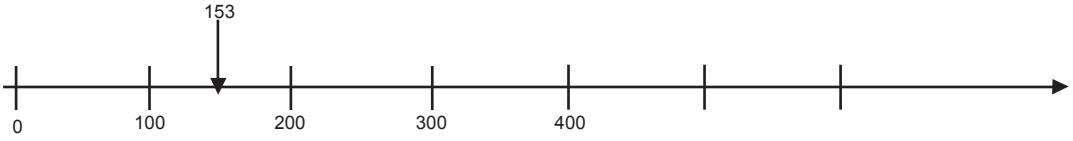
Two number lines on chart paper – one marked in 100s and the other in 10s
Marker pens

Maths Note

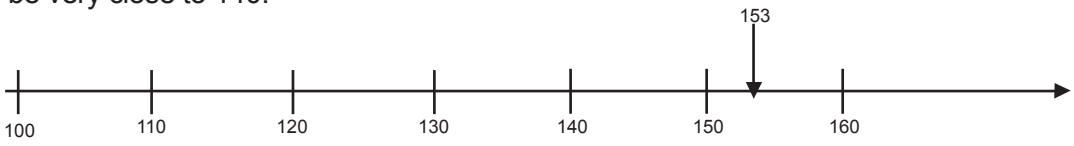
Students relate 3-digit numbers to known 100s or 10s in order to place them on the number line. For example, they would realize that 153 is about half way between 100 and 200 or between 150 and 160 to place it on number lines.

Put up the number line marked in 100s. Tell the students that it is a number line marked in 100s. Ask them where the number 153 will be on the number line. Ask a student to come to the front and show or point to the place where it should be, and ask why it should be there. After everyone realizes that 153 should be somewhere in the middle of 100 and 200, write it and indicate the place with an arrow head line, as shown below. Similarly, repeat the process with other numbers such as 210, 390, 99, 600, etc.

Make sure that the students are able to point at a reasonable location for each number before writing and indicating with marker pens.



Put up the number line marked in 10s. Repeat the process of asking the students where a number would be on the number lines and marking it. The students should be able to explain why a number should be at the point they indicate. For example, 141 should be between 140 and 150, and that it should be very close to 140.



Then, discuss with the students which 153 is closer to – 150 or 160. **Is it really close to 150 or quite close?** Always ask the students how they know when they respond.

Assessment for Learning

See that the students can explain why a number should be at a particular point on the number line.

Toward the end ask questions such as:

> **Why does 412 go between 400 and 500? Should it be closer to 400 or closer to 500? Why?**
> **Why does 374 go between 370 and 380?**

Extension

Have the students do the relevant activities in their Student Activity Books.

Lesson 7 Comparing 2-digit and 3-digit Numbers

Objectives

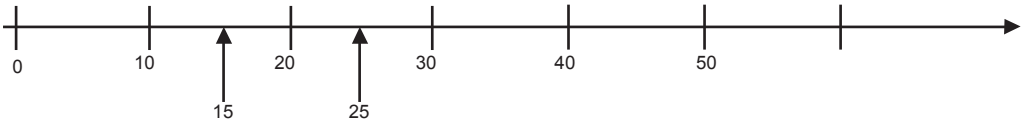
Compare two numbers and use comparative terms and symbols to describe the comparisons.

Materials

Number lines made during the previous lesson
Base ten blocks

Write two simple numbers on the board (e.g. 25 and 15) and ask: **Which number is greater – 25 or 15? How do you know?** Distribute the base ten blocks to the students in groups and ask them to show that 25 is greater than 15 by modeling both the numbers. 25 is greater than 15 as 25 has 2 tens and 5 ones whereas 15 has only 1 tens and 5 ones.

Tell the students that they can also compare numbers by placing them on a number line. Draw a number line on the board, as shown below. Ask them where 25 and 15 should be place on the number line. Then explain that the number which is to the right is greater than the number on the left. 25 is greater than 15 as it is to the right of 15. Also, explain that 15 is less than 15 as it is to the left of 25 on the number line.



Ask the students to compare a few more pairs of number (e.g. 30 and 40, 25 and 30). For each comparison, ask them why one is greater than the other, and why one is less than the other. Students should be able to compare two numbers using a combination of reasoning with both number lines and base ten blocks.

Ask the students to compare two 3-digit numbers (e.g. 300 and 450). **Which number is greater: 300 or 450? Why? How can you show or say that 450 is greater than 300?** Encourage the students to show how 450 is greater than 300 by using both the base ten models and number lines. For the number line, you could refer them to the one made during the previous lesson.

Ask the students to compare and tell which number is greater for a few more pairs of 3-digit numbers (e.g. 450 and 460, 450 and 455, 213 and 500). For each comparison, ask them to explain or show why and how.

Make sure the students have some experience where the number with the greater first digit is not the greater number (e.g. comparing 92 and 118).

Toward the end, ask questions such as:

Which is greater: 125 or 532? How do you know?
Give an example of a number that is less than 362.
How can you compare 3-digit numbers to decide which is greater? Use an example to explain.
Can a number that begins with a 3 be less than a number that begins with a 2?

Maths Note

Students should be aware that they can compare numbers either by placing them on a number line and finding which number is farthest to the right or else by using models to see which has more hundreds or possibly more tens or ones. They should realize that if a number has more hundreds in it than another number, it must be greater. If the numbers have the same number of hundreds, the greater number has either more tens, or, if the number of tens is the same, more ones.

The symbols for greater than or less than can be used. For example, 513 > 275 (513 is greater than 275) because 513 is more than 5 hundreds, but 275 is not even 3 hundreds.

Students might observe that any 3-digit number is greater than any 2-digit number since 2-digit numbers are less than 100 and 3-digit numbers are greater than 100.

Assessment for Learning

See that the student can tell which number is greater, or less, and why for a given pair of numbers to compare.

Extension

Ask the students to tell which is greater between 25 and 25 and 25 and 30. Write the comparisons in words as shown below. You could first write the sentences in the first column. After that, remind that that if 25 is greater than 15, it means 15 is less than 25. Similarly, 25 is less than 30. Then write them down as in the second column below.

25 is greater than 15	15 is less than 25
30 is greater than 25	25 is less than 30

Introduce the symbol ">" for "greater than". Explain it and write the comparison sentence using it below each of the word sentence in the first column above. Discuss with the students why it is useful to use symbols in writing, in that it saves time and space. You might explain that the symbol, >, looks like the mouth of a snake, and that the snake is always after more or greater number of mice. This would help the students in remembering.

25 is greater than 15 25 > 15	15 is less than 25 15 < 25
30 is greater than 25 30 > 25	25 is less than 30 25 < 30

Then, introduce the symbol "<" for "less than". Use < to compare the numbers in the second column above below each of the word sentences. Use the same story as above to tell that a snake always opens its mouth wide toward many mice or rats.

Ask the students to practise writing both these symbols in their notebooks. Show and guide them how to write the symbols. You might ask a few students to come to the front and write the symbols on the board.

Have the students then write the appropriate symbol in the box between the pairs of number as shown below in their notebooks.

50 ☐ 30	30 ☐ 50
340 ☐ 240	590 ☐ 143
356 ☐ 98	88 ☐ 106

After all the students have understood and done the above, write the following on the board and draw their attention to it. Ask: Which number is greater between these two numbers? Which symbol (< or >) should we be writing in the box here? Tell that when the numbers are the same, or equal, we write the "equals symbol", "=" to say that the numbers are the same. Then write it in the box. Tell the students that the equal symbol is like two short parallel lines, since they have already dealt with the idea of parallel lines in Chapter 3.

100 ☐ 100

Ask the students to compare and write appropriate symbol between the pairs of numbers such as provided below in their notebooks.

530 ☐ 238	630 ☐ 630
59 ☐ 143	400 ☐ 400

Have the students do the relevant activities in their Student Activity Books.

Chapter Assessment

Formative Assessment

Formative assessment ideas, tips and reminders are provided within each lesson under the heading called Assessment for Learning. In addition, you should use a formative assessment tool called the Chapter Checklist. Prepare the Formative Assessment Recording Sheet for the chapter as shown below. You should look for evidence in each student, throughout the teaching of the chapter, that he or she has understood the key concepts and can perform the key mathematical skills by ways of observing, listening and asking probing questions. Accordingly, keep the records for each student by putting a mark, such as a tick mark, for each of the chapter goals once you are convinced that the student has achieved them. You could also keep relevant anecdotal records.

Using the Chapter Checklist purposefully will give you the benefit of ensuring that each student's learning progress is assessed in a systematic manner. What is even more important is the opportunity it will provide you to help each student along in achieving the chapter goals. Since this is meant as a formative assessment tool, you will not be giving any mark to the students by using it. However, investing time in carrying out this assessment technique will contribute positively in the students being able to do well in the summative assessments, including the examinations. You can also refer back to these records as you look for progress during the year and/or seek to address areas of concern.

Formative Assessment Recording Sheet
CHAPTER 8 NUMBERS GREATER THAN 100

Chapter Checklist (Look for evidence throughout the chapter that the student has understood the key concepts and can perform the key skills.)

Student Name		Chapter Goals (The student is able to):					
		Represent 3-digit numbers with base ten blocks.	Describe 3-digit numbers as groups of hundreds, tens and ones.	Describe 3-digit numbers as groups of tens and ones.	Skip count numbers by 100s, 25s and 10s.	Write the 3-digit numbers in words	Compare 2-digit and 3-digit numbers and use the symbols, >, < and = appropriately.
1							
2							
3							
4							
5							
6							
7							
8							

Summative Assessment

As explained in the Introduction to the Teacher's Guide, the student's learning in each chapter will be measured primarily through the use of an assessment method called the Interview-based Performance Task. The primary purpose of this assessment is to thoroughly assess the level of understanding of the students in terms of the key concepts and skills as required in the chapter. It provides an opportunity for the students to display their understanding by ways of telling, describing, showing, and demonstrating in a non-threatening environment.

One of the beauties of this assessment method is that it allows you to teach and clarify things even as you are assessing the students. The fact that you have to provide marks to the students through the use of Interview-based Performance Tasks should be considered a secondary purpose. The Summative Assessment Recording Sheet (shown on the next page) is included in the Student Activity Book for your use with each student. Please refer to the Introduction to the Guide for the details on the marking scheme.

Summative Assessment Recording Sheet

Student Name: _____ Roll no.: ____ Section: ____

CHAPTER 8 NUMBERS GREATER THAN 100

Interview-based Performance Task (Please refer the Introduction to the Teacher's Guide for Class 2 for the marking scheme while using the Interview-based Performance Task.)

Task and Interview prompts	Key concepts and skills to look for
Have base ten blocks and a blank paper ready. Write a 3-digit number (e.g. 236) on the paper, and ask the student: **Represent this number with the base ten blocks.** **How can you describe 236 as groups of hundred, tens and ones?** **How can you represent 236 by using only the ten and ones blocks and not using any hundred blocks?** **Now describe 236 in terms of only tens and ones.** **Write 236 in words.** Write another number (e.g. 250) next to 236, as shown here: 236 250. Ask: **Which is greater: 236 or 250? Why? Which number is less then? Write the symbol: > or < between these two numbers.** Write the following sequences on the paper, and ask the student to complete them. Ask how they know the remaining numbers in each of the sequences. 300, 400, 500, ____, _____, _____ 125, 150, 175, 200, ____, _____, _____, _____	The student is able to: - Model a 3-digt number with base ten blocks in more than one way. - Describe a 3-digit number in terms of hundreds, tens and ones. - Describe a 3-digit number in terms of only tens and ones. - Write a 3-digit number in number words. - Compare 3-digit numbers and say which is greater and which number is less. - Use the greater than sign and less than sign correctly. - Skip count numbers in 100s. - Skip count numbers in 25s

Comments and Marks

Strengths:

Areas of Need:

Follow up Steps:

Teacher's Signature and Date:

Summary of the Summative Assessment for Chapter 8

CA marks from Chapter 8 (Marks out of 10): _____

CHAPTER 9 DATA AND PROBABILITY

Chapter Overview

What is data? Data is a collection of facts or opinions. Data may be collected for a purpose through a planned design or taken from a readily available source. We use data for several purposes, including: to extract understanding and meaning out of it; to predict future events under similar situations; to confirm certain assumptions; and to help make decisions.

Data is collected through various means, such as observations, interviews, questionnaires, polls and surveys. After data has been collected, it has to be organized and presented. The organization and presentation of data take many forms, for the purpose of data analysis. So, data management is basically about sorting data. Graphs are powerful data displays since visual displays are easy to interpret very quickly.

Probability is the study of the chances of something happening. It is about predicting an event occurring in the future. Generally, we base our predictions on the pattern of what has already happened within the available data.

The students have had some experience in dealing with data and probability concepts in Classes PP and 1. They have collected simple data through observations and framing and using simple questionnaires, recorded data with tally marks, and presented data with concrete, picture and bar graphs. They also have learnt to use basic probability language in predicting events and to conduct simple probability experiments.

This chapter will extend and deepen the students' experience and understanding of data and probability. Students will frame simple questionnaires to collect simple data, record the data with tally marks, and create bar graphs to present and interpret the data collected. They will also interpret bar graphs presented to them. They will predict future events for familiar situations and for experimental results using the probability terms.

This chapter has 6 lessons as detailed in the Table of Contents.

Basic Principles about Data and Probability

- There are different ways to collect data.
- Data is collected for various purposes.
- To collect new data, we should create appropriate questions and choose appropriate ways to gather them.
- Once the data has been collected, there are always different ways to sort or organize the data, depending on the type of data and the purpose for its collection.
- Once the data is organized and displayed, it can be analysed to look for patterns and to draw inferences.
- Graphs are powerful data displays since visual displays are easy to interpret quickly.
- Bar graphs are used to compare the frequency within categories.
- When a bar graph is created, the bars should be separated. Each square represents one response.
- Probability is about predicting the chances of an event occurring.
- We use data to predict the likelihood or chances of something happening in the future.
- Although we can predict the likelihood of an event, we can you can never be certain what will happen.

Chapter Goals

- Create or frame survey questions to collect first hand data.
- Use tally marks to record data (or responses to the survey questions).
- Interpret the information contained in a bar graph provided.
- Create bar graphs for the data collected.
- Use probability terms such as likely, unlikely, possible, impossible and certain to predict future events.
- Conduct simple probability experiments and predict future events based on the experimental results.

Maths Words

Questionnaire, tally marks, bar graph, title, label, likely, unlikely, possible, impossible, certain, data, probability, chance

Lesson 1 Creating Survey Questions

Objectives

Create survey questions that can be used to collect data.

Materials

Chart paper
Marker pen

Tell the students that you will be asking each one of them a question, and that the question will be the same for everyone. Put up the question, along with the options for the answers, written on a chart paper. Record the responses with tally marks, as in the example shown below. Encourage the students to tell about what this question does. It helps find information about the classmates. An important feature of this question is that it defines the options for the answers (into 4 categories in this particular case).

How many sisters do you have?

0 sisters	𝍸	4
1 sister	𝍸 ||	7
2 sisters	𝍸	5
More than 2 sisters	||	2

Tell the students to think of things they would like to find out about their friends where there are only a few possible answers. You might ask the students to work on this in pairs or small groups. As they work, go around and help them to decide on a question. **What have you thought of asking your friends? How will you ask it? What would be the answers to your questions?** You might realize that some questions the students think of asking might not be appropriate to ask. In such cases, suggest to the students to modify or change their question, or offer an alternative question. Help the students write their questions in their notebooks along with the options for the answers, so that they could use it to ask others and record the responses with tally marks.

Following are some questions that might be developed either by the students themselves or with your suggestion. With students the possible answers would have to be written in the format as shown above.

- **How many persons live in your house? (2 persons, 3 persons, 4 persons, more than 4 persons)**
- **How many brothers do you have? (0 brothers, 1 brother, 2 brother, more than 2 brothers)**
- **Which of these colours do you like the most? (blue, green, red, pink, yellow)**
- **How long does it take for you to walk to school from your home? (15 minutes or less, 15 to 30 minutes, 30 minutes to 1 hour, more than 1 hour)**

After all the students or groups of students have decided and written down their questions in their notebooks, ask them to share with the class about their questions.

Toward the end, ask questions such as: **Why might it be difficult to collect information if you simply ask: What is your favourite sport?**

Maths Note

Collecting data is an important life skill. Students need to develop their ability to think out how data is best collected and then organized. They should develop questions with only a few possible responses so that they can handle the data they collect. If they try out a question and many unexpected answers arise, they should think about how to modify their questions, so that the question defines the options of the responses.

Assessment for Learning

See that the students are clear about the questions they have written in their notebooks.

Lesson 2 Collecting and Organizing Data

Objectives

Conduct surveys, and record the collected data using tally marks.

Materials

Notebooks and pencils

Maths Note

The students should actually collect the data for the questions they have framed during the last lesson, and summarise it later.

Take the students outside in an open space. Tell the students that each one of them should collect information from all the others in the class to their questions. This could be done if the class size is small (say, with student number up to 15). You could have the students do this in an orgainsed way. For example, ask the students to line up in a single line. The student from the start of the line will go ask and record the responses to his or her question after which the student will take his or her position. Tell the student to use tally marks to record the responses. Then, the next student will do the same. This will continue for all the students.

If the class size is large, you would need to divide the class into two groups, and ask the students to ask within their groups only. Follow the above process with each group.

As the students go about asking and recording the responses, go around and see that they are able to do it correctly.

After all have finished collecting their data, encourage the students to share what they think of the information they have collected. **What was your question? Which answer was the most popular? Were you surprised by it? How many friends have you asked?**

Assessment for Learning

See that the students have recorded the response using tally marks in a reasonably organied manner in their notebooks.

Tell the students to take care of the question and the data they have collected for subsequent use in a future lesson on making bar graphs.

Extension

Have the students move into an open space that would be sufficient for making a human graph. Ask students for the time of year their birthday occurs. You may use January to March, April to June, July to September, and October to December as the four options. Each student then goes to the appropriate location and becomes part of the bar graph. Note that you will need a wall or the beginning of a field or something to denote the “zero line” as the axis. Then it is critical that the spacing be such that the first person in each bar be lined up with corresponding persons in other groups. This is essential to facilitate comparison and the effectiveness of the visual display. You can ask for a volunteer observer and swap positions with that child. The observer steps outside of the graph and tells all an observation that can be made by looking at the graph. The observer then goes back to their place and you swap positions with another student.

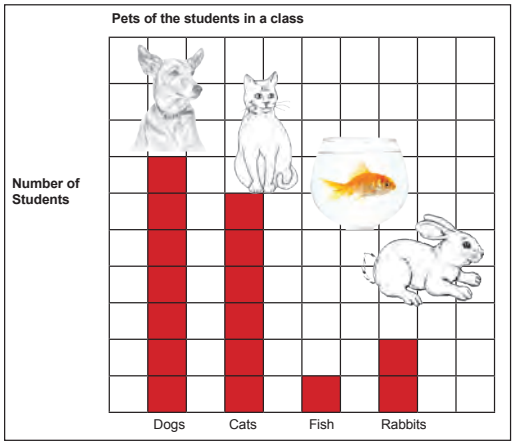
Lesson 3 Interpreting Bar Graphs

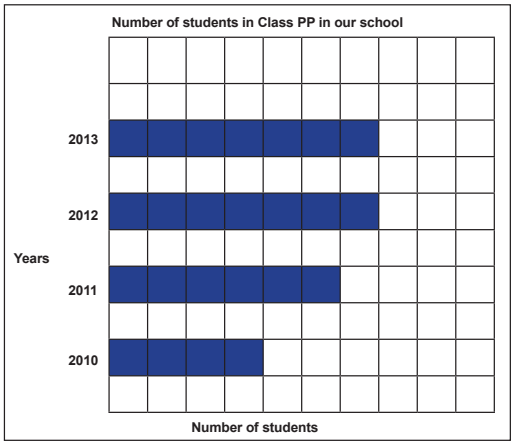
Objectives

Interpret information from a given bar graph.

Materials

A horizontal bar graph and a vertical bar graph made on chart papers.





Prepare two simple and appropriate bar graphs on chart papers in advance. One of the graphs should show the bars vertically and the other should show the bars horizontally. You could use the examples provided here.

First, put up the vertical bar graph. Explain to the students that this bar graph shows information about the pets the students in a class have at their homes. Explain the title, the labels, and the bars to the students. Encourage the students to describe what they can tell from the graph. Ask questions such as: **What types of pets do the students have? Which pet animal is there with the most number of students? How many students have rabbits as their pets? Which pet is least common with the students? Why might that be?**

One of the reasons for having the second graph is to expose the students to bar graphs with horizontal bars. The example suggested here is that you could use real data of your school for the number of students in Class PP for the current and the last two to three years. Therefore, the years, for the labels of the bars, and the number of students will have to be appropriately used. If the number of students in your school has consistently been, say, more than 30, then you could write the numbers starting from 30 for the first square of the grid, or make the numbering appropriate to your situation. However, scales should not be used yet, as mentioned in the Maths Note here.

As in the case with the first graph, explain what the graph shows. Explain the title and the labels of the graph. Ask questions such as: **How many students are there in Class PP this year? How many students were there in Class PP in (2012)? What do you observe in the number of students over the years? How many students do you think will be there in Class PP next year? Why do you say that**

Toward the end, ask questions such as:

What is the difference between these two bar graphs?
Why does it make sense to call these bar graphs?
Why is it useful to separate the bars?

Maths Note

Bar graphs are used to provide an easy to interpret visual display that can be used to compare the numbers in different categories of information. The bar graphs do not yet use scales to represent responses in this class, which means each square of the grid represents one response only. Bar graphs can be horizontal or vertical. Each row or column is labeled with the name of the category and the graph has a title.

Assessment for Learning

See that the students can tell the basic information displayed by the bar graphs. See also that they can identify and describe the titles and labels of the graphs.

Lesson 4 Creating Bar Graphs

Objectives

Create simple bar graphs with titles and labels for the simple information collected.

Materials

Chart paper
Marker pen
Crayons
Student Activity Books

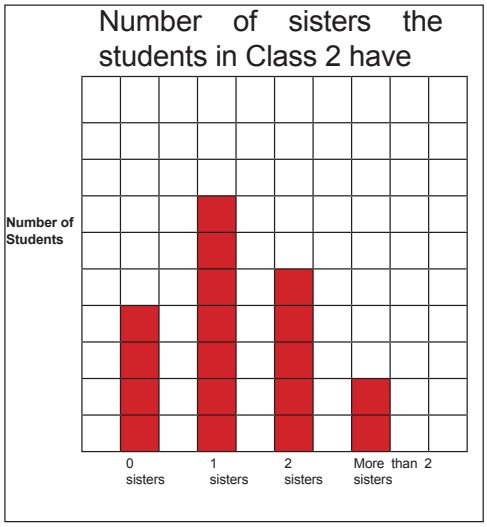
Maths Note

The students learned how to create simple bar graphs in Class 1. The grid paper that they colour to make the graphs should be provided; they are included in the Student Activity Books.
It is important to emphasize that the bars be separated with uniform space in between the bars, that the bars be labeled and that the graph have a title.

Make square grids with pencils on a chart paper in advance. Tell the students that you will make a bar graph together. Use the data collected in Lesson 1 of this chapter concerning the number of sisters the students have.

How many sisters do you have?

0 sisters	𝍸	4
1 sister	𝍸 ||	7
2 sisters	𝍸	5
More than 2 sisters	||	2



Point out how you first start with collected data, count the number of pieces of data in each category and then colour the squares appropriately. Explain the title and the labels for the graph. Have the students interpret the graph. Ask questions such as: **What does this graph show? How is the title of this graph? How many of you have no sisters? How many of you have more than 2 sisters?**

Ask the students to make their own bar graph for the same information in their Student Activity Book on the page where an empty grid paper is presented. As the students work on their graph, ensure that they write the title and the labels for the graph properly. Have them colour the squares with crayons.

Assessment for Learning

See that the students can identify and tell the title and labels for their graphs.

Extension

Ask the students to make bar graphs based on the data they have collected earlier during Lesson 2. The graphs can be done in their Student Activity Books on the pages where the empty grid papers are presented. Help them with writing appropriate titles and labels. Ensure that the students realize that they can make bar graphs with either horizontal or vertical bars.

Once everyone has made their bar graphs, encourage the students to describe and share their graphs with others. Ask them questions like: **What does your graph show? What is the title of your graph? How did you make your bars? Did you make horizontal or vertical bars in your graph?**

Encourage the students to interpret the graphs made by their friends. Encourage them to ask questions to each other on the graphs they have made.

Lesson 5 Using Probability Language

Objectives

Use words such as certain, impossible, possible, likely and unlikely to describe future situations.

Maths Note

Probability is the study of the chances of something happening. It is about predicting an event occurring in the future. Generally, we base our predictions on prior experiences and/or knowledge of situational circumstances. We will learn to express our prediction of the occurrence of an event in the future in five ways. If we are sure that an event will take place in the future, then we say it is certain; if we are sure that an event cannot take place in the future, then we say it is impossible; if we think that an event may or may not take place, then we say it is possible; we use the word likely when we think the chances of something happening is higher than it not happening; we use the word unlikely when the chances of something happening is lower than it happening.

Theoretically we cannot know absolutely about any future event (except in some extreme circumstances that are certain or impossible). That is why we focus attention on prediction.

The students have had some experience using the terms certain, impossible and possible to describe their predictions in Class 1. This lesson will review these and extend into using the terms likely and unlikely.

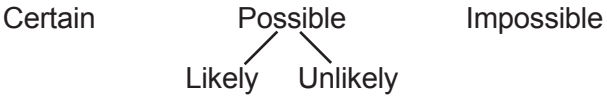
Materials

None

Ask the students a few questions such as: **Do you think you will become shorter in height by next week? Do you think you will sleep tonight? Do you think you will slip and fall down while walking back home today?** Encourage the students to respond to each of these questions and ask them to explain their predictions. See if they use the words like certain, impossible and possible in giving their responses, although it is not necessary that they use these words at this point.

Remind the students that we are predicting when we talk about something happening or not happening in the future. Tell them that, in mathematics, we use specific words to describe our predictions. Explain the meaning of the words certain, impossible and possible to the students. You might provide the explanations as mentioned in the Maths Note here. Write these three words on the board, or on chart paper, for future reference. Provide a relevant example for each of these words.

Then, tell that for an event that is possible, we can further talk of it in terms of how likely it will happen. If it is possible, but not very likely to happen, then we use the word unlikely to describe it; if it is possible with a good chance of happening, then we use the word likely to describe it. Write these two words on the board, or chart, to the three words already written. For example, it is possible that it will rain tomorrow; but it will be unlikely, if it is not in the autumn season. It is possible that you will talk with somebody while walking back home today; in fact, it is likely that you will talk with somebody.



Tell the students that you will make a statement about a future event and that they will have to predict it using one of these five words. In some cases, you could get more than one word for the same statement. There really will not be one correct prediction for any event. Ask the students to tell the reasons for the choice of their words. Following are some statement you could use for this activity.

- A yak will be a student in our class next week.
- All of us will come to school tomorrow.
- The sun will shine tomorrow.
- Crows will become white when they grow old.
- His Majesty the King and Her Majesty the Queen will visit our school this year.
- It will snow this winter here.
- One day you will fly in Druk Air.
- Some of you will become pilots after you finish you studies.
- Some of you will become teachers in the future.
- All of you will become teachers in the future.
- None of you will become teachers in the future.
- If you put a stone in water, it will float.
- Someday humans will grow wings and fly like birds.

Toward the end, ask questions like: **What is it called when we talk about the chances of something happening in the future? How many words can we now use to make a prediction? What are these words? Can you tell an example of something that is possible, but unlikely?**

Assessment for Learning

See that the students can predict reasonably future events using the five probability words.

Extension

Ask each student to think of a statement about something happening in the future. Each student will then will say his or her statement to the class. The class will respond with a probability word. Encourage the student to confirm, or ask the class to explain for the probability word they said to his or her statement.

The students can also play this in pairs where one partner says a statement and the other responds with an appropriate term. They then switch their roles.

Lesson 6 Conducting Probability Experiments

Objectives

Investigate probability through experiments using coloured cubes and/or dice.

Materials

Dice (a pair for each group of students)
Experimental recording sheet (one for each group of students)

Show a die to the students and tell them that it has 6 faces and that each face shows one of the different numbers: 1, 2, 3, 4, 5 and 6. Ask the students: **If I roll this die, what is the probability that I will get one of the numbers from 1 to 6? Which probability would be most suitable: possible, certain, or impossible? If I roll this die, what is the probability that I will get the number 5? What is the probability that I will get number 7 if I roll this die? Is it likely that if I roll this die 10 times, I will get the number 2 on one of the rolls?** You could then roll the die 10 times and record the results each time on the board using tally marks.

Distribute a die and a sheet of paper to record experimental results each to small groups of students. Ask the students to roll the die 10 times and record the results each time using tally marks in the sheet provided.

Roll a die again and again and record the results each time.

Number	Number of times (Use tally)
1	
2	
3	
4	
5	
6	

At the end of rolling 10 times, ask the students to observe and describe their results. **Did you get all the numbers at least once in your 10 rolls? What number did you roll the most times? What number did you roll the least times? If you repeat the rolling of your die for another 10 times, do you think you will get the same results? If you roll the die one more time, what number is most likely to appear on the top? Why?**

Ask the students in the groups to roll the die at least 10 times and record the results. At the end, ask the students to observe and describe any pattern in the result. Ask questions like: **Which number appeared the maximum number of times? Did every number appear more or less the same number of times? If you roll the die one more time, do you think the chance of getting any of the 6 numbers is the same?**

Maths Note

The study of probability requires exploration of unpredictable events. The students need to realize that it is usually not possible to be sure what will happen but predictions tend to improve based on seeing what happens in a number of similar situations. Students get a better understanding of probability if they conduct simple experiments and observe the results. For example, if they roll a die many times, they start to get a sense that each number is equally likely to be rolled.

In the experiments suggested in this lesson, the students should look for patterns in the data and predict the outcome for a future event, using probability terms such as possible, likely, unlikely, certain and impossible.

Assessment for Learning

See that the students can record the results properly using tally marks. Also, see that they can describe the experimental results, and make predictions for future numbers.

Extension

Distribute a pair of dice and a recording sheet for the experimental results to groups of students. Ask them to roll the pair of dice, determine the sum of the two numbers rolled and record it on the sheet. Ask the students to roll the dice for at least 20 times. Then, ask them to describe the pattern in the results. Ask them to predict the results if they repeat the rolling for another 20 times. Have them repeat the rolling the dice and recording the sums of the numbers in sets of 20 rolls.

Roll a pair of dice, determine the sum of the two numbers and record it. Repeat this for at least 20 times.

Sum	Number of times (Use tally)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

Provide a set of coloured cubes (the exact mix of colours is not important, though make sure there is more than one colour. Ask the students to place only one colour in a container. Then have them predict the colour of the cube that will be "blindly" drawn out of the container. Reinforce the idea of certain probability. Then have them name a colour that would be impossible to draw out of the container. (Any other colour would be fine.)

Now have the students put a mix of colours in the container. Tell them that they will now draw a single cube out of the container. Have them write down an example of a colour (or something else like "the cube is not red" that is likely) and another that is unlikely. They can then carry out the experiment several times and see if their prediction is accurate. Check that the selections are not in fact, impossible or certain.

Chapter Assessment

Formative Assessment

Formative assessment ideas, tips and reminders are provided within each lesson under the heading called Assessment for Learning. In addition, you should use a formative assessment tool called the Chapter Checklist. Prepare the Formative Assessment Recording Sheet for the chapter as shown below. You should look for evidence in each student, throughout the teaching of the chapter, that he or she has understood the key concepts and can perform the key mathematical skills by ways of observing, listening and asking probing questions. Accordingly, keep the records for each student by putting a mark, such as a tick mark, for each of the chapter goals once you are convinced that the student has achieved them. You could also keep relevant anecdotal records.

Using the Chapter Checklist purposefully will give you the benefit of ensuring that each student's learning progress is assessed in a systematic manner. What is even more important is the opportunity it will provide you to help each student along in achieving the chapter goals. Since this is meant as a formative assessment tool, you will not be giving any mark to the students by using it. However, investing time in carrying out this assessment technique will contribute positively in the students being able to do well in the summative assessments, including the examinations. You can also refer back to these records as you look for progress during the year and/or seek to address areas of concern.

Formative Assessment Recording Sheet
CHAPTER 9 DATA AND PROBABILITY

Chapter Checklist (Look for evidence throughout the chapter that the student has understood the key concepts and can perform the key skills.)

Student Name		Chapter Goals (The student is able to):						
		Create or frame survey question to collect first hand data.	Use tally marks to record data.	Interpret the information contained in a bar graph provided.	Create bar graphs for a given set of simple data.	Use probability terms such as likely, unlikely, possible, impossible, and certain to predict future events.	Conduct simple probability experiment and record results	Predict future events based on the results of a probability experiment
1								
2								
3								
4								
5								
6								
7								
8								

Summative Assessment

As explained in the Introduction to the Teacher's Guide, the student's learning in each chapter will be measured primarily through the use of an assessment method called the Interview-based Performance Task. The primary purpose of this assessment is to thoroughly assess the level of understanding of the students in terms of the key concepts and skills as required in the chapter. It provides an opportunity for the students to display their understanding by ways of telling, describing, showing, and demonstrating in a non-threatening environment.

One of the beauties of this assessment method is that it allows you to teach and clarify things even as you are assessing the students. The fact that you have to provide marks to the students through the use of Interview-based Performance Tasks should be considered a secondary purpose. The Summative Assessment Recording Sheet (shown on the next page) is included in the Student Activity Book for your use with each student. Please refer to the Introduction to the Guide for the details on the marking scheme.

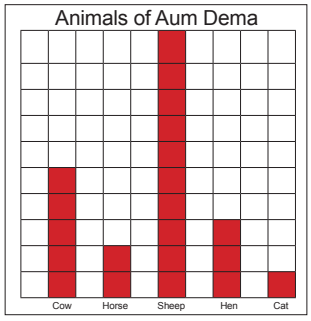
Summative Assessment Recording Sheet

Student Name: _____ Roll no.: ____ Section: ____

CHAPTER 9 DATA AND PROBABILITY

Interview-based Performance Task (Please refer to the Introduction to the Teacher's Guide for Class 2 for the marking scheme while using the Interview-based Performance Task.)

Task and Interview prompts	Key concepts and skills to look for
Make a bar graph as shown here on a paper. Explain what it shows briefly and ask the student questions such as: **How many types of animals does Aum Dema have? How many cats does she have? Which animal does she have the greatest number of? What is the title of this bar graph?** Put about 3 red cubes and 15 blue cubes in a feely bag or a container, with the full knowledge of the student. Mix the cubes thoroughly. Tell the student to say a probability word (certain, impossible, possible, likely, unlikely) for the statements you will make related to drawing out cubes from the container without looking. Ask the student to tell the reason for the choice of the words for each situation. **I will draw out a blue cube.** **I will draw out a red cube.** **I will draw out a black cube.** **I will draw out either a blue cube or a red cube.**	The student is able to: - Read information from a bar graph. - Identify and tell the title of a bar graph. - Predict the outcome of an experiment using probability words such as impossible, possible, certain, likely and unlikely. - Explain the reasons for the predictions made.



Comments and Marks

Strengths:

Areas of Need:

Follow up Steps:

Teacher's Signature and Date:

Summary of the Summative Assessment for Chapter 9

CA marks from Chapter 9 (Marks out of 10): _____

CHAPTER 10 MEASURING MASS, CAPACITY AND TIME

Chapter Overview

The mass of an object is the amount of matter in it. Weight is the amount of gravitational pull or force that is exerted on an object. The weight of an object is directly proportional to its mass. Which means, the more the mass of an object, the greater will be the gravitational force exerted on it by the Earth, if the object is on the Earth. Sometimes, people use mass and weight interchangeably. But strictly speaking, they are not the same. The mass of an object does not change whether it is on the Earth or on the Moon. But its weight will be just about one sixth on the surface of the Moon when compared with its weight on the Earth.

Capacity of a container is the amount it can hold.

The idea of time is basically about how long an event takes. Unlike mass, capacity, length and area, it is not an attribute of an object. But time shares a commonality with these attributes of objects in that it is measurable.

Mass, capacity and time are measurement concepts like length and area. Measurement is really about comparison – comparison of how much one feature of an object is as compared to the same feature of another thing.

The students have had some experiences with the idea and measurement of mass and capacity in Classes PP and 1, such as comparing, estimating and measuring mass and capacity using non-standard units. The students will review these concepts in this chapter. In addition, they will be introduced to the standard units like kilogram and litre for measuring mass and capacity respectively.

On the concept of time, the students have had experiences in sequencing events in order and in reading and writing time from an analogue watch or clock in hours in Class 1. This chapter will extend into reading and writing time in hours and minutes using both the analogue and the digital watches or clocks. They will also learn to estimate and measure the time elapsed between two events and develop sense of how long a minute, an hour, a week, a month, a season and a year are.

This chapter has 10 lessons as detailed in the Table of Contents.

Basic Principles about Measuring Mass, Capacity and Time

- The definitions of mass, capacity and time are based on the processes for comparing one item to another with respect to heaviness, holding capacity or duration.
- Whether one object has more or less mass than another is independent of their shape or size.
- Any individual item might have more of a measure than a second item, but less of the measure than a third item (e.g., A might be heavier than B but lighter than C).
- Any measurement comparison can be stated in two different ways (e.g., A is heavier than B or B is lighter than A).
- Mass, capacity and time can be compared both directly and indirectly, using a third item or event.
- The measurement of time is not so much about reading clocks (although that is a useful skill) as about how long an event takes or its duration.

Chapter Goals

- Measure mass using non-standard units.
- Measure mass in kilograms.
- Measure capacity of containers using non-standard units.
- Measure capacity of containers in litres.
- Gain a sense of how long a minute is and how long an hour is.
- Tell the names of days, months and seasons in sequence.
- Tell the relationship among days, weeks, months, seasons and years.
- Read and write time in hours and minutes from an analogue clock.
- Read and write time in hours and minutes from a digital clock.
- Calculate the time elapsed between two events.

Maths Words

Mass, units, non-standard unit, standard unit, kilogram, capacity, litre, time, hour, minute, clock, analogue, digital,

Lesson 1 Measuring Mass with Non-standard Units

Objectives

Measure the mass of familiar objects with non-standard units.

Materials

Pan balances
Objects to be used as non-standard units such as snap cubes, marbles, coins, new chalk sticks and new crayons
Books, blocks, containers, used torch batteries, fruit or vegetable items (such as potatoes, radishes, cucumber, apples and cabbages)

Arrange to have the above mentioned materials. If possible there should be one pan balance and adequate numbers of the non-standard units for each group of students.

Introduce the pan balances and the units and tell the students that they will be using these tools to measure the mass of some objects. Demonstrate measuring the mass of an object (e.g. a book) using a non-standard unit (e.g. snap cubes) using a pan balance. Express the mass of the book in terms of the unit (e.g. **The mass of this book is 27 snap cubes**). Explain what it means by that (e.g., **The mass of this book is 17 cubes because it takes 17 cubes to balance the book**). Tell the students that you can also measure the mass of the book using other units. For example, measure the mass of the book using new chalk sticks and express the mass appropriately (e.g. **The mass of the book is 13 chalk sticks**). Ask: **Why is the mass of the book 13 chalk sticks? Did it take more chalk sticks or more snap cubes to balance the book? Which one would be heavier between a chalk stick and a snap cube? How do you know?**

Provide a pan balance and adequate number of the non-standard units to the students in groups. Ask them to measure the masses of various suitable objects. For example, the students could be measuring the mass of their books, geometrical instrument boxes, containers, duster, staplers, their lunch boxes, stones and wooden blocks. As they work, go around to ensure that they are handling the pan balance correctly. Encourage the students to first always estimate the mass by feeling both the object of interest and the chosen units in their hands. Ask question like: **How many cubes do you think will balance this container? What will be the mass of this container? Can you measure the mass of this container using another unit?** Also, ensure that every student in the group gets opportunity to measure the mass of at least one item.

Toward the end, ask questions like:

About how many _____ do you think it will take to balance _____? Why?
If something is heavier, will it take more or fewer units to balance it? Explain.
Suppose you know that a book has a mass of 15 coins and a stone has a mass of 10 coins. Which is heavier – the book or the stone?

Maths Note

This is a review and extension of work from Class 1. Units should continue to be simple everyday materials such as marbles or linking cubes, but they should be uniform. They should be neither too light nor too heavy for the items being measured. It is important for the students to continue to predict or estimate the mass of the objects in terms of the chosen non-standard units.

Assessment for Learning

See that the students can estimate reasonably the masses of objects in terms of the chosen non-standard units, and that they can use pan balance to measure and express the masses appropriately. Also, ensure that all the students have got adequate opportunity to handle pan balance to measure the mass of objects.

Suppose you know that a book has a mass of 15 cubes and a wooden block has a mass of 10 coins. Do you know which is heavier? Why?

Extension

Have the students complete the relevant activities in their Student Activity Books.

Lesson 2 Introducing the Kilogram

Objectives

Gain a sense of the heaviness of 1 kilogram.
Measure and express the mass of some things in terms of kilogram.

Materials

A kilogram weight (if possible, as seen in the grocery stores)
A mass of 1 kilogram (such as packaged salt, sugar, or wheat flour)
Empty plastic bags
Sand or dry soil
Pan balances

Arrange to have the above materials in advance. Introduce a mass of 1 kilogram through 1 kilogram weight that is found in use in grocery stores and packaged masses of 1 kilogram such as packaged salt, sugar, dalda or wheat flour (atta or maida).

Maths Note

Students have not yet had any experience using standard units to measure mass. This will be their first opportunity. It is important to have one example of a kilogram weight that students can feel to get a sense of how heavy it is.

Tell the students that the units of mass that they have used so far such as cubes and coins are called non-standard units, and that people do not normally use them in measuring masses. Tell them that people use a standard unit called kilogram to measure mass. Show a 1 kilogram weight if you have managed to get one. Ask if the students have seen this before, and explain that it is used to measure the mass of vegetables, rice, sugar, butter, etc in shops and market places. You could then pass around the 1 kilogram weight for the students to feel and get a sense of how heavy it is. Then, you could also pass around masses of 1 kilogram of packaged materials such as sugar, salt, dalda, flour or rice for the same purpose. After everyone has felt how heavy a kilogram is, ask questions like: **Is a mass of 1 kilogram heavy? How many kilograms do you think you can hold on your hand? What things in the classroom would be about 1 kilogram in mass? What would be more than or heavier than 1 kilogram? What things would be less than 1 kilogram?**

Provide each student with an empty and used plastic bag. Provide a pan balance and a mass of 1 kilogram to the students in groups. Take the students outside to a place where you have sand or dry soil. Ask the student to make their own 1 kilogram mass by putting the sand/soil into the plastic bags and measuring them against the 1 kilogram mass. They should tie up the loose end of their plastic bags securely and use their personal 1 kilogram mass to measure the masses of other objects.

Ask the students to use their 1 kilogram mass to measure the mass of other objects such as their books, their pack lunches, their bags of books, and other suitable things. As they work on their measurements, go around and ask questions like: **How many kilograms is this stone? How many kilograms do you think will balance these 3 books stacked together?** Encourage the students to estimate the masses of object in kilograms before they measure them.

Then, ask the students to identify things in the classroom that are very close to

1 kilogram in mass. This will help them conceptualize the unit more.

Toward the end, ask questions such as:

Is a kilogram heavy?
Would it be easy to carry something that had a mass of 5 kilogram?
All of you have 1 kilogram mass each. Whose kilogram mass would be the heaviest?
If I put (Sonam's) kilogram mass on this pan of the balance, and (Sandeep's) kilogram mass on the other pan of the balance, what will happen? would the two kilograms balance each other?
If you put 1 kilogram of sugar on one pan and 1 kilogram of salt on the other pan of a balance, what will happen?
Why would (Maya's) kilogram have the same mass as (Dema's) kilogram?

Assessment for Learning

See that the students can estimate the masses of objects reasonably in kilograms, and that they can measure and express the masses in kilograms appropriately.

Extension

If possible, arrange to bring a body weighing machine to the class. Tell what it is and how to use it to the students. Set the machine to the correct mode. Ask the students to place one of their personal 1 kilogram bags on the machine and show them how to read the mass. Ask them if they put 10 of their personal kilogram bags, what mass the machine would show. Experiment with various combination of their personal kilogram bags to read the machine.

Measure the body mass of a student on the machine. Have them read the mass from the machine. Then identify the next student to measure his or her body mass. Ask the students to estimate his or her body mass first: **What would be his (or her) body mass? How many kilograms do you think he (or she) would weigh?** Then, have the student stand on the machine while others will read his or her mass. In this way, have all the students measure their body masses one by one.

Toward the end, ask questions such as:

Who is the heaviest in this class? How many kilograms did you weigh?
Who has the least body mass? How many kilograms was that?
Will your body mass be the same if you measure after 1 month? Why?
About how many kilograms do you think I would be?

(Note: As mentioned in the Chapter Overview, there is difference between mass and weight of a body. However, there is a close relationship between the mass and weight of a body on the surface of the earth. People informally use mass and weight interchangeably. This may be happening more out of ignorance than not. To weigh is to find the weight, not the mass, but the machine is set to report the mass of objects on the earth but it does so by finding the weight. The only way to measure mass directly is with a pan or common balance. Machines that use springs find the weight. However, it will not be appropriate to discuss this with the students at this stage, and telling the students that they are measuring their body mass with the machine will be alright.)

Have the student complete the relevant activities in their Student Activity Books.

Lesson 3 Measuring Capacity in Non-standard Units

Objectives

Measure and record capacity using non-standard units.

Materials

A variety of containers such as plastic bottles, jugs, cups and spoons
A bucket of water

Maths Note

This is a review and extension of work from Class 1. It is important for the students to continue to predict or estimate the capacities of the containers in terms of the chosen non-standard units.

Show two containers of different capacities and ask the student: **Which one of these do you think would hold more water? Why? Then, which would have more capacity?** Remind them that the capacity of a container is the amount of something it can hold. Then ask the students to estimate the capacity of one of the containers. **How many cups of water do you think will this (bottle) hold?** Record the estimates of teh students on the board. **How can we test or find out how many cups it really holds?** Listen to their suggestions. You could either fill the bottle by pouring water in it with the cups over and over again, or fill the bottle first and then empty it into the cup over and over again. Measure the capacity of the bottle using water and cup. Record the number. At the end, ask: **So how many cups of water does the bottle hold?** Remind that that is the capacity of the bottle. Remind them that the cup is the unit of measuring the capacity of the bottle in this case. Have the students say after you the sentence: **The capacity of the bottle is (12) cups.**

Ask the students: **If we measure the capacity of this bottle with a spoon, will it show more number or less number than (13)? Why? Will the capacity of this bottle change if we measure it with a spoon and not with a cup?**

Provide the students with a larger container and a smaller container each in groups. Tell them that you want them to measure the capacity of the larger container by using the smaller one as the unit. First, ask each one of them to estimate the capacity of theri container. Then, take the students to the water tap area and have them measure the capacities of the containers and test their estimates. As they work, ask questions to individual student to groups of them, such as: **How did you measure the capacity of your (can)? What is the capacity of it? Did it hold exactly (10) cups or a little more than (10) cups, or a little less than 10 cups?** Then teach the students to express the capacities appropriately, such as: **The capacity of this can is a little more than 10 cups.** Also, ask: **Was your estimate a good one? What makes it a good one?**

Assessment for Learning

See that the students can express the capacities of the containers in terms of the non-standard units.

Toward the end, ask the students to tell capacities of their containers, and how they measured to the rest of the class in turns. You could help them describe these by supporting the students with probing questions and encouragement to speak.

Extension

Have the students complete the relevant activities in their Student Activity Books.

Lesson 4 Introducing the Litre

Objectives

Become familiar with the standard capacity unit – the litre.
Measure the capacity of familiar containers in litres.

Materials

Containers that come in 1 litre such as mineral water bottles and types of containers
A variety of other containers
A bucket of water

Maths Note

Students have not yet had any experience using standard units to measure capacity. This will be their first opportunity. It is important for the students to gain a sense of how much 1 litre is relative to other things with which they are familiar. Students will be familiar with 1 litre in certain shapes (e.g. mineral water bottle) but not in other shapes (e.g. the size of a litre when it is a cube).

Tell the students that the units that they have used so far, such as cups and spoons are all non-standard units and that people do not normally use them to measure and talk about capacities in the real life. Tell that just like for mass and length we use a standard unit to measure capacity, and that it is called litre. Show the students a mineral water bottle and tell them that 1 litre is the amount that it holds. Show a smaller bottle and tell that it holds less than 1 litre. Show a larger container and tell that it would hold more than 1 litre.

Show a cup they used during the last lesson and ask: **About how many cups would make 1 litre?** Encourage the students to estimate. **How can we test that?** You might fill the bottle with water and then pour water out into the cup over and over again until it is emptied. Then, express it as: **1 litre is about 9 cups; It takes 1 litre to fill 9 cups.** Show a larger cup or a mug, and ask: **If we fill this mug with the water from this 1 litre bottle, will it show a greater number or a lesser number than with the cup? Why? About how many mugs do you think will make 1 litre? How can we test that?** Ask a student to test that. After that, ask: **Which has more capacity – the mug or the cup? Why?**

Provide the students with a mineral water bottle or any other container that has a capacity of 1 litre and a larger container each in groups or pairs. The larger containers could be buckets, jerry cans, or other suitable containers. Take them to the water tap area and ask them to measure the capacities of their containers in litres. They should always estimate the measurement before actually measuring. It is more fun to do this estimation if everyone in a group makes their own estimate. It is fun to see who is closest. Later they should be asked what strategies they use to estimate (e.g. imagining how many bottles fit in the bucket, and then imagining the space in between the bottles).

Assessment for Learning

See that the students can express the capacities in litres appropriately as the case might be.

As they work, go around and ask them questions such as: **How many litres does it take to fill this can? What is the capacity of this can then?** Model expressing the capacities of the containers appropriately (e.g. The capacity of this can is a little more than 6 litres; or, the capacity of this can is between 6 and 7 litres; or, the capacity of this can is about 5 litres, etc.).

Toward the end, encourage the students to share with others how they measure and found out about the capacities of their containers in terms of litres. This would provide more practice for the students in describing or expressing the capacities of their container appropriately and also improve their communication skills and confidence. You could support them in this with asking probing

questions and encouragement. Also ask questions such as: **Would you beable to drink a litre of water in one day? Would you be able to hold a litre of water in your hands if you filled them?**

Extension

Have the students complete the relevant activities in their Student Activity Books.

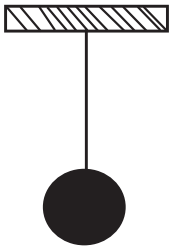
Lesson 5 Measuring Time

Objectives

Use non-standard units to measure time or the duration of an event.
Gain a sense of a minute and an hour.

Materials

A pendulum
A stop clock, or a normal clock or watch



You could improvise a pendulum by tying a mass (e.g. a stone, a marble, or a snap cube) at the end of a string of about 20 to 30 cm long. Show it to the students and tell them that it is called a pendulum, and that we can use it to measure time or how long an even takes place.

Start the pendulum swinging and tell that students that they will count the swings of it. You could consider a forth and a back movement of the bob as one swing. Stop the swinging and restart it to practice counting the swings for a few times.

Stop the swinging and ask students to predict how many swings of a pendulum it will take them to write their names once. In particular, ask a student to tell how many swings it will take for him or her to write his or her name. Ask the student to come to the front and write his or her name on the board. As the student starts writing the name, start the pendulum and ask the other students to count the swings silently and to stop the counting when the writing is finished. Ask the class: **How many swings did you count? How long (in terms of the swings of the pendulum) did (Lhaden) take to write her name? How did she do with her prediction?**

Repeat this process with some more students. You might ask the students to volunteer for this. At the end, ask the students questions such as: **Can someone finish writing his or her name in 2 swings of a pendulum? Why? Will it take about 70 swings of a pendulum to write your name once? Why? How long, or how many swings of a pendulum, would normally take to write a name like Tshering Yangchen? How long do you think it will take to write a name like Bidur Rai?**

Ask questions like: **What other activities, other than writing names, do you think you can do in about 7 swings of a pendulum? How long (in terms of the number of swings of a pendulum) do you think it will take to sing a song?** Ask the students to sing a song (for example, a nursery rhyme). While they sing the song, ask a group of students to silently count the swings of a pendulum that you will set into motion as the song begins. Discuss how long the singing took place, in terms of the number of swings of the pendulum, at the end.

Repeat with other simple activities such as asking as student to run or walk around the school building once, while the other will keep count of the number of swings of the pendulum.

Toward the end, ask questions such as:

Maths Note

It is important for the students to gain a sense of how long a duration is, or how long an event takes place. As with other measurements, before students use standard units (such as minutes) to measure time, they should be using non-standard units. Examples of non-standard units include the swing of a pendulum or the number of times a sand timer must be turned to measure the duration of an event. Students should also get a sense of the size of one minute and one hour.

Assessment for Learning

See that the students can reasonable estimates of the number of swings of a pendulum for certain familiar activities or events.

How can you tell if one event is shorter than another one using a pendulum?
How many swings of a pendulum do you think will happen to wash your hands?
How many swings of a pendulum do you think will happen as you put on your shoes?

Extension

Tell the students that they measure time that some activities take in terms of the number of swings of a pendulum. Tell them that the swings were used as units of measuring time, such as measuring how long it took to write a name, to see how long it takes to sing a song, or to see how long it takes to walk or run around the school building. Explain to them that this gave them an idea of how long it takes to do something, but that in real life we do not normally measure or tell time using the number of swings of a pendulum. In real life, we now measure time in terms of minutes and hours and we use watches or clocks to help us with that. It would be good to tell students that old clocks used pendulums to keep accurate time. So those pendulums were standard units, set to take exactly one second (you can speed up a pendulum by making it a little shorter, or slow it down by making it longer)

To get a sense of the duration of a minute do the following activities:
Start a stop watch, or begin at the start of a minute on your watch, and ask the students to count the numbers slowly. Ask them to stop when it has taken 1 minute. Ask: Up to what number did you count? Tell the students that the time they took to count slowly to (60, if they counted up to 60) was 1 minute.

Ask the students to count the number of swings of a pendulum in 1 minute.
At the end, ask: **How many swings did the pendulum make in 1 minute?**
What takes more time – 1 minute or 10 swings of the pendulum? Why?

Ask the students write their names in their notebooks over and over again at the start of a minute. Ask them to stop when the time of 1 minute is over. Ask the students to tell how many times they have written their names. Inform that the time they had to write their names was 1 minute.

To get a sense of an hour, talk about activities that normally take an hour and that are familiar to the students. For example, it could be the duration of the lunch break in the school; it could be the time it would take to walk from the school to another place in the community; it could be the time it would take to cook and eat a meal; it could be the time it would take to heat water and take a bath.

Toward the end, ask questions such as:
What could you do in a minute?
What could you do in an hour?
Is the difference between an hour and a minute long or short?
Why?

Lesson 6 Days, Weeks, Months and Seasons

Objectives

Estimate and measure the passage of time using days, weeks, month, seasons and years.

Materials

Calendars

Review the names of the days in a week with the students. Ask questions such as: **What day is today? Can you say the names of the days? How many days are there in a week?** Have the student chant the names of the days from Sunday through Saturday. Tell the order of the days in a week with Sunday for the 1st, Monday for the 2nd and so on. Tell that this order does not change, but repeats over and over again. You might use a calendar to help the students with this.

Review the names of the months. **What date is today? What month are we in now? Can you say the names of the month?** Have the students chant the names of the months from January through December. Ask the student how many months there are in a year. Tell the order of the months with January for the 1st month, February for the 2nd month, March for the 3rd month, and so on to December for the 12th month. Tell that this order does not change, but repeat over and over again in cycle. This should be done with the help of a calendar for the year, so that the students can see the order clearly.

Ask the students to investigate the number of weeks in a month. Put the students in groups and ask them to figure out how many weeks there are in a month. You could assign a group to a month. Student would need to consult a calendar in the class. You should first make sure they can identify the length of a week on the calendar. This could be done by asking a student to point out today. And then ask what day is one week from now, and what day is two weeks from now? After finding out the number of week in a month, the groups should report back to the whole class. For example, they should be saying: Our group looked at the month of July. There are 4 weeks and 3 days in July this year.

Toward the end, ask questions such as:

About how many weeks are there in a month?
Can there be more than 5 weeks in a month?
How many days are there in a week?
How many months are there in a year?
What is the first month of the year?
What is the third month of the year?
What month comes after August?
What month comes before December?
What day comes before Thursday?
How long is a week? Which is longer- a week or a month? Why?

Maths Note

Students should gain a sense of how long, relatively speaking, weeks, months, seasons and years are. It is important that students have opportunities to read, use and work with calendars. This extends the work with the calendar they did in Chapter 1.

Students should learn that the cycle of seasons, months and days of the week does not change but the day of the week on which a particular date falls can change from year to year.

Assessment for Learning

See that the students can tell the names of the days and the names of the months in their correct order, and also that they realize there are normally 4 weeks in a month.

Extension

The students should learn that there are 4 seasons in a year and that the seasons cycle – winter, spring, summer and autumn and then back to the next winter. Teach them the names of the seasons, their main characteristics and the months that make up each season in Bhutan. This may be find a good connection with what the students might have learnt in EVS and English. Ask questions such as: **How many seasons are there in a year? What are the names of the seasons? What season comes after winter? What comes after spring? What comes after spring? What is the last season in a year? What happens in winter? How is the weather most of the days in the summer? In which season do we see plants flower? In which season do we harvest rice?** etc.
You might want to provide the following table and fill up what manly happens each of the seasons in discussion with the students.

Seasons	Months	What happens
Winter	December January February	
Spring	March April May	
Summer	June July August	
Autumn	September October November	

Have the students to review and practice saying the names of the days and the months. A good way of rehearsing the days of the week and the months of the year is to have students sit in a large circle. They take turns saying the next day of the week, or the next month. If this circle is done a number of times (preferably not all in the same day) they will memorize the sequence well. It would be beneficial not starting from January always, and not starting from Sunday always, so they note the cyclical nature of these things.

Ask the students to write the names of the days in proper sequence. Although we normally start the days of the week with Sunday and end with Saturday, you should ask the students to start the days of the week with different days too. For example, if you ask the students to start the week with Thursday, they should tell or write the days as: Thursday, Friday, Saturday, Sunday, Monday, Tuesday and Wednesday. This way the students will understand the cyclical nature of the days better.

Ask the students to write the names of the months in order. As with the case of the days in a week, we normally start the names of the month with January and end with December. But you should also ask the students to start with any month and continue the sequence. For example, a student starting with May would continue the sequence as May, June, July … and end with April. This would enable the students to understand the cyclical nature of the months.

Ask the students to write the names of the seasons in order. Again, as in the case with days and months above, you should ask the students to begin with different seasons so that they understand the cyclical nature of the seasons better.

Lesson 7 Time on an Analog Clock

Objectives

Read and write times in hours and minutes from an analog clock.

Materials

A real analog wall clock
Drawings of clocks showing different times to minutes and hours, as shown here

Maths Note

Students have already read times to the hour in Class 1 from analog clocks. An analog clock is simply a clock the face of which shows the numbers from 1 to 12 and the hour, minute and second hands. The time is read according to the position of these hands. In this lesson, the students will learn to read and write times to the hours and minutes. They should focus on telling the time as "a minutes past b hours" initially. The student should know that 60 minutes make an hour. There is no reference to seconds at this point.

With the help of the wall clock, remind the students that the numbers on a clock go from 1 to 12, with 12 at the top of the clock and 6 at the bottom. Show the hour hand, the minute hand and the second hand. Tell them that they will focus on the hour and the minute hands and ignore the second hand for the time being.

See if the students can tell the time at the moment: **What time is it now? How do you know that?** Tell them that the hands are moving because of the battery in the clock, and that if you take out the battery or batteries, the movements will stop. Remove the battery/batteries. Set all the hands at 12. Then, ask: **Where are all the hands pointing at? What time is does the clock show now?** Ask the students to watch as you move the minute hand from 12 and back to it. Ask: **What has happened to the hour hand as I moved the minute hand from 12 and back to it? What time does the clock show now?** Repeat moving the minute hand from 12 and back to it several times, and ask the students to describe the movement of the hour hand and read the time for each complete rotation of the minute hand. Also, ask the students to read the time when the minute hand is at 6. For example: **The minute hand is at 6, which means it have half a rotation, where is the hour hand? Is it half way between (2) and (3)? How would you tell the time at this position of the hour and minute hands?**

Assessment for Learning

See that the students can read and tell the times as "__ minutes past __ o'clock".

Explain to the students that for the hour hand its movement from one number to the next is one hour. So, when the hour hand has moved from 12 to 6, it shows a time of 6 hours; and when it has moved from 12 and back to 12, it has completed 12 hours. But for the minute hand, its movement from one number to the next is 5 minutes. Show the 5 smaller markings between two numbers. So movement of the minute hand from 12 to 1 is 5 minutes; from 1 to 2 shows 10 minutes; from 2 to 3 shows 15 minutes, and so on. Practise counting the minutes from 12 and back to 12 in 5s as 5, 10, 15, 20, … 60.

Ask the students to observe and tell: **How many minutes are measured as the minute hand completes 1 rotation from 12 and back to 12?** (You might have to actually move the minute hand one the clock). **So, when the minute hand measures 60 minutes, how many hours does the hour hand measure? How many minutes is the same as 1 hour? How many minutes are there in 1 hour? How many minutes are there in half an hour?**

Then, teach the students how to read times in terms of minutes and hours as "a minutes past b o'clock". Position the minute and hour hands as shown here and read the times as, "15 minutes past 1 o'clock". Tell why or how the minute

hand is showing 15 minutes and that it is after 1 o'clock.

Then, show the minute hand pointing at 6 and the hour hand pointing at mid-way between 1 and 2; read the time as "30 minutes past 1 o'clock". Explain that it means 30 minutes after 1 o'clock and ask why the hour hand is half way between the 1 and the 2.

Then, show the minute hand pointing at 11 and the hour hand pointing almost at 2; and read the time as "55 minutes past 1 o'clock". Ask the students why the hour hand should be between the 1 and 2, and that why it should be closer to the 2 than the 1.

Then, show the minute hand pointing at 12 and the hour hand pointing at 2; and read the time as 2 o'clock. Explain that it is the same as "60 minutes past 1 o'clock".

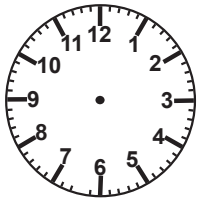
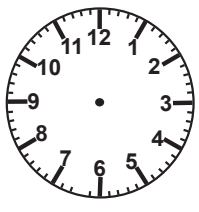
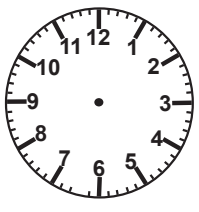
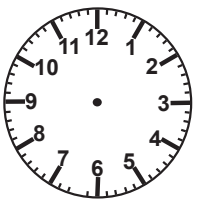
Position the minute and the hour hand at various places, and ask the students to read the time appropriately each time as "__ minutes past __ o'clock". Include cases where the minute hand is showing the minutes other than the multiples of 5 such as 33 minutes past 5 o'clock.

Put up the chart, prepared in advance, as shown here. Ask the students what time each clock is showing. Ask some students to come to the front and write the numbers for the minutes and hours.

 ___minutes past ___o'clock	 ___minutes past ___o'clock	 ___minutes past ___o'clock	 ___minutes past ___o'clock

Extension

Put up the drawings of the faces of the clocks without the hour and the minute hands along with the descriptions of the times for each on a char paper as shown here. Model drawing the hour and the minute hands for the first clock. Remind the students that the hour hand should be shorter and the minute hand should be longer. Ask some students to come to the front one by one and draw the hour and the minute hands on the face of the clock for the time described. Ask the rest of the class to confirm. The drawing could be drawn with pencils, so that they could be erased and corrected if need be.

 25 minutes past 8 o'clock	 10 minutes past 3 o'clock	 41 minutes past 5 o'clock	 35 minutes past 10 o'clock

Have the student compete the relevant activities in their Student Activity Books.

Lesson 8 Time on a Digital Clock

Objectives

Read digital clocks and write times in digital clock format.
Read analog clocks and write time in digital clock format.

Materials

Analog watches
Digital watches
The two chart drawings made for the last lesson

> **Maths Note**
>
> Students need to learn to read digital clocks, as they become more prevalent in society and know what times like 8:30 or 7:15 mean. They need to know that the number after the colon tells how many minutes have passed after an hour which is shown by the number before the colon. They should learn that the o'clocks corresponds to writing :00 after the hour numbers.

Tell the students that there are two types of clocks or watches. Tell them that some clocks show the hour and the minute hands, like the ones they have used so far. You might tell that these types of clocks are called analog clocks. Tell them that some clocks show only the numbers such as 2:30. You might tell them that such clocks are called digital clocks. If possible show to the students both the types of watches and describe the differences more clearly. Some student might be wearing the watches.

Put up a drawing of an analog clock showing a time such as 25 minutes past 2 o'clock as shown below. Then, put up the drawing of a digital clock showing the same time. Read the time as "two twenty five". Explain that the number after the colon shows that minutes past after the hour and the number before the colon shows the hour.


A digital watch


An analog watch

Draw the students' attention to the drawings of the analog clocks on the chart papers used during the last lesson. Ask them how they would write each of the times in digital clock format. You could ask the students to come to the front and write the times in digital format for each of the drawings on the charts. Ask the students to read the time in digital format as "three ten" for 3:10. Ask them to explain what 3:10 means as 10 minutes past 3 o'clock.

Toward the end, ask questions such as:

How will you see the time on a digital clock for 30 minutes past 2 o'clock?
How would you read 6:15? What does that mean?
What time will it be 15 minutes before 8 o'clock?

> **Assessment for Learning**
>
> See that the students read the times shown by digital clocks or written in digital clock format. And also see that they can explain what they mean.

Extension

Have the students complete the relevant activities in their Student Activity Books.

Lesson 9 Elapsed Time

Objectives

Calculate the amount of time between two events where only simple calculations are required.

Materials

Wall clock (or an improvised wall clock)

Remove the batteries from the wall clock and set the clock to 2:30. Ask: **What time does the clock show?** Encourage the students to tell it as both "two thirty" and "30 minutes past 2 o'clock". Then, ask: **We can also say that the clock shows half past two. Why can we say that the time is half past two?**

It is likely that some students will know why or figure out why for the question above. You could then reaffirm (and repeat) what the student(s) said or explain here if the students could not figure out why: Explain to the students that since 60 minutes make an hour, 30 minutes means half an hour. Therefore, 30 minutes past 2 o'clock can be said as "half past 2 o'clock". Explain further that the hour hand is point half way between 2 o'clock and 3 o'clock.

Practise reading times as "half past __ o'clock" by pointing the minute hand at 6 and the hour hand at various appropriate places half way between two numbers.

Tell the students various stories with times involving o'clocks and half hours in which they have to calculate the time difference. You could use the examples suggested below.

I cleaned my house yesterday. I started the cleaning at 5 o'clock and finished it at 7 o'clock. How many hours did I spend in cleaning my house?

The bus from Paro to Thimphu starts at half past 9 o'clock from Paro and reaches Thimphu at 11 o'clock in the morning. How many hours does the bus take for the journey?

The same bus returns to Paro in the afternoon from Thimphu. It starts at 1:00 and reaches Paro at 2.30. How many hours does the bus take for the return journey?

Kaka studies from 5:00 to 6:30 in the evenings. How many hours does he study?

The monks in the dzongs wake up at 5 o'clock in the morning and have their breakfast at 8 o'clock. How many hours are there between their wake-up time and breakfast?

A hospital opens at 9:00 in the morning and closes at 2:00 in the afternoon on the Saturdays. How many hours does the hospital remain open on the Saturdays?

Maths Note

Students should be able to determine how much time has passed between two events, or between two times. For example, they should realize that there are 2 hours between 3 o'clock and 5 o'clock and 2 and a half hours between 3:00 and 5:30. They should learn that since 60 minutes make an hour, 30 minutes is half an hour. Therefore, they should also learn that "30 minutes past 2 o'clock", or 2:30, can be said as "half past 2 o'clock".

Assessment for Learning

See that the students can calculate and tell the amount of time between two events.

Students should experience a number of situations involving these sorts of times. You could also ask the students how many hours they spend in the school on a typical day. Ask questions like: At what time do you arrive in the school? At what time do you go home from the school? How many hours do you spend in the school?

Extension

Tell the students simple stories in which you tell the initial time and the amount of time it takes to complete and ask the students to determine the time at the end. You could use similar to the examples suggested below.

> **I started washing my cloths at 5 o'clock. It took one and half hours to finish the washing. What would be the time when I finished washing the cloths?**
>
> **A monk prays for 1 hour every morning. If he starts his prayer at 5 o'clock, when does he finish his prayers?**
>
> **Jigme ran for 1 hours starting at 6:30 in the morning. What would be the time when he stopped running?**

Have the students complete the relevant activities in their Student Activity Books.

Chapter Assessment

Formative Assessment

Formative assessment ideas, tips and reminders are provided within each lesson under the heading called Assessment for Learning. In addition, you should use a formative assessment tool called the Chapter Checklist. Prepare the Formative Assessment Recording Sheet for the chapter as shown below. You should look for evidence in each student, throughout the teaching of the chapter, that he or she has understood the key concepts and can perform the key mathematical skills by ways of observing, listening and asking probing questions. Accordingly, keep the records for each student by putting a mark, such as a tick mark, for each of the chapter goals once you are convinced that the student has achieved them. You could also keep relevant anecdotal records.

Using the Chapter Checklist purposefully will give you the benefit of ensuring that each student's learning progress is assessed in a systematic manner. What is even more important is the opportunity it will provide you to help each student along in achieving the chapter goals. Since this is meant as a formative assessment tool, you will not be giving any mark to the students by using it. However, investing time in carrying out this assessment technique will contribute positively in the students being able to do well in the summative assessments, including the examinations. You can also refer back to these records as you look for progress during the year and/or seek to address areas of concern.

Formative Assessment Recording Sheet
CHAPTER 10 MEASURING MASS, CAPACITY AND TIME

Chapter Checklist (Look for evidence throughout the chapter that the student has understood the key concepts and can perform the key skills.)

Student Name		Chapter Goals (The student is able to):						
		Measure mass using non-standard units and in kilograms.	Measure capacity using non-standard units and in litres.	Tell the names of days, months and seasons in sequences.	Tell the relationships between days, weeks, months, seasons and years.	Read and write times to hours and minutes from an analog clock.	Read and write times to hours and minutes from a digital clock.	Calculate the time elapsed between two events.
1								
2								
3								
4								
5								
6								
7								
8								

Summative Assessment

As explained in the Introduction to the Teacher's Guide, the student's learning in each chapter will be measured primarily through the use of an assessment method called the Interview-based Performance Task. The primary purpose of this assessment is to thoroughly assess the level of understanding of the students in terms of the key concepts and skills as required in the chapter. It provides an opportunity for the students to display their understanding by ways of telling, describing, showing, and demonstrating in a non-threatening environment.

One of the beauties of this assessment method is that it allows you to teach and clarify things even as you are assessing the students. The fact that you have to provide marks to the students through the use of Interview-based Performance Tasks should be considered a secondary purpose. The Summative Assessment Recording Sheet (shown on the next page) is included in the Student Activity Book for your use with each student. Please refer to the Introduction to the Guide for the details on the marking scheme.

Summative Assessment Recording Sheet

Student Name: _____ Roll no.: ____ Section: ____

CHAPTER 10 MEASURING MASS, CAPACITY AND TIME

Interview-based Performance Task (Please refer the Introduction to the Teacher's Guide for Class 2 for the marking scheme while using the Interview-based Performance Task.)

Task and Interview prompts	Key concepts and skills to look for
Have some rice (or sand), an empty plastic bag, a pan balance, and 1 kg weight (or 1 kg mass such as a package of salt). Tell/ask the student: **Put about a kilogram of rice in this plastic bag. How do you know that it is about 1 kilogram? How can you measure it so that you have exactly 1 kilogram of rice here? Can you measure 2 kilograms of rice in another plastic bag?** Have a container which has a capacity of 1 litre such as a mineral water bottle, a larger container, a bucket of water, a jug and a funnel if possible. Tell the student that the bottle has a capacity of 1 litre. Ask/tell the student: **What would be the capacity of this (larger) container? How can you measure it? What is the capacity of it?** Draw a diagram of an analog clock showing a time such as half past 3 o'clock. Ask/tell the student: **What time does this clock show? What is another way of saying this time?**	The student is able to: - Estimate a mass of 1 kilogram reasonably. - Measure mass in kilograms. - Predict or estimate the capacity of a container in litres reasonably. - Measure the capacity of a container in litres. - Describe or express the capacity of a container in litres appropriately. - Read the times from and analog clock. - Tell a time in terms of "__ minutes past __ o'clock". - Tell the time in digital clock format such as "two thirty" for 2:30.

Comments and Marks

Strengths:

Areas of Need:

Follow up Steps:

Teacher's Signature and Date:

Summary of the Summative Assessment for Chapter 10

CA marks from Chapter 10 (Marks out of 10): _____