



MINISTRY OF
EDUCATION

SAMPLE LESSON PLANS

**STRANDS: Number,
Measurement, Geometry,
Statistics and Probability and
Algebra**

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Acknowledgements

The handbook, **Sample Lesson Plans for Primary Schools**, is a direct response by the Ministry of Education to promote numeracy within the school for each teacher.

This book has taken a number of months to complete. The period of time has made it possible to appraise and test the lessons using various strategies to ensure their effectiveness. The team of persons who worked on this project have years of experience in the teaching and learning process in the classroom. They have contributed to the intellectual stimulus which aids the successful completion of this project.

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Seymour Hamilton
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Introduction

It is the start of the new school year and Mrs. Baxity is thinking about her new students and the mathematics lesson she has to deliver. She will be meeting her students for the first time, but already has their performance data at hand. She has to teach 'Number', but is quite puzzled. She is aware that she will need to deliver an effective mathematics lesson – one that will heighten students' interest, build computational fluency and develop their skills to reason and solve problems.

Most classroom teachers will admit they have had an experience similar to Mrs. Baxity's; planning an effective mathematics lesson can be challenging. In light of the varying learning styles of students, it is of paramount importance that lessons are designed to meet such diverse needs and to maximize all students' learning.

Mathematics should be taught through processes which focus on modelling, communication, connections, reasoning, proofs and problem solving. Such processes should be considered when planning to teach a lesson in any of the mathematics strands: Number, Geometry, Measurement, Algebra, Statistics and Probability. Effective teaching requires the development of students' cognitive abilities; students' learning occurs most efficiently when they are afforded rich experiences through a student-centred, activity based approach. Effectively employing such an approach requires careful planning of lessons.

This handbook is designed to provide teachers with lesson planning ideas for the teaching of mathematics at the primary level. It features a set of sample lesson plans for each of the five content strands of the Revised Primary Curriculum: Number, Geometry, Measurement, Algebra, Statistics and Probability. Lessons have been included, per strand, for each GRADE LEVEL so that teachers of all grades in the primary school may glean ideas for improving their lessons.

The lessons are written using a "three-part" model: STARTER ACTIVITY, MAIN ACTIVITY and PLENARY. Appropriate ASSESSMENT activities are also included. The STARTER ACTIVITY is intended to awaken students' interest in the TOPIC to be taught. Some of these activities may also be useful in assessing students' mastery of the prerequisite concepts and preparing them for the TOPIC to be delivered. The MAIN ACTIVITY is the key teaching point of the lesson and usually entails students discovering some new idea through their engagement in carefully planned activities. The PLENARY acts as the summary for the lesson and cements the TOPIC taught.

The lessons included in this handbook are meant to be a guide for the teacher in selecting learning objectives and corresponding teaching strategies for attaining these objectives. The order in which lessons are presented in the handbook is not to be taken as a model for sequencing the teaching of various concepts. Each lesson is to be considered on its own. While complete lessons are presented, the writers are aware that there are various formats for lesson plan writing. Teachers are therefore free to modify the lessons according to the accepted lesson plan format for their school and the abilities and interests of the students. Care should be taken however to ensure that all the critical elements of the lesson plan are maintained.

NUMBER

LESSON 01 ○ ORDINAL NUMBERS

SUB-TOPIC: Identifying ordinal numbers

GRADE LEVEL: Grade 1

DURATION: 1 hour

SPECIFIC OBJECTIVE



By the end of the lesson, students should be able to:

- use the ordinal numbers first, second, third, through to fifth

PREREQUISITE KNOWLEDGE

Students should already:

- a) have knowledge of number names and their symbols up to 10
- b) be able to count in order up to 10

MATERIALS/MANIPULATIVES

Picture, number cards, word cards, objects from the environment

CONTENT OUTLINE

- An ordinal number is a number that states the position of an object in a sequence.
- The symbolic representations of ordinal numbers are formed by combining the corresponding cardinal number and the last two letters of the ordinal number name.
- Note the pattern:
 - First is written by combining 1 and st to produce 1st
 - Second is written by combining 2 and nd to produce 2nd
 - Third is written by combining 3 and rd to produce 3rd
 - Fifth is written by combining 5 and th to produce 5th

PROCEDURE

Mental/Oral Starters

- The entire class will be taken outside in a controlled area. Several items (such as a leaf, a stone, a stick, a bottle cover, or a bottle) will be strategically placed for five students to find. All five students will return to the starting point with the objects.

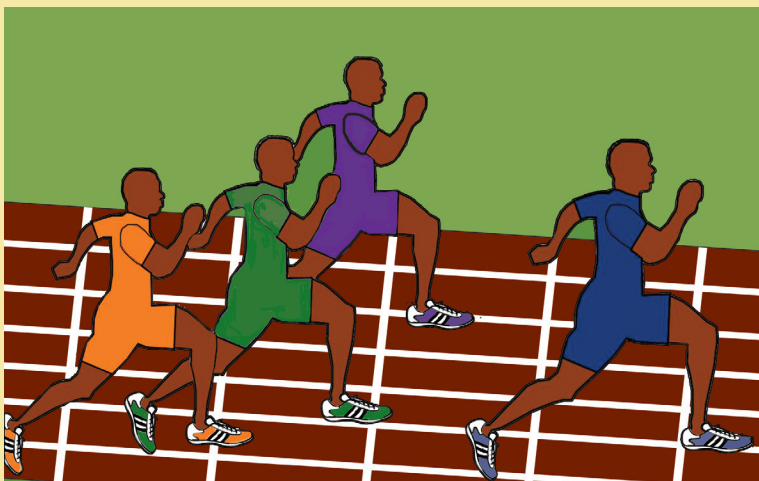
Main Activity

- The five students who participated in the race will be asked to line up in the order in which they returned to the starting point. The class will be asked to explain why each child was placed in his or her respective position. Through further discussion, the concept of first, second, third, fourth and fifth will be established.
- The students who participated in the race will be given cards with the names of their positions. Five other students will be given cards with the numbers 1 to 5. They will be asked to stand beside their “partner” already in line. Each pair of cards will be placed on the chalkboard.
- Children attach ordinal number cards to the first 5 positions in race.
- The class will be engaged in discussions to ascertain if they can write symbolic representations for ordinal numbers. Students will then be selected to write the symbols for ordinal numbers first to fifth on the chalkboard.

PLENARY

Students will observe the picture below which depicts a 100m final. They will listen while the teacher reads the story, “The Race”, recorded below. The students will be later engaged in a discussion about the outcome of the race.

The Race



Marlon and John are the fastest runners at Hope Primary School. They were very excited as it was Sports Day and they would both compete with each other in the final race of the day. The gun went off and the boys started running. Members of their houses were cheering as they knew either boy would win. As the race progressed, the cheering slowly died

down, as Paul, a tall unpopular boy, ran past the other boys as they approached the finish line. Everyone was surprised to see that Paul won the race, outpacing Marlon who came second and John who came third. They both started crying. James, who always finished last, was very happy because he was fourth.

ASSESSMENT

Divide the class into groups of 5. To each group, randomly distribute pre-prepared 2-sided cards with the ordinal number symbol on one side and its ordinal number name on the other side (each group gets a set of cards with ordinal numbers 1st/first to 5th/fifth). Instruct students to order themselves based on the position on the card they receive.

LESSON 02 ○ ORDINAL NUMBERS

SUB-TOPIC: Sequencing

GRADE LEVEL: Grade 1

DURATION: 1 hour

SPECIFIC OBJECTIVES

By the end of the lesson students should be able to:

- apply ordinal number concepts to real-life situations
- use the terms "before" and "after" correctly in relation to ordinal numbers



PREREQUISITE KNOWLEDGE

Students should already:

- have knowledge of number names and symbols
- have basic knowledge of ordinal numbers
- have knowledge of the names and order of the days of the week and the months of the year

MATERIALS/MANIPULATIVES

Coloured chalk, calendar, name cards (days of the week and months of the year), picture story cards

CONTENT OUTLINE

- An ordinal number is a number that states the position of an object in a sequence.
- The symbolic representations of ordinal numbers are formed by combining the corresponding cardinal number and the last two letters of the ordinal number name. For example:
 - First is written by combining 1 and **st** to produce 1st.
 - Second is written by combining 2 and **nd** to produce 2nd.
 - Third is written by combining 3 and **rd** to produce 3rd.
 - Twelfth is written by combining 12 and **th** to produce 12th.

PROCEDURE

Mental/Oral Starters

- The students will observe a sequence of three actions demonstrated by the teacher. The class will then list the actions performed in order.
 - Touch your head (first), stand at attention (second), and hop (third)
 - These will be written on the chalkboard and used to play “Simon says”

For example, the command “Simon says third action” would be given and students would be required to hop. Teacher will indicate the time allotted for this activity.

Main Activity

- Students will be asked to read or say the months of the year as the teacher points to the words on her chart.
- Five students will be asked the months in which they were born. They will be given a card on which their birth month is written. Teacher will pose the following questions to the class:
 - a) Whose birthday comes first?
 - b) Whose birthday is last?
 - c) Whose birthday is third?
 - d) Whose birthday comes after _____?
 - e) Whose birthday comes before _____?
- The chalkboard will be divided into two columns. In one column the ordinal numbers 1st, 2nd, 3rd ... 12th will be written. The other column will be labelled “months of the year”. The students will be asked the following questions in the stated order. Once the correct answer for a question is received the student who provided the answer will be given a name card to place on the board beside the relevant position.
 - a) What is the third month of the year?
 - b) Which month comes before the third month?
 - c) Which month comes after the third month?
 - d) Which month comes before the second month?
 - e) What is the ninth month of the year?
 - f) Which month comes before the sixth month?
 - g) Which month comes after the sixth month?

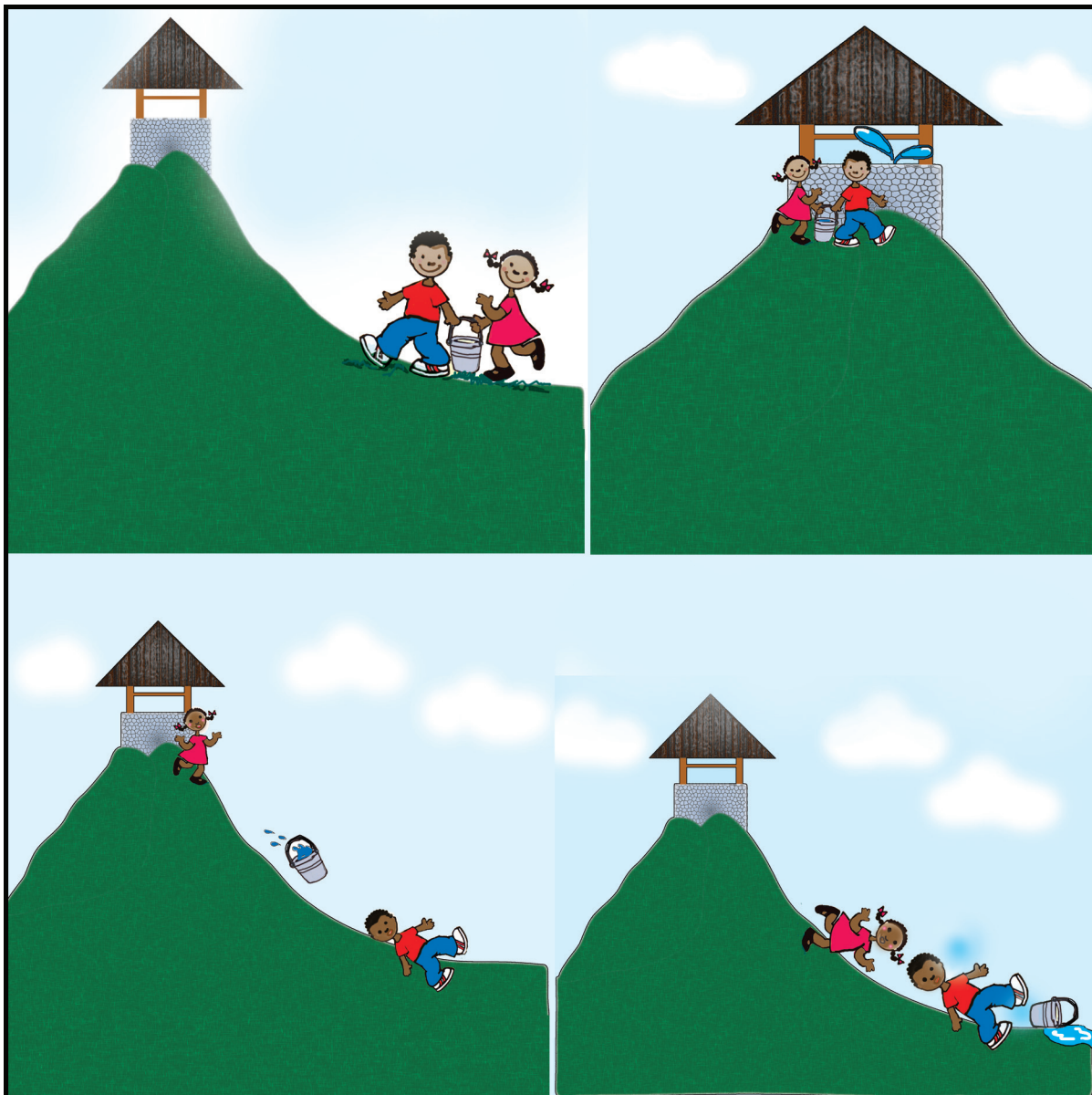
PLENARY

Students will be asked to pick cards from a box with the months of the year written on them. They will place them on an interactive chart with slots that are labelled 1st month, 2nd, 3rd, etc. This will be followed by a discussion about the students' placement of the cards.

ASSESSMENT

Students and teacher will read the nursery rhymes ("Jack and Jill" and "Little Miss Muffet") from a chart, multimedia, etcetera, so that they are reminded of the sequence of events in the stories. The students will be placed in groups and each group given a set of picture cards. The task is to arrange the cards in the correct order to tell the story. In addition, questions related to the stories will be given. (These questions are listed below at end of the two picture stories.)

JACK AND JILL



Little Miss Muffet



- What happened first?
- What happened after... (Miss Muffett saw the spider) (Jack fell down)?
- What happened before... (she saw the spider) (Jack and Jill got the water)?
- Describe the third picture.

LESSON 03 ○ PLACE VALUE

SUB-TOPIC: Understanding place value

GRADE LEVEL: Grade 2

DURATION: 1 hour

SPECIFIC OBJECTIVES



By the end of the lesson, students should be able to:

- use concrete materials to group objects to illustrate tens and ones
- use symbols (numerals to represent groups of tens and ones)
- identify the place value of digits in a two-digit base ten numeral

PREREQUISITE KNOWLEDGE

Students should already know:

- a) how to count from 1 to 100
- b) how to count in twos and threes

MATERIALS/MANIPULATIVES

Interlocking cubes, die, organizational mats, counters (bottle caps, fudge sticks, etc.)

CONTENT OUTLINE

Place value is the *position of each digit* in a number. The place value of each digit in a number increases in powers of tens, from right to left. In a two digit number, there are two place values, Tens and Ones.

PROCEDURE

Mental/Oral Starters

Place students in groups of four and provide each group with one of the following sets of counters:

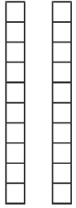

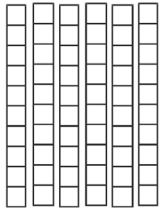

- 14
- 19
- 21
- 26
- 30
- 43

Instruct students to form as many groups of ten as possible using the set given.

Each group should report results.


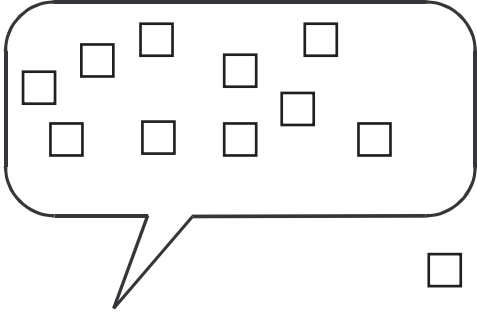
Main Activity

The whole class will observe as the teacher uses an organizational mat to show the following numbers: 21, 18, 62 and 55.

	Tens	Ones
21		
2 tens and 1 unit show 21		
62		
6 tens and 2 units show 62		

Children will be provided with counters (cubes, bottle caps, etc.)

Working in pairs, students will take turns to toss a die. For example, Mike tosses the die and gets a 6; he counts out 6 cubes and places them in the ones column. Mike tosses again and gets a 5; he counts out 5 and places them in the ones column. He notices that he can exchange a group of 10 cubes for 1 ten with one remaining. The trading game continues until all the cubes that were provided are used up.

Tens	Ones
	

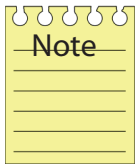
PLENARY

Hundred Chart Activity

Using mini-hundred charts, students will be asked to shade the numbers according to clues given to them. The numbers that are shaded on their mini-hundred chart should form a design.

Examples of clues to be given to students include:

- a) Mark the numbers with '4' in the tens place and '8' in the ones place.
- b) Mark the numbers with '6' in the tens, and '2' in the ones place.
- c) Mark the numbers with '5' in both places.



Decide on a design and provide the additional clues as required. Example, to teacher: circle the number which has 2 in the tens place and 3 in ones place.

HUNDRED 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

ASSESSMENT

Students will be given a Place Value Worksheet to complete.

PLACE VALUE WORKSHEET
<p>1. Write the number that has a five in the ones place and a three in the tens place.</p> <p>The number is : _____</p>
<p>2. a) What is the place value of each digit underlined in the numerals below?</p> <p style="text-align: center;"><u>5</u>2 6<u>7</u> 9<u>8</u></p> <p>The PLACE VALUE is: _____ _____ _____</p>
<p>b) Students will be shown diagram of articles in tens and ones and asked to write the numeral to represent these. <i>E.g. Ten fishes plus one fish gives _____.</i> (Expected response is 11.)</p>

LESSON 04 ○ ADDITION WITH RENAMING

SUB-TOPIC: Adding whole numbers with a sum less than one hundred
GRADE LEVEL: Grade 2
DURATION: 1 hour

SPECIFIC OBJECTIVES

By the end of the lesson, students should be able to:

- add a two-digit number to a one- or two-digit number with or without renaming
- solve problems requiring the addition of two-digit numbers with or without renaming



PREREQUISITE KNOWLEDGE

Students should already:

- have a clear understanding of the 'ten make one' aspect of the base ten system
- have a basic understanding of addition facts
- know how to count and identify numbers up to 99
- be familiar with correct representation of two-digit numbers on place value chart
- be familiar with base ten materials

MATERIALS/MANIPULATIVES

Base ten materials, problem wheel, card with 'mental starter', chart with story

CONTENT OUTLINE

- Addition is the combination of two or more sets
- Renaming is necessary when a sum of ten or more is obtained.

PROCEDURE

Mental/Oral Starters

–What is the message?

Solve each addition problem and, using the code below, write the corresponding letter on the line and decode the secret message.

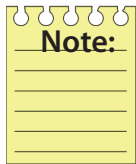
$$\begin{array}{r} \overline{3+5} \quad \overline{7+2} \quad \overline{6+1} \quad \overline{4+2} \quad \overline{3+2} \quad \overline{3+1} \quad \overline{2+1} \quad \overline{0+2} \quad \overline{6+4} \end{array}$$

A = 9 F = 3 T = 7 U = 2 N = 10

S = 4 I = 5 M = 8 H = 6

Main Activity

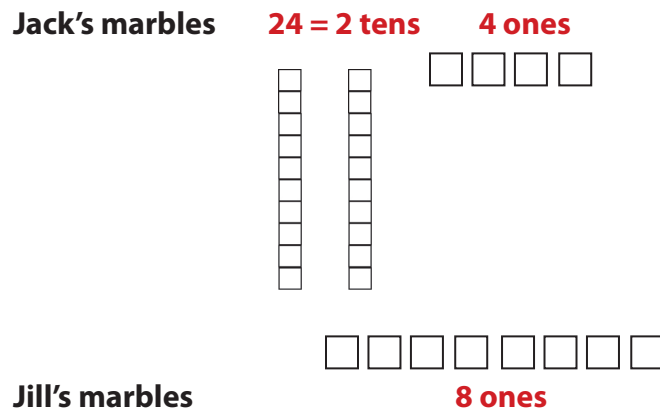
- Manipulatives will be placed on the desks – longs (one group of ten), and ones – while students work at the mental starter. Each child should be given ten longs and thirty ones.
- Review tens and ones using the story below.



Note: *The story will either be written on the board before the class begins or on a chart, so that teacher and students can read it together*

Jack and Jill were on their way to school. They stopped at a shop, Jack bought 24 marbles and Jill bought 8.

Students will use manipulatives to show Jack's marbles and Jill's marbles.



Students will be asked the following questions:

- How many groups of ten and ones are in the group of marbles Jack bought?
- How many marbles did they buy altogether?
- Give the children time to investigate and use their own strategy to arrive at the answer. Collect the answers and ask individual students to explain how they arrived at their answer. Represent some of these strategies on the board.

- Select the strategy where students trade ten ones for one long for further discussion to bring out renaming as shown below.
- Through questioning, students will be guided to realize that the problem $24 + 8$ can also be written as
- The use of the columns will be facilitated to make a connection to what was practically done. In this method, the ones column is first added. If there are ten or more ones, we trade ten of them for a long as shown above.

$$\begin{array}{r}
 24 \\
 + 8 \\
 \hline
 \end{array}$$

$24 + 8 = 32$

- The 2 tens are now increased to 3 tens. The remaining ones, in this case 2 ones, are written under the ones column.
- **Problem Wheel** – A wheel is to be created with eight sectors. Each sector of the wheel will contain a simple addition story problem.
- Working in pairs, students will take turns to spin the wheel. With the use of flats and longs they will model and solve the story problem indicated by the pointer.

PLENARY

Engage students in a discussion about the need for renaming when adding two-digit numbers.

Suggested questions include:

- When does it become necessary to rename?
- Can you think of some addition problems where renaming would be necessary (or not necessary)?

ASSESSMENT

Each child picks a problem from a grab bag and provides a solution utilizing flats and longs.

Students could use blocks to represent solutions in at least two different ways.

LESSON 05 ○ CHANGING MIXED NUMBERS TO IMPROPER FRACTIONS

GRADE LEVEL: Grade 3

DURATION: 1 hour

SPECIFIC OBJECTIVES



At the end of this lesson, students should be able to:

- identify mixed numbers
- write mixed numbers as improper fractions

PREREQUISITE KNOWLEDGE

Students should possess knowledge of:

- a) the four basic operations on proper fractions
- b) the concept of fraction (how many halves, thirds, fourths, etc. make up the whole)
- c) types of fractions (improper, mixed, proper)

MATERIALS/MANIPULATIVES

Fractional pieces (two sets of fractional pieces), fraction bingo, worksheet

CONTENT OUTLINE

- An improper fraction is a single fraction that is more than a whole, which is expressed with the number representing the numerator being larger than the number representing the denominator. Example $\frac{5}{3}$.
- A proper fraction is a single fraction that represents an amount that is less than the whole, which is expressed with a numerator that is smaller than the denominator. Example $\frac{2}{3}$.
- A mixed number consists of a whole number and a proper fraction Example $1\frac{2}{3}$.

PROCEDURE

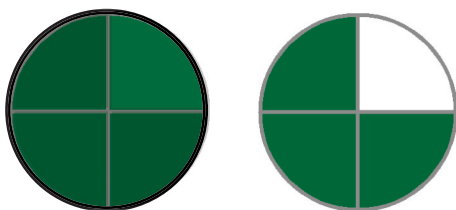
Oral/Mental Starters

- Students will be given pairs of colour coded cards with cues such as bun, cheese, bread, butter, Adam, Eve, etc. One colour will represent numerator and the other colour will represent denominator. The cards will be designed with numbers to give an improper fraction when matched. Students will be asked to find their partner and read the improper fraction formed.

Main Activity

- Students will be placed into groups. Each group will be given a different number of fractional pieces representing different fractions, e.g. thirds, fourths, fifths, etc. as revision. Each group will then be asked to use their fractional pieces to make as many wholes as possible. For example, students with thirds could make 1 whole with three thirds.
- The students will be asked to explain their models. *Example:* How many pieces did you begin with? How many wholes were made? How many were left over? How would you call this fraction? How would you write it? What represents the numerator, denominator, and the whole? (Emphasis must be placed on identifying the three parts: whole number, denominator and numerator.) I had 4 thirds which is the same as $1\frac{1}{3}$.
- Students will be given other fractional pieces. They will be led into counting the number of each fractional piece that they have and then writing these in words on the board. Example: One group has eight thirds, another five halves, and another nine fifths. They will then assemble them into wholes and fractional parts and be required to write the mixed number form of the fractional pieces given.

For example:

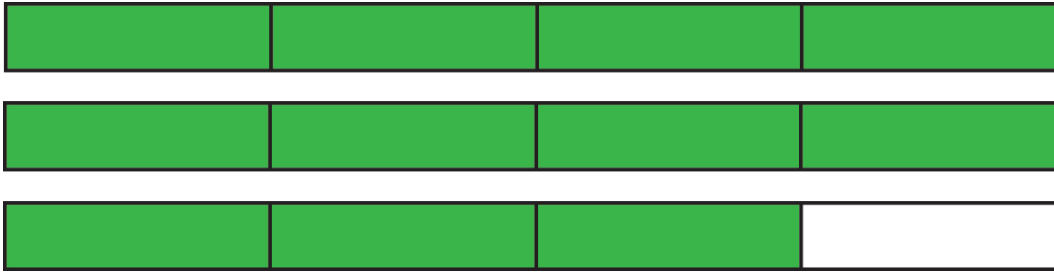


7 parts modelled and the size of each part is one-fourth, therefore this is written as improper fraction seven-fourths written as $\frac{7}{4}$ which is the same as $1\frac{3}{4}$ as a mixed number.

- Using the diagram below, students will be guided through questioning to seeing and understanding that the total number of parts used is the numerator, and the size of each part gives us the denominator.

Questions

1. How many parts are shaded in the three shapes below? (*Expected response* 11)
2. What is the size of each part? (*Expected response* fourths)
3. Which represent the numerator and which represent the denominator?
4. How would you write this as a fraction? (*Expected response* $1\frac{11}{4}$)
5. How many wholes are there? (*Expected response* 2)
6. How many fourths are remaining? (*Expected response* $\frac{3}{4}$)
7. How would you write this as a mixed number? (*Expected response* $2\frac{3}{4}$)



PLENARY

Students in groups will explain in their own words how to write a mixed fraction from a model. This will be organized as notes for students.

ASSESSMENT

The teacher will guide students in a bingo game (Matching Three)

Rules

- The teacher will display a card showing a model of a mixed number
- If the mixed number is on a student's game card, he or she may cover it
- The first player with three in a row calls out "BINGO"
- That player reads out his or her covered numbers for the teacher to check. If correct, the game is over and a new game will begin.

Sample Bingo Card

$3\frac{1}{5}$	$2\frac{1}{4}$	$3\frac{1}{5}$
$2\frac{1}{3}$	$1\frac{2}{5}$	$2\frac{1}{2}$
$2\frac{3}{5}$	$3\frac{3}{4}$	$\frac{5}{4}$

LESSON 06 ○ ADDITION WITH RENAMING

GRADE LEVEL: Grade 3

DURATION: 1 hour

SPECIFIC OBJECTIVES

By the end of the lesson, students should be able to:

- add whole numbers up to six digits
- solve problems which require the use of addition



PREREQUISITE KNOWLEDGE

Students should already be able to:

- add numbers without renaming
- rename up to thousands
- identify the value of each digit in a number up to four digits
- understand addition

MATERIALS/MANIPULATIVES

Dienes blocks (flats, longs and units), abacus, worksheets, cards with problems

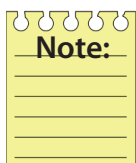
CONTENT OUTLINE

- The decimal system is based on a 'ten make one' relationship. Each place value is ten times greater (or less) than the place to its right (or left).
- Addition is an operation on two or more numbers that gives a sum greater than each of the addends.

PROCEDURE

Mental/Oral Starters

Students will create palindromes from numbers that are not palindromes without renaming. These numbers will be given to the students. Examples: 123, 12 and 53. This is to review addition without renaming.



Note: *Palindromes are numbers that are read the same way forward or backward.
Example: 444 or 282.*

The Activity

Step 1: Write a given number

Step 2: Write the reverse of the number

Step 3: Add the numbers together. If the result reads the same in either direction it is called a palindrome

For example, $123 + 321$

$$\begin{array}{r} 123 \\ + 321 \\ \hline 444 \end{array} \qquad \begin{array}{r} 321 \\ + 123 \\ \hline 444 \end{array}$$

Main Activity

- Students in groups will be given base ten pieces (flats, longs and units) and cards with the same problems. (All groups will be given the same problem.)

The first problem will be done as follows:

Sandy bought 478 toys and Kim bought 637 toys. How many toys did they buy altogether?

- Students will read the problem.
 - Students will write number sentence representing the problem ($478 + 637$).
- Students will represent the problem on a place value chart or abacus and solve using their base ten pieces (Dienes blocks).

Thousands	Hundreds	Tens	Ones
	4	7	8
	6	3	7
1	1	1	5

15 ones = 1 ten and 5 ones

11 tens = 1 hundred and 1 ten

11 hundreds = 1 thousand 1 hundred

- The other problems will be done similar to the example used above.

PLENARY

Engage students in a discussion about the need for renaming when adding numbers. Suggested questions include:

- When does it become necessary to rename?
- Can you think of some addition problems where renaming would be necessary (or not necessary)?

ASSESSMENT

Play Addition Relay Game

Place students in teams of no more than seven. The first person in each team will complete the first problem on the worksheet. Then he/she will pass the worksheet and a pencil to the next person in his/her row. This will continue until all problems are sequentially completed by the team.

Rules of the Game

- Each player must contribute to the team by working a problem when it is his/her turn.
- Discussion of answers should only be done after the game.
- The team that finishes first with the most correct responses will be the winner.

Students will discuss their challenges and share their successes/attempts.

WORK SHEET

1.
$$\begin{array}{r} 2\ 341 \\ + 7\ 662 \\ \hline \end{array}$$

Answer: _____

2. Tony has \$17,052 in his bank account. His brother Mark has \$23,459. How much do they have altogether?

Answer: _____

3.
$$\begin{array}{r} 2\ 935 \\ + 3\ 765 \\ \hline \end{array}$$

Answer: _____

4.
$$\begin{array}{r} 5\ 460 \\ + 5\ 939 \\ \hline \end{array}$$

Answer: _____

5.
$$\begin{array}{r} 5\ 772 \\ + 5\ 432 \\ \hline \end{array}$$

Answer: _____

5. John has 4,375 marbles. His brother gave him some more marbles, and he now has 4,500 marbles. How many groups of 25 marbles should he add to his original number to get 4,500 marbles?

Answer: _____

6. A baker baked 567 loaves of bread. Another baker baked twice as many. How many did they bake altogether?

Answer: _____

7. There were 2,325 football fans in the National Stadium for the game on Friday night. On Saturday there were 3,627 fans. What is the total number of football fans that came to both games?

Answer: _____

LESSON 07 ○ FRACTIONS

SUB-TOPIC: Addition of fractions with unlike denominators
GRADE LEVEL: Grade 4
DURATION: 1 hour

SPECIFIC OBJECTIVES

By the end of the lesson, students will be able to:

- apply equivalence to the addition of fractions



PREREQUISITE KNOWLEDGE

Students should already

- have a conceptual understanding of a fraction
- have an understanding of equivalent fractions
- be able to identify 'like' fractions
- have an understanding of multiples
- be familiar with the use of fraction pieces

MATERIALS/MANIPULATIVES

Fraction pieces

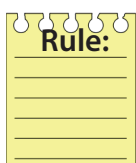
CONTENT OUTLINE

Addition of two or more fractions is the combination of the fractions which results in a sum that is greater than the addends. To add fractions with different denominators, the concept of equivalence is applied so that all the addends can have a common denominator.

PROCEDURE

Mental/Oral Starters

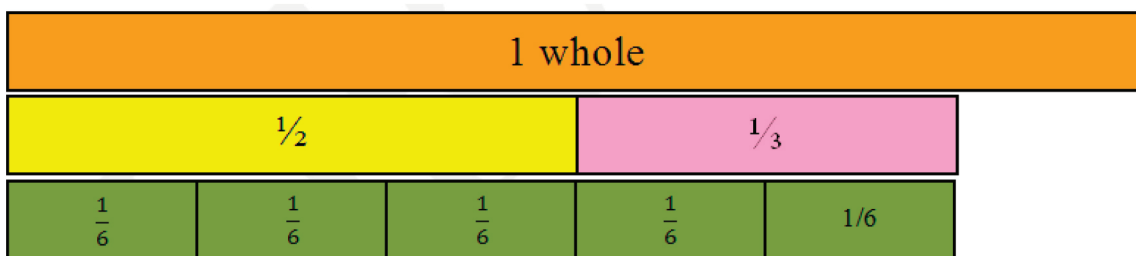
- Students will be placed in groups to play a game 'Fraction Match Up'.
 - Each group will be given a stack of cards face down, each card bearing different fractions
 - Students will take turns to flip cards leaving the flipped card face up on the desk
 - On recognizing two fractions that are equivalent, a student will yell 'match up' and take the pair



One student will be designated in each group as a judge. The judge will be given the answer card with all possible pairs. Children are allowed three wrong answers before being eliminated from the game.

Main Activity

- Students will remain in groups and will be given a problem:
Mary has half of a chocolate and John has a third.
How much chocolate do they have altogether?
- Using fraction pieces, students will model the problem. Students will be questioned in order to ascertain the problems they have with adding the two fractions and then they will generate conjecture on how they could solve the problem. (Example is given below using a diagram.)
- It is possible that in modelling the problem students will join the pieces in an attempt to represent the solution as illustrated below.



- Students will be questioned to find out what name could be given to the fraction formed. They will then be guided through a process of fitting smaller fraction pieces (for example, sixths, eighths, etc.) exactly over the sum. The aim is for the students to identify how many pieces of which fractional part will fit exactly over the sum.
- Students will then determine the number of smaller parts that cover each fraction in the addends. For example, in the illustrations above, $\frac{1}{2}$ is equivalent to three sixths and $\frac{1}{3}$ is equivalent to two sixths. Through questioning, students will highlight the relationship between the denominators in the addends and the equivalent fractions formed.
- Students will be given the following additional problems to solve using the method described in previous steps:

a) $\frac{1}{3} + \frac{1}{4}$

c) $\frac{2}{5} + \frac{1}{2}$

b) $\frac{1}{5} + \frac{1}{2}$

d) $\frac{2}{3} + \frac{5}{6}$

PLENARY

In journals, students will describe how to add fractions with unlike denominators.

ASSESSMENT

Students will remain in groups and each group will be given a set of questions to model using fractional pieces. In solving the problems they will try to rename the addends using equivalent fractions with common denominators. Groups will share their efforts with the class.

LESSON 08 ○ FRACTIONS

SUB-TOPIC: Applying equivalence to addition and subtraction of fractions

GRADE LEVEL: Grade 4

DURATION: 1 hour

SPECIFIC OBJECTIVES

By the end of the lesson, students will be able to:

- apply the concept of equivalence to the addition of fractions



PREREQUISITE KNOWLEDGE

Students should already have:

- a) a conceptual understanding of a fraction
- b) an understanding of equivalent fractions
- c) the ability to identify 'like' fractions

MATERIALS/MANIPULATIVES

Multiplication tables, plain paper, crayons and fraction cards (cards with fractions written on them)

CONTENT OUTLINE

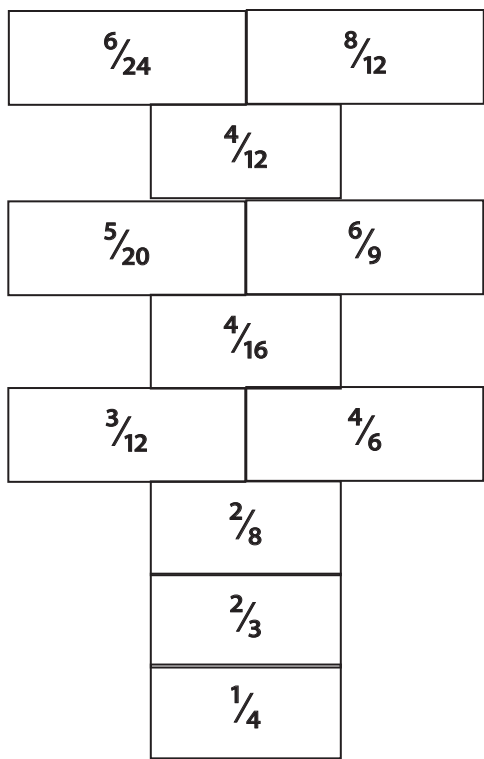
One method of adding fractions with different denominators is to rename the fractions by applying equivalence, so that the fractions to be added have the same denominator.

PROCEDURE

Mental/Oral Starters

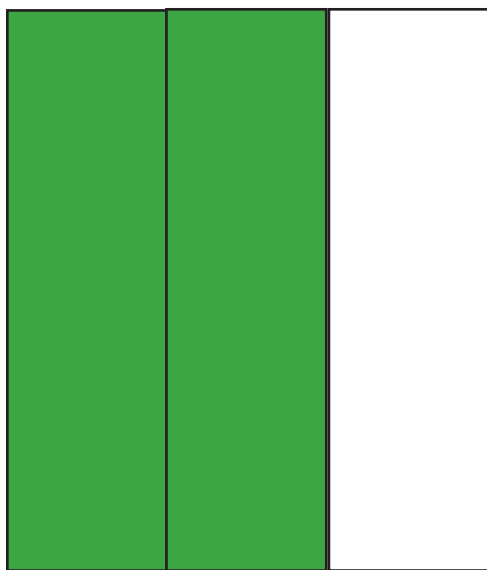
- Students will play the game 'equivalent hopscotch'. A diagram of the regular hopscotch will be drawn in which teacher will place fraction cards. The fractions will be strategically placed so that at least four of them are equivalent to the one that the teacher will highlight.

The aim of the game is to hop only on those which are equivalent. Fractions may be replaced for each round.



Main Activity

Using two fractions from the hopscotch, $\frac{2}{3}$ and $\frac{1}{4}$, students will be provided with pre-cut, equal sized rectangles to represent the two fractions. Vertical lines will be used to divide one rectangle to show thirds while horizontal lines will be used to divide the other rectangle to show fourths as illustrated below.

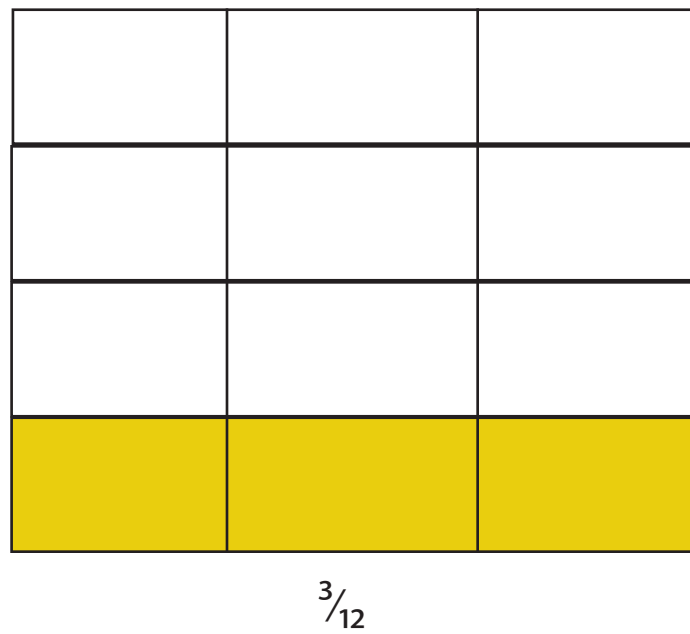
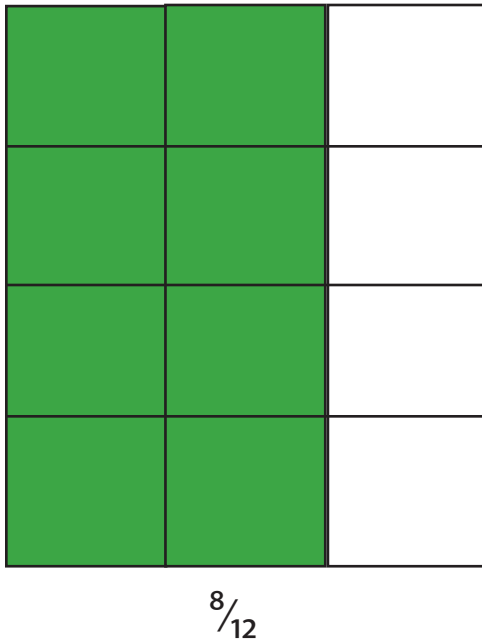


$\frac{2}{3}$



$\frac{1}{4}$

- Students will be instructed to modify their drawings so that each third is divided into quarters and each quarter is divided into thirds as illustrated below.

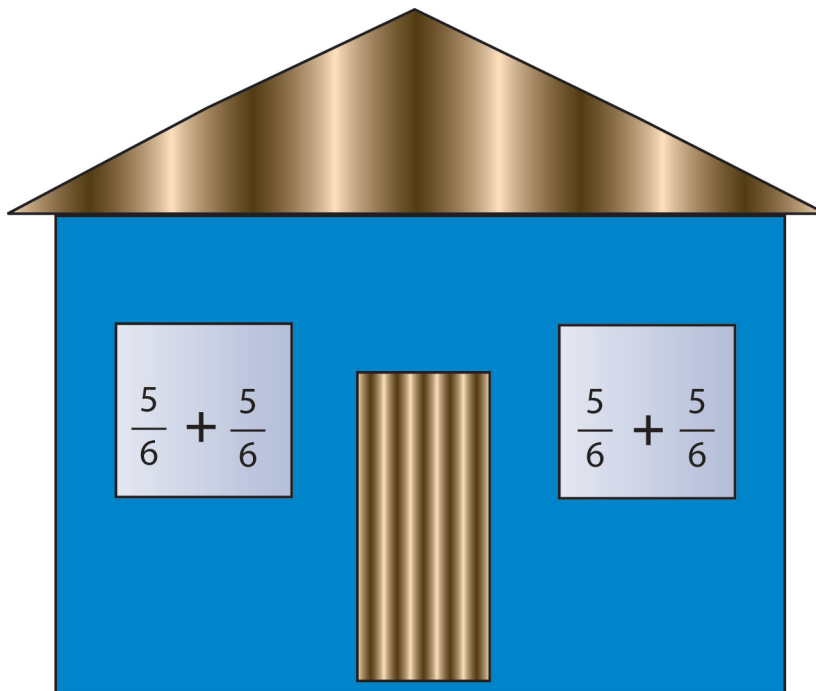


- Through questioning, students' attention will be drawn to the number of equal parts that both rectangles are divided into, and they will also see that the new fractions formed are equivalent to the original addends.
- Students' attention will be drawn to a multiplication table placed on the chalk board. With teacher's help students will be led to observe patterns of equivalence on the chart. The students will be guided to see how they could use the pattern of equivalence on the multiplication chart to solve addition of fractions with different denominators.
- The multiplication table will allow students to identify a common multiple of the denominators. This will be done by identifying one denominator in a row and the other denominator in a column, thereby locating a number where a pointer would point if moved downward and across (as indicated below).
- Students will then identify a pair of equivalent fractions that have this common denominator.

Multiplication Table					
1	2	3	4	5	6
2	4	6	8	10	12
3	6	9	12	15	18
4	8	12	16	20	24
5	10	15	20	25	30

PLENARY

Students will be engaged in an activity in which a house will be drawn on cartridge paper and placed on the chalkboard. This house will have some pockets (for example doors, windows, roof) where problems involving addition of fractions with different denominators will be placed. Each group will be given a card with the solution to one of the problems. As a group, the students will work the problems in the slots to identify the correct slot in which to place their solution.



ASSESSMENT

Students will solve the following addition problems using either the multiplication table or rectangular grid. Students will share solutions with class.

- a) John has two thirds of a cake; Mary gave him another one fifth of the same size cake. How much cake does John now have?
- b) Paul's friend ate three eighths of a pizza and Sue ate one third of the same pizza. How much of the pizza was eaten?

LESSON 09 ○ SUBTRACTION OF FRACTIONS WITH UNLIKE DENOMINATORS

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson students should be able to:

- subtract proper fractions with renaming
- solve problems which require operations on fractional numbers



PREREQUISITE KNOWLEDGE

Students should already

- have knowledge of multiplication of whole numbers
- have a conceptual understanding of fractions
- be familiar with equivalent fractions
- have knowledge of comparing and ordering fractions

MATERIALS/MANIPULATIVE

Fraction pieces, fraction charts, blank papers, crayons, and chocolate bar

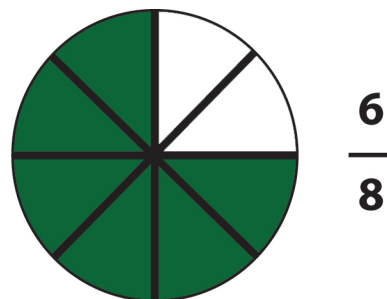
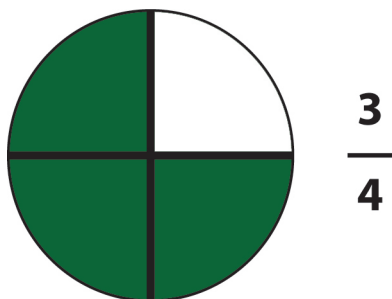
CONTENT OUTLINE

Subtracting fractions with different denominators includes rewriting each fraction with a common (same) denominator. This involves finding an equivalent fraction with the same denominator to represent the fractions to be subtracted.

PROCEDURE

Mental/Oral Starters

Students will be arranged in pairs. Each pair will be given a diagram of a proper fraction. At the teacher's instruction, each pair will move about to find matching equivalent fractions. Following this activity, the students will share what they have observed about equivalent fractions.



Main Activity

- Students in their groups will be given a fraction kit, containing a whole, halves, fourths, eighths, twelfths. Teacher will ask the following questions:
 - How many fourths make a whole?
 - How many halves make a whole?
 - What is another fraction for two quarters?
- Similar activity will be done with the other fractions.
- Students will be guided into finding common fractional pieces to represent both $\frac{3}{4}$ and $\frac{1}{3}$ to get $\frac{9}{12}$ and $\frac{4}{12}$. Students will show other fractions as equivalent fractions using fractional pieces.
- Students, as whole class, will then be given the problem situation below and will be guided through the steps of subtracting fractions using the fractional pieces:

Mr. Smith needs to move half of the library books into the library's new addition.

Yesterday he moved $\frac{1}{5}$ of the books. What fraction of the books does he still need to move?

Using fractional pieces, the students will be guided through the following task:

$$\frac{1}{2} - \frac{1}{5}$$

- Students will be asked to tell what they noticed about the denominators of the fractions in the problem $\left(\frac{1}{2} - \frac{1}{5}\right)$. (They are not the same denominator)
- Students will be asked to identify from their fraction kit, a piece that can represent each fraction
- Students will be guided into finding common fractional pieces to represent both $\frac{1}{2}$ and $\frac{1}{5}$ to get $\frac{5}{10}$ and $\frac{2}{10}$ respectively
- Therefore, the new question becomes $\frac{5}{10} - \frac{2}{10} = \frac{3}{10}$

PLENARY

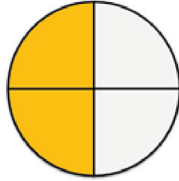
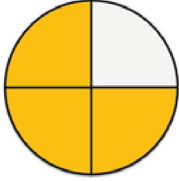
Students will be placed into two groups and asked the following questions in competition format. The group to score 10 points first will be the winning team; 2 points will be given for suitable responses.

- a) Using fraction pieces, what is the difference between $\frac{5}{6}$ and $\frac{1}{4}$?
- b) What must be done to fractions with unlike denominators before we subtract?
- c) Explain how to find equivalent fractions for $\frac{1}{2}$ and $\frac{2}{5}$.

ASSESSMENT

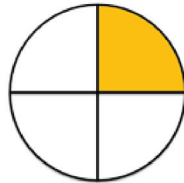
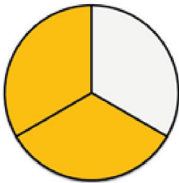
Students will be asked to use the appropriate fraction pieces to assist them in determining the difference for the following fractions:

1. a)



$$\underline{\hspace{2cm}} \quad \text{minus} \quad \underline{\hspace{2cm}} \quad = \quad \underline{\hspace{2cm}}$$

b)



$$\underline{\hspace{2cm}} \quad \underline{\hspace{2cm}} \quad = \quad \underline{\hspace{2cm}}$$

c) $\underline{\hspace{2cm}}$ minus $\underline{\hspace{2cm}}$ = $\frac{1}{5}$

2. a) Without using the fraction pieces, what is the difference between $\frac{5}{6}$ and $\frac{1}{2}$?

b) Is $\frac{15}{16} - \frac{4}{5}$ less than, equal to, or greater than $\frac{1}{2}$?

3. Find the difference for the following:

a) $\frac{3}{8} - \frac{1}{8}$

b) $\frac{1}{2} - \frac{1}{6}$

c) $\frac{3}{2} - \frac{3}{4}$

4. Natalie studied $\frac{3}{4}$ hour for a mathematics test while Janet studied $\frac{5}{6}$ hour. Who studied longer? How much longer?

LESSON 10 ○ MULTIPLICATION OF DECIMALS BY A WHOLE NUMBER

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of this lesson, students should be able to:

- find the product of a whole number and a decimal number with no more than 3 decimal places



PREREQUISITE KNOWLEDGE

Students should already know:

- place value up to thousandths
- multiplication of whole numbers
- addition of decimal numbers
- how to represent decimals using hundred grid

MATERIALS/MANIPULATIVES

Base ten models: tenths, hundredths and thousandths grid, crayons, calculators

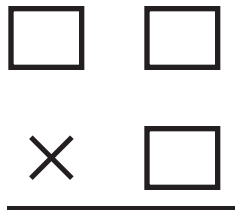
CONTENT OUTLINE

Multiplication is an operation that involves combining equal sized groups.

PROCEDURE

Mental/Oral Starters

- Teacher will draw a 2×1 multiplication template on the board for students to copy.

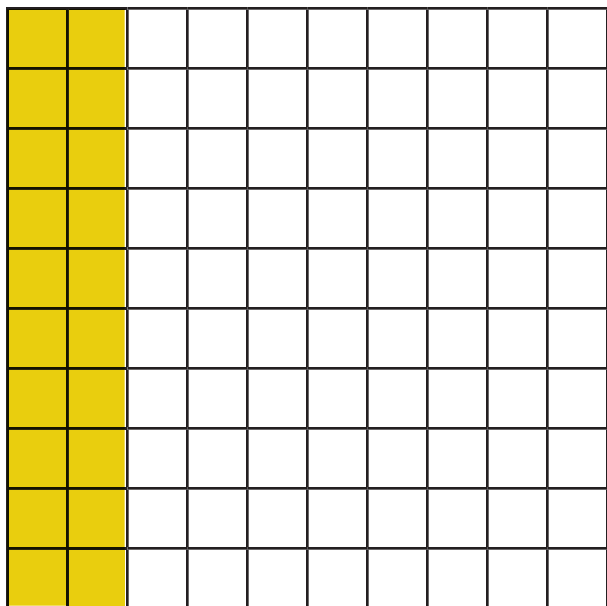


- Teacher will roll a die three times. After each roll students will decide in which box they will place the number rolled in order to obtain the smallest (or largest) product possible.

Main Activity

- Students will work in pairs to shade given decimal numbers (less than 1) on grid paper.

Example: Shade grid paper to show 0.20



- Students use another colour to shade 0.20 a second time.
- Students will continue to work in pairs to show the value of 2, 3 or 4 groups of 0.20. Students will write mathematical sentences to represent operation done.
- Given a blank grid, students will be asked to shade 0.25 of the grid; they will also be asked to shade another 0.25 using another colour. To ensure that students understand the use of the grid in multiplying decimals by whole numbers, teacher will ask the following questions:
 - How many squares in all are shaded?
 - How could this be found using addition?
 - How could this be found using multiplication?
 - What would be 3×0.25 ?
- Students will be placed in groups of five. Each group will be given a different multiplication problem to model on large letter sized grids:

a) 4×0.45

b) 3×0.39

c) 4×0.35

d) 5×0.29

e) 3×0.43

f) 4×0.38

PLENARY

Each group will mount its solution on the wall for a class discussion. Possible questions for discussion are:

- What challenges did you encounter?
- Why were two grids used?
- Can you think of questions that would require three grids?

ASSESSMENT

Assessment will be continuous throughout the lesson using the following checklist:

Checklist

Areas	Yes	No	Comments
Were students able to shade the grid correctly?			
Were students able to model multiplication questions on the grid?			
Were students able to identify multiplication problems represented on a grid?			
Were students able to use two grids when necessary?			
Were students able to identify solutions using the grid?			

LESSON 11 ○ MULTIPLICATION OF DECIMALS BY POWERS OF TEN

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of this lesson students should be able:

- to multiply a decimal number by 10, 100, 1000



PREREQUISITE KNOWLEDGE

Students should already know how to:

- represent place value up to thousandths
- multiply whole numbers by 10, 100, 1000
- model decimals on grid paper

MATERIALS/MANIPULATIVES

Calculators, dice and place value chart

CONTENT OUTLINE

When a number is multiplied by ten, each digit in the answer becomes ten times larger, and therefore its position shifts one place to the left on the place value chart. Similar conclusions can be drawn about multiplying by 100 and 1000.

PROCEDURE

Mental/Oral Starters

Students will be engaged in a game entitled 'circles and stars'. In this game, students will work in pairs and will use two dice of different colours to multiply numbers. One colour will represent the number of circles to be drawn and the other colour will represent the number of stars to be drawn in each circle. Each pair will play five rounds. The pair of students whose products give the larger sum after three rounds is the winner.

Main Activity

- Students will be asked to use their calculators to evaluate the following:
 - 478×10
 - 478×100
 - 478×1000

They will then record their answers in the table below.

Hundred Thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones	Multiply by
			4	7	8	
						10
						100
						1000

- Discuss the following questions:
 - What happens to the digits in the number 478 when you multiply by:
 - 10?
 - 100?
 - 1000?
- Teacher will ensure that students understand that when a number is multiplied by ten, each digit in the answer becomes ten times larger, and therefore its position shifts one place to the left on the place value chart. Similar conclusions can be drawn about multiplying by 100 and 1000.
- Students will be asked to use their calculators to evaluate the following:
 - 3.58×10
 - 3.58×100
 - 3.58×1000

They will then record their answers in the table below.

Thousands	Hundreds	Tens	Ones	Decimal Point	Tenths	Hundredths	Multiply by
			3		5	8	
							10
							100
							1000

- The class will have a discussion to help the students realise:
 - a) that, like before, the digits in the answer move to the left as they become larger by powers of ten
 - b) that each time the number becomes ten times larger, a zero is placed at the end
- Students will be asked to complete the following without using the calculator:

Thousands	Hundreds	Tens	Ones	Decimal Point	Tenths	Hundredths	Multiply by
			6		0	1	
							10
							1,000
							100

- Students will be asked to complete the following number sentences:
 - a) $6.01 \times 10 =$ _____
 - b) $6.01 \times 1,000 =$ _____
 - c) $6.01 \times 100 =$ _____

PLENARY

Students will be asked to make a journal entry on how to multiply decimal numbers by powers of ten.

ASSESSMENT

Complete the following multiplication sentences:

- a) $5.003 \times 100 =$ _____
- b) $0.03 \times$ _____ $= 30$
- c) $20.20 \times 1,000 =$ _____
- d) _____ $\times 100 = 34.5$

LESSON 12 ○ MULTIPLICATION OF FRACTIONS BY A FRACTION

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES



At the end of the lesson, students should be able to:

- find the product of two fractional numbers less than 1
- solve problems which require operations on fractional numbers

PREREQUISITE KNOWLEDGE

Students should already:

- have a conceptual understanding of fractions
- know the process of deriving equivalent fractions
- be able to add and subtract fractions

MATERIALS/MANIPULATIVES

Fraction pieces, fraction cards, blank transparencies

CONTENT OUTLINE

Multiplying a number by a fraction involves dividing a number into equal pieces and taking out a specified number of equal pieces. Multiplying a number by $\frac{3}{4}$, for example, requires that the number be divided into 4 equal pieces and 3 of these parts be taken out for consideration.

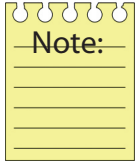
Mental/Oral Starters

- Students will play the "I Have, Who Has" game. Cards will be distributed as students are engaged in answering and asking questions.

Example:

I have 1 Who has $1 \div 2$?	I have $\frac{1}{2}$ Who has $3 \div 4$?	I have $\frac{3}{4}$ Who has $5 \div 9$?	I have $\frac{5}{9}$ Who has $2 \div 7$?
I have $\frac{2}{7}$ Who has $4 \div 5$?	I have $\frac{4}{5}$ Who has $7 \div 11$?	I have $\frac{7}{11}$ Who has $5 \div 2$?	I have $\frac{5}{2}$ Who has $10 \div 3$?
I have $\frac{10}{3}$ Who has $3 \div 8$?	I have $\frac{3}{8}$ Who has $11 \div 10$?	I have $\frac{11}{10}$ Who has $6 \div 20$?	I have $\frac{6}{20}$ Who has $9 \div 9$?

- Teacher will cut card along the lines. Each card will be folded and placed in a bag/box. Each student will randomly select one piece.
- Any student can start the game by asking the question on their card. The person with the correct answer will respond by saying, "I have..., who has...?" (Students should say the fraction name, for example, "a half", and NOT "one over two".)
- The game ends when it reaches the student who started the game.



Note: *The game may be extended to any number of cards desired.*

Main Activity

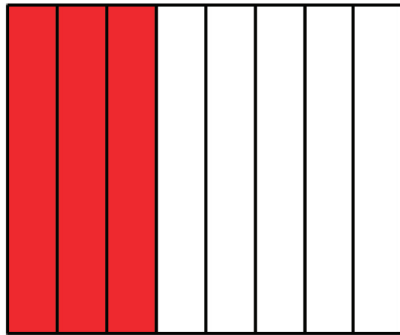
- Students will be given the problem task below to write number sentence.

Problem Task:

In Andrea's garden, $\frac{3}{8}$ is planted with flowers, and $\frac{2}{3}$ of that flower section has red roses. What fraction of the entire garden is planted with red roses?

- Students will be guided by teacher in using an area model to solve the problem
- $$\begin{array}{r} 3 \quad 2 \\ - \times - \\ 8 \quad 3 \end{array}$$
- Students will be placed in groups of five to shade a rectangle (or square), partitioned vertically, to represent $\frac{3}{8}$ (shown in red) and each group will be given another rectangle (or square), partitioned horizontally, to represent $\frac{2}{3}$ (shown below in blue on transparency).
 - Students will be guided into superimposing the two squares to show the product of the 2 fractions to be $\frac{6}{24}$ or $\frac{1}{4}$.

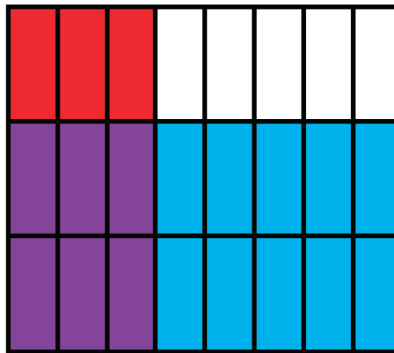
N.B. Teacher will ask students appropriate questions to help them to recognize that the area that is double-shaded represents the product



$$\frac{3}{8}$$



$$\frac{2}{3}$$



$$\frac{3}{8} \times \frac{2}{3} = \frac{6}{24} = \frac{1}{4}$$

- Students will be asked to work independently to record the previous activities in their notebooks, using the fractional pieces as a guide to the appropriate fractional parts. Students will be guided into multiplying one proper fraction by another.

PLENARY

Students will be asked to explain in their own words how to multiply fractions with and without models.

For example, what is the product of $\frac{1}{2}$ and $\frac{4}{5}$?



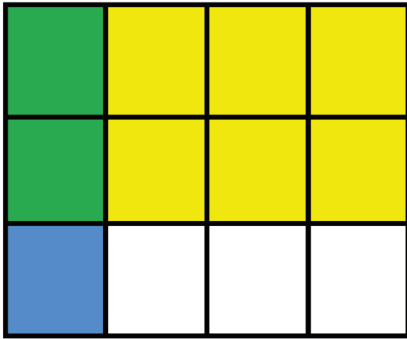
Answer: $\frac{4}{10}$

ASSESSMENT

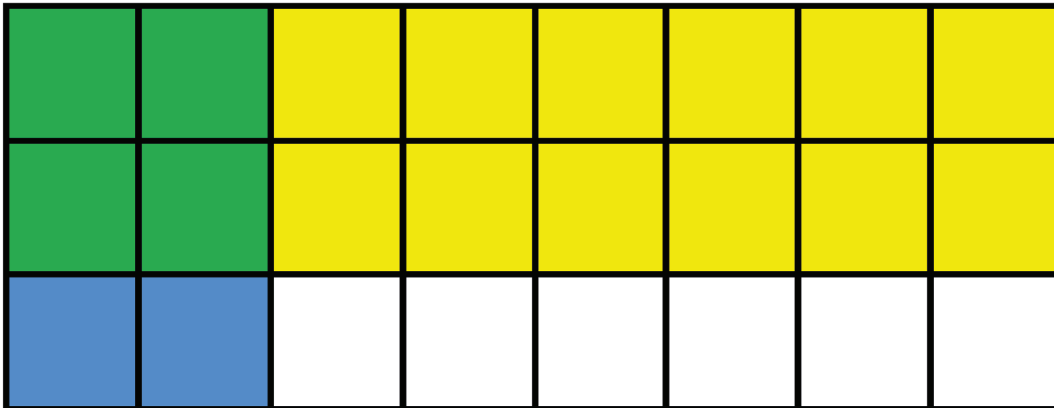
Complete the following problems:

1. Write a multiplication sentence for each picture.

a)



b)



2. Find the product of the following:

a) $\frac{6}{11} \times \frac{4}{9}$

b) $\frac{2}{3} \times \frac{9}{10}$

3. Draw rectangles showing the products of the following:

a) $\frac{1}{4} \times \frac{4}{5}$

b) $\frac{2}{3} \times \frac{5}{8}$

LESSON 13 ○ DIVISION OF FRACTIONS (WITH MIXED NUMBERS)

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES



By the end of the lesson pupils will be able to:

- use models to represent division of fractions
- accurately solve division problems that involve fractional numbers

PREREQUISITE KNOWLEDGE

Pupils should be able to:

- identify and name fractions
- recall division and multiplication facts
- subtract fractions
- multiply fractions
- reciprocate fractions

MATERIALS/MANIPULATIVES

Strips of paper, rulers, deck of card

CONTENT OUTLINE

In a division problem, the number that is divided is called the dividend while the number that divides the dividend is called the divisor. The number of times the dividend is divisible by the divisor is called the quotient. (The quotient tells us how many times the divisor can be subtracted from the dividend). The reciprocal is the same thing as inverse of a number.

PROCEDURE

Mental/Oral Starters

The 'Cardy fractions'. Students will be placed in pairs and each pair will be given a set of cards with the prime numbers from 2 to 19. Each student will be asked to select a card from the set. Both numbers selected will be used to form an improper fraction. Students will be required to convert the improper fraction formed to a mixed number. The first pair to successfully convert three improper fractions to mixed numbers will be declared winner.

Main Activity

- Students will be given strips of paper to solve the problem below.

Miss Ruby the dress maker has $3\frac{5}{8}$ meters of cloth that she wants to cut into $\frac{1}{2}$ meter lengths. How many $\frac{1}{2}$ meter lengths of cloth will Miss Ruby have?

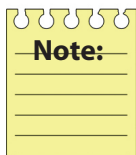
- A sample model may be



- Divide the pieces in halves.



- Students and teacher will discuss the previous activity using the following guided questions:
 - How many halves will Miss Ruby get from her $3\frac{5}{8}$ metres of cloth?
 - What is the relationship between $\frac{1}{8}$ and the divisor? ($\frac{1}{8}$ is $\frac{1}{4}$ of the divisor, which is $\frac{1}{2}$).
 - Use fraction pieces to establish this relationship.



Note:

Students should realize that there are 7 halves in $3\frac{5}{8}$. There is also $\frac{1}{8}$ left, which is $\frac{1}{4}$ of the divisor. Therefore, there are $7\frac{1}{4}$ halves in $3\frac{5}{8}$. Miss Ruby will have 7 complete $\frac{1}{2}$ metre lengths of cloth.

- Students will work in pairs using fraction pieces to model two problem situations posed to them, and write a mathematical sentence that represents the situation.

Problem 1

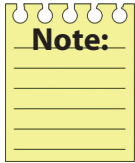
My jug holds $\frac{1}{2}$ l of water. I have a cup that holds $\frac{1}{4}$ l. How many times can I fill the cup from my jug?

N.B. Teacher will monitor the students working on the task and ask the same type of guided questions when students appear to be struggling with how to represent the situation.

Problem 2

Richard has $3\frac{1}{2}$ cups of raisins to make rock buns. The recipe uses $\frac{1}{3}$ cup of raisins in each batch. How many batches of rock buns can Richard make?

Richard can make $10\frac{1}{2}$ batches of rock buns.



Note:

Write the number sentences on the chalkboard after each situation, noting the relationships among the numbers in the number sentence. Have students look for any patterns or relationships they note in the number sentences.

PLENARY

Students will be asked to make a journal entry on how to use rectangles to model division of fractions.

ASSESSMENT

1. Mr. Williams has a half of a container of ice cream and wants to divide it into one-cup servings to share with the students in my class. A cup is one-sixteenth of the container. How many cups would he get?
 - a. Use diagrams to model the worded problem.
 - b. Write a number sentence and show how to solve the problem

LESSON 14 ○ ADDITION OF DECIMALS

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson students, should be able to:

- Solve problems involving addition of decimals, using appropriate models
- use money related problems in addition of decimals



PREREQUISITE KNOWLEDGE

Students should already know:

- place value concepts for decimal numbers
- addition facts of whole numbers
- addition of fractions
- rounding off decimals to 1, 2 or 3 places

MATERIALS/MANIPULATIVES

A die, grid paper, pencil, ruler, and base ten blocks (or any other representatives of tens and ones)

CONTENT OUTLINE

Decimals are fractions with denominators expressed in power of ten.

PROCEDURE

Mental/Oral Starters

The teacher will draw 6 horizontal line segments on the board, and strategically place a decimal point between any two lines. The last line will be called the reject line. Teacher will toss die six times and, after each roll, students will record the number on a line – trying to form the largest (or smallest) possible decimal number. Students will place an unwanted number on the reject line

Example

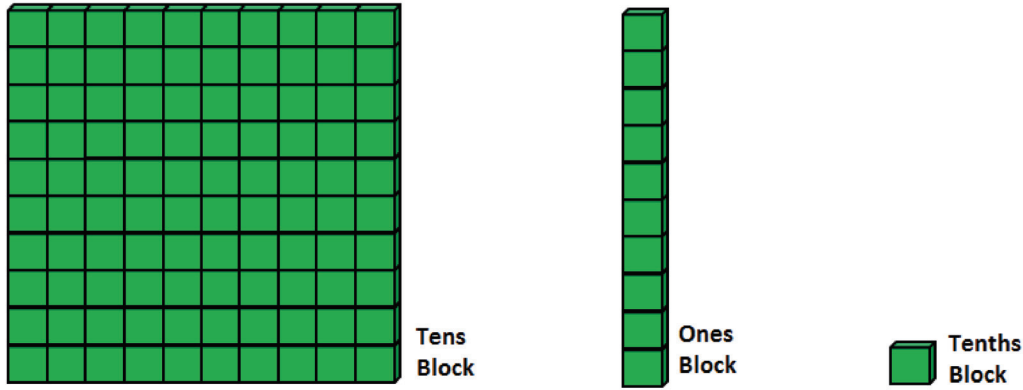
___ ___ ___ . ___ ___ Reject ___

At the end, students will be asked to call the number they have formed. The student with the largest or smallest number will be the winner.

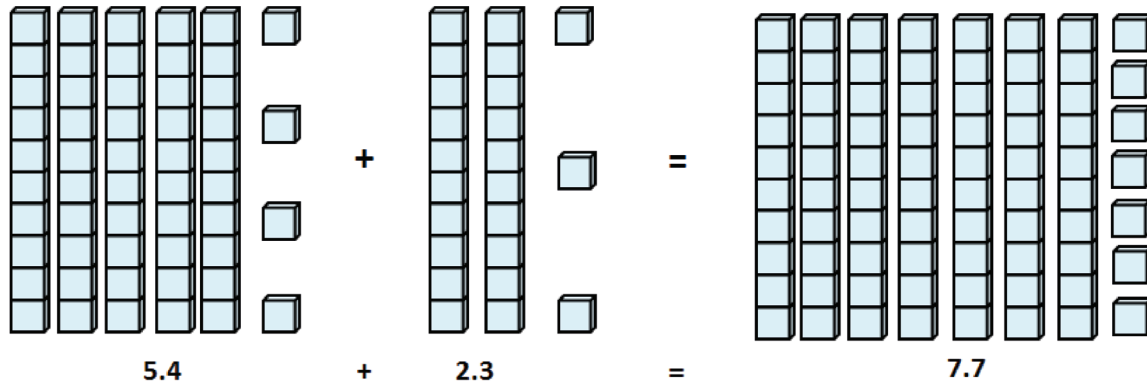
Main Activity

Group Activity 1: Addition of decimals using flats and longs or the interlocking cubes

- Students will be placed in groups and given a problem task to model the information using flats and longs to determine the answer.



Example: Using the interlocking cubes or blocks, add $5.4 + 2.3$.



- Students will be guided to use blocks to answer the following questions:

Kevin wants to buy a new ball that costs \$56.70. He had \$13.20 in his savings pan. Today, he put \$25.10 in his savings pan.

 - How much money does Kevin have in his savings pan now?
 - How much more money does he need in order to buy the ball?

Group Activity 2: Addition of decimals using Hundred Grid Sheet

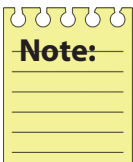
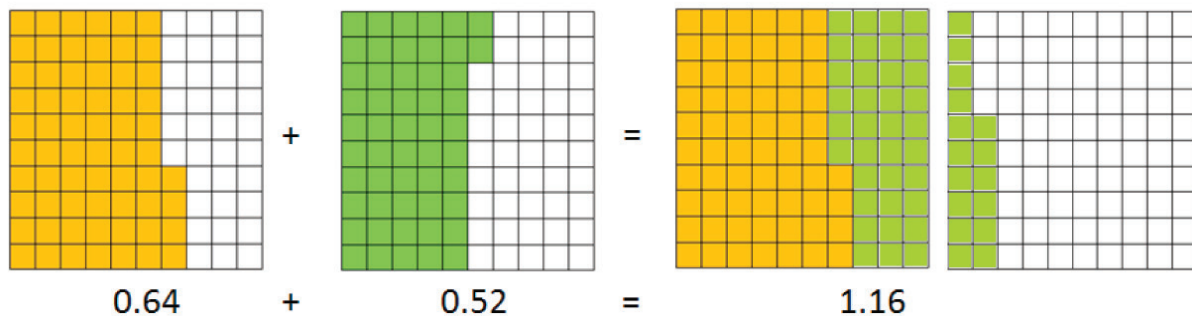
- Students will be assigned Task 2. They will use a hundred grid sheet to determine the answer.
- Students will shade the corresponding decimal number on 10 x 10 grid paper to represent each value.

Task 2

Sandra has \$0.64 and John has \$0.52.

- How much money do they have altogether?
- If they used their total amount of money to buy one marble, how much would it cost them to buy three similar marbles?

Solution for part a.



Note:

Students will count each square to find out the total squares that are shaded. Students would recall that ten one tenth equal ones. Therefore by counting they will get 116 one tenth which is equal to 1.16.

PLENARY

Students will be selected at random to share what they have learnt as it relates to the SPECIFIC OBJECTIVES of the lesson.

ASSESSMENT

- Find the sum of 12.4 and 0.863
- What is the total cost for a patty costing \$110.50 and an orange juice costing \$72.80?
- Add together \$253.76, \$512.1 and \$7.536

LESSON 15 ○ INTRODUCTION TO RATIOS

GRADE LEVEL: Grade 6

DURATION: 1 hour

SPECIFIC OBJECTIVES

Students should be able to:

- express similar quantities as a ratio
- write a ratio using different forms (1:5, 1 to 5, $\frac{1}{5}$)



PREREQUISITE KNOWLEDGE

Students should be able to:

- a) form equivalent fractions
- b) simplify fractions
- c) perform the four basic operations on fractions
- d) use and interpret Venn diagrams

MATERIALS/MANIPULATIVES

Counters (fudge sticks, marbles, etc.)

CONTENT OUTLINE

- A ratio is a multiplicative comparison of two quantities or measures.
- Multiplying or dividing a ratio results in an equivalent ratio.

PROCEDURE

Mental/Oral Starters

Students will be shown pictures of the same object but one picture will be proportionately larger than the other. Through guided discussion, students will state the similarities and differences between the pictures, thereby capturing a multiplicative comparison. Students will be asked to give examples of other real life situations in which a multiplicative comparison can be seen – for example, maps of countries, plans for buildings, models, etc.

Main Activity

- Twelve students will be randomly selected and placed into two groups based on gender. Other members of the class will count the number of boys and girls and their findings will be recorded on the chalkboard in the form *no. of boys : no. of girls*. The class teacher will then explain that this is the method used to express ratios.

- Teacher will engage the students in a discussion to ascertain what they know about the concept of ratio. The teacher will write the ratio for the previous activity on the chalkboard, for example: 4 boys and 8 girls, the ratio would be (4:8, 4 to 8, and $\frac{4}{8}$).
- Questions will be asked to guide students into understanding the concept represented; that is, to every 4 boys there is a match of 8 girls. Using the same example, teacher will ask the students:
 - how many boys will match with 16 girls?
 - How many boys will match with 4 girls?

Based on discussion, students and teacher will complete the following table:

Boys	Girls
4	8
?	16
20	?

- Students will then be asked to tell what they did to arrive at their answers.
- Students will then be asked to group themselves according to houses, tally the number of students in each house and then write the ratio of number of students in their house to the number of students in other houses.

For example, no. of students in blue house: no. of students in red house, and so on.

- Students will be placed in mixed ability groups and assigned different types of counters (fudge sticks, marbles, etc.) to reinforce the concept of ratio. They will then be asked to record all the different ratios they can find from the manipulatives that they were assigned. Each group will be asked to make a presentation of their findings.

PLENARY

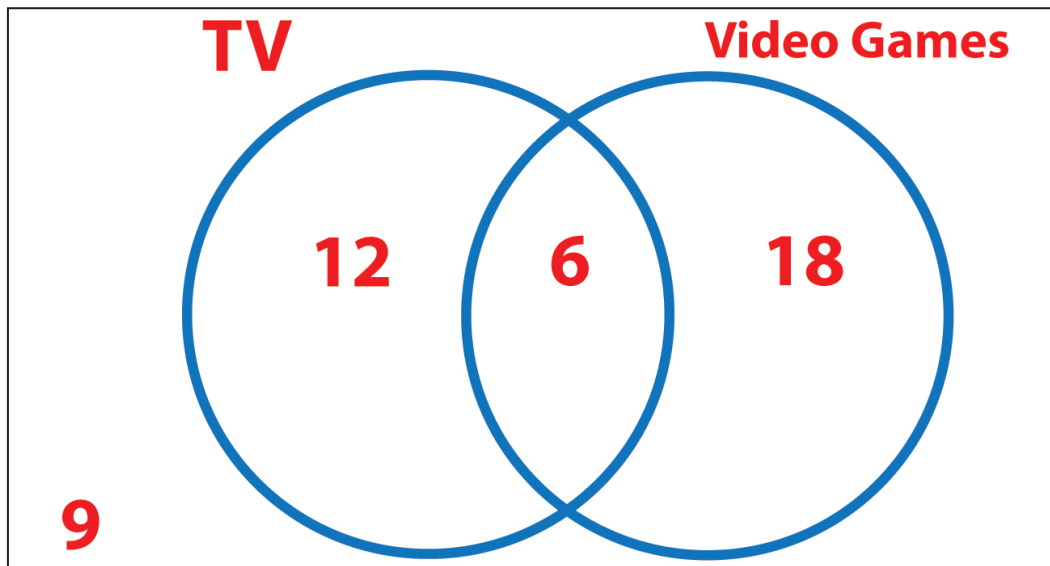
Each group will be required to select a question from a ratio question box. For example:

- What is a ratio?
- Give an example of how ratio is used in real life
- If for every three green bananas there are two ripe bananas, how would you write this as a ratio?

Individual groups will then be required to share their responses with the whole group.

ASSESSMENT

Some students in a class like watching TV while others like playing video games. Some do not like any of these activities. The Venn diagram below shows this information.



From the Venn diagram above, write down at least 5 ratios about the students in the class.

LESSON 16 ○ RATIO AND PROPORTION

GRADE: Grade 6

DURATION: 1 hour

SPECIFIC OBJECTIVES

Students should be able to:

- write equivalent ratios for a given ratio
- solve problems which require the use of equivalent ratio



PREREQUISITE KNOWLEDGE

Students should know:

- a) the concept of ratio
- b) how to form equivalent fractions

MATERIALS/MANIPULATIVES

Colour coded counters

CONTENT OUTLINE

- Part-to-whole – ratios can express comparisons of a part to a whole, example the number of male teachers to the total number of teachers in a school; number of mangoes to number of all fruits in a basket. Fractions are also part whole ratios.
- Part-to-part ratios – a ratio can be expressed as one part of a whole to another part of the same whole: for example, the number of mathematics teachers in the school can be compared to the number of English teachers, the number of students in Blue House compared to the number of students in Red House.
- A proportion is an equation stating that two ratios are equivalent.

Example: $\frac{4}{6} = \frac{12}{18}$

PROCEDURE

Mental/Oral Starters

Students will be given a description of a fruit basket consisting of varying number of apples, plums and cherries. Teacher will guide students in answering questions such as:

How would you compare

1. the number of apples to the number of plums?
2. the number of apples to the total number of fruits?

Students will write different ways in which these comparisons can be expressed.

Main Activity

- Students will be placed in groups and each group will be given twenty red and twenty blue counters. Each group will be asked to model examples of ratio.
- Students will be asked to model a specific ratio, for example 2 blues to 6 red. They will then be asked to predict the number of blue counters required to complete the ratio, if the number of red counters were doubled. Students will use their counters to model the number of counters required to complete the given ratio. The teacher will discuss students' responses.
- Teacher and students will have a discussion about proportion. Students will then write in their own words what is their understanding of a proportion.
- The groups will be given a predetermined number of yellow and blue counters. They will be required to form equivalent ratios. For example, one group will be given 3 yellow counters and 4 blue counters. They will then be given six yellow counters. The students will be required to determine the number of blue counters that are needed to ensure that the two ratios are equivalent. Each group will be required to give a mathematical defense of their answer.

PLENARY

The students will remain in their groups. They will then be given the following problem to solve:

*If it takes four cups of water and one cup of syrup to make a jug of drink,
how many cups of water and how many cups of syrup do we need to make*

- a) 3 jugs of drink?
- b) 4 jugs of drink?
- c) 5 jugs of drink?

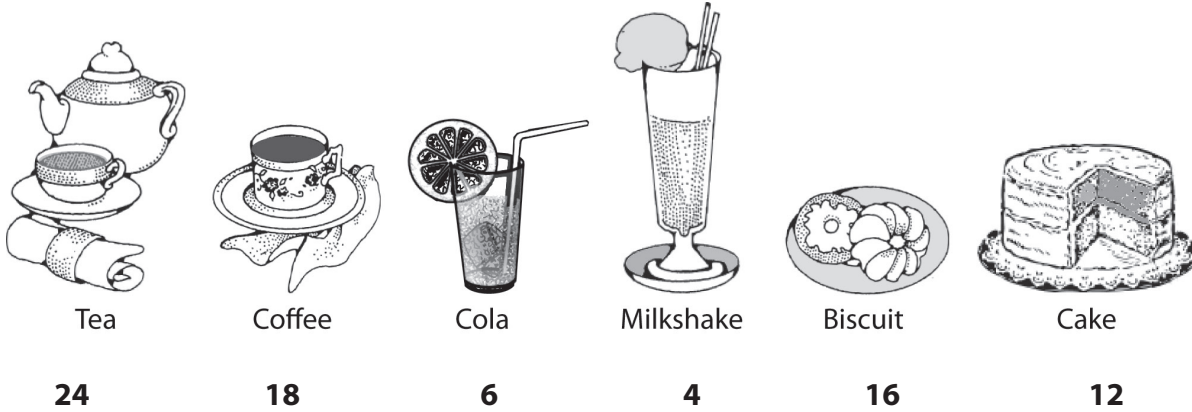
ASSESSMENT

Students will be given the following worksheet to solve the problems:

WORKSHEET ON RATIO

Grade Six

The information below shows the amount of each item that was sold by a restaurant between 8:30 a.m. and 9:30 a.m.



Items	Cost
Tea	\$30.00 per cup
Coffee	\$40.00 per cup
Cola	\$60.00 per cup
Milkshake	\$35.00 per cup
Biscuit	\$20.00 per pack
Cake	\$50.00 per slice

1. Write down the ratio in the simplest terms for each of the following:

- number of biscuits to number of slices of cakes sold
Ratio _____
- the cost of the tea to cost of biscuits
Ratio _____
- the number of colas to the number of milk shakes
Ratio _____
- The cost of the tea to the cost of the total slices of cake
Ratio _____

- e) The total cost of all items sold to the total number of items
Ratio_____
- f) What proportion of the total cost was tea?
Proportion_____
- g) What proportion of total sales was drinks?
Proportion_____
2. Jeremy's school bag contains 3 videocassettes, 4 crayons, 7 books, and 2 pencils. Find the ratio of:
- a) books to videocassettes Ratio_____
- b) pencils to crayons Ratio_____
- c) books to videocassettes to pencils Ratio_____
3. A Toyota car factory made 40 sports cars with a sunroof and 20 sports cars without a sunroof. What is the ratio of the number of cars without a sunroof to the number of cars with a sunroof?
4. Forty students have vanilla ice cream and 6 students have cherry ice cream. What is the ratio of the number of students who have vanilla ice cream to the number of students who have cherry ice cream?
5. Complete the ratio table:

8	3
16	6
24	
32	
40	15

6. Fill in the missing number to complete the proportion:

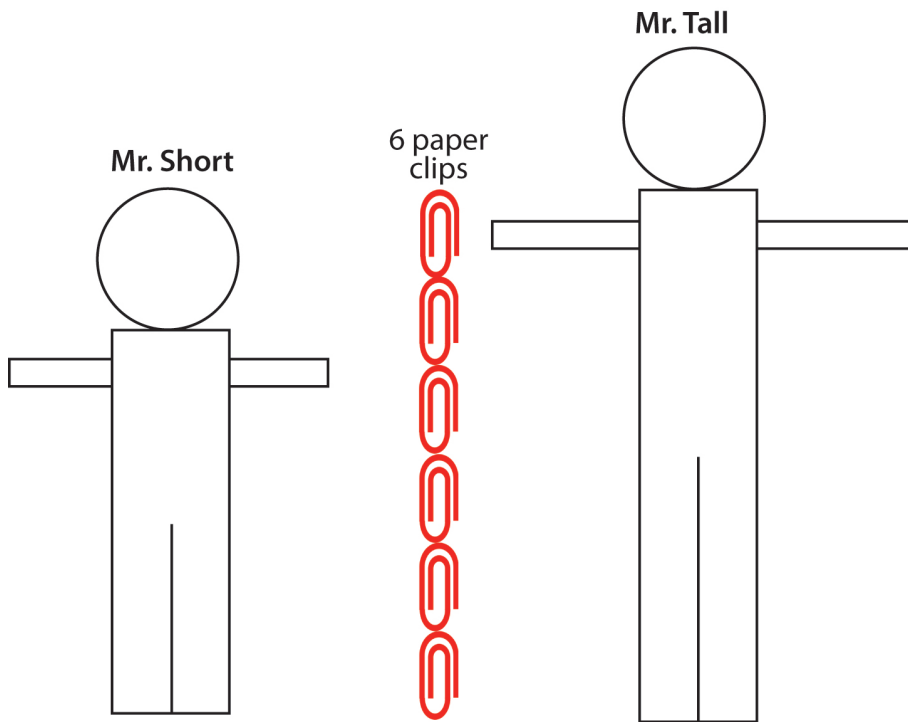
$$\frac{\quad}{8} = \frac{5}{40}$$

7. Find the unit rate:

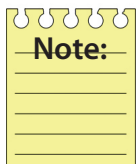
50 plants in 5 rows = per row

8. Winston measured his father's chicken house and made a scale drawing. The wall, which is 50 metres long in real life, is 5 centimetres long in the drawing. What scale did Winston use?

9. Here is a picture of Mr. Tall and Mr. Short



Mr. Short is six paper clips in height. If he is measured in large buttons he is four large buttons in height. Mr. Tall is similar to Mr. Short but is six large buttons in height. Predict the height of Mr. Tall in paper clips. Explain.



Note: *Some of the questions can be given as homework activities.*



MEASUREMENT

LESSON 01 ○ MEASURING AND ESTIMATING LIQUID

GRADE LEVEL: Grade 1

DURATION: 1 hour

SPECIFIC OBJECTIVES



After engaging in the activities in this lesson, students should be able to:

- state the unit used to measure liquid
- identify containers that hold approximately one litre
- use the litre measure to identify containers that hold more than, less than, about one litre, two litres, three litres, etc.

PREREQUISITE KNOWLEDGE

Students should already:

- a) be able to read and write numbers
- b) have knowledge of fractions

MATERIALS/MANIPULATIVES

Empty liquid containers of various capacity/sizes, containers with water.

CONTENT OUTLINE

The basic unit for measuring liquid is litre. Examples of liquids measured in litres are water, drink, oil.

PROCEDURE

Mental/Oral Starters

The teacher will place a container with water on a table (more than half full). Students will be asked to say how much water they think is in the container (*expected answers*: a lot, half or another fraction, etc.) Students should recognize that they cannot tell/describe exactly how much water is in the container.

The teacher will use this opportunity to establish the need for a standard way of measuring liquid.

Main Activity

- Students will be shown four bottles of different sizes and shapes, each containing 1 litre of water. Students will be asked if they think the liquid in all bottles measure the same. After students respond, they will be permitted to test by pouring the liquid from each into a standard litre measuring cup/bottle. They should realize that all measurements are the same

although the bottles are different sizes and shapes. The teacher will use this opportunity to introduce the term litre.

- Place students in groups of 4. Give each group a 1-litre measuring container. Create a station in one corner of the room where various containers with water are placed. Students will identify which of these containers are most likely to contain 1 litre of water. They will also sort the other containers into two groups: those less than a litre and those more than a litre. Examples of containers include:
 - tied bags of various sizes
 - large and small bottles
 - a bucket
 - cups of various sizes
- Discuss groups' estimates for each container. Where necessary, use the litre measuring cup to verify whether a container holds 1 litre.

PLENARY

- Engage students in a discussion about the situations in which they are most likely to use about 1 litre of water:
 - brushing their teeth
 - drinking after a meal
 - having a bath
 - watering the garden
 - helping mommy/daddy to wash their car

ASSESSMENT

Give students drawings of the following household items and ask them to use their crayons to colour code them to show those that can hold less than (red) or more than (blue) 1 litre:



LESSON 02 ○ PERIMETER

GRADE LEVEL: Grade 3

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson, students will be able to:

- explain the meaning of perimeter
- measure the perimeter of various objects and polygons



PREREQUISITE KNOWLEDGE

Before doing this lesson, students should already know:

- a) the basic units of length
- b) how to use the ruler, tape measure, and metre stick
- c) how to add or subtract simple measurements which use whole numbers of metres or centimetres
- d) about plane shapes
- e) how to round off to the nearest whole number
- f) about the concept of regular and irregular figures

MATERIALS/MANIPULATIVES

Strips of paper, thumb tacks/paper clips

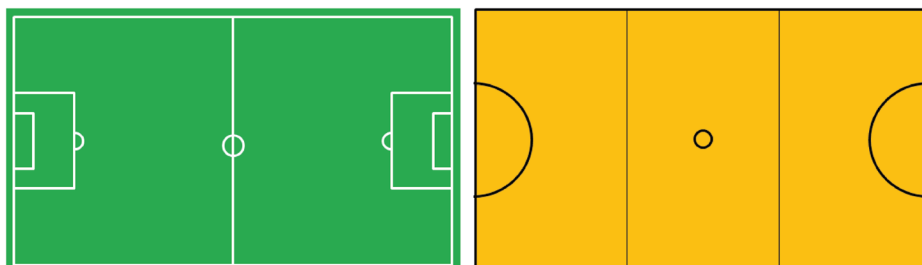
CONTENT OUTLINE

Perimeter is the measurement of the entire length of the edge, boundary or rim of a regular or irregular figure.

PROCEDURE

Mental/Oral Starters

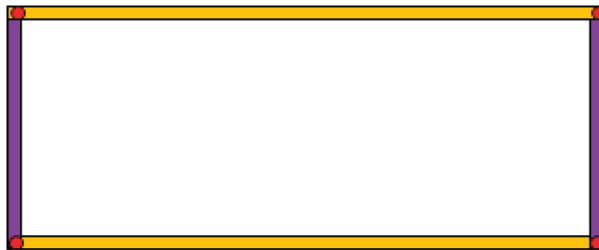
- Draw a large model of a football field/netball court on the floor in the classroom or any convenient and available space (use tape if desired to mark out the model).



- Discuss with students what they understand the word “outside” to mean as is used in football/netball, etc. Ensure that students appreciate that the boundaries of the field/court determine when the ball has gone outside the playable area.
- Tell students that another word for the boundaries of the field/court is perimeter. Have a few students walk around the boundary to establish the idea that perimeter of the field/court is the distance around it.

Main Activity

- Place students in groups of 4. Give each group 4 paper clips or thumb tacks as well as two pairs of strips of cartridge paper, strawboard or cardboard.
- Tell each group to use the strips of paper and the thumb tacks or paper clips to make a rectangle as shown below:



- Instruct students to measure and write down the length of each side of the rectangle created in their group.
- Have each group remove one thumb tack/paper clip from the rectangle to create a straight line with the pieces of cardboard/cartridge paper (shown below).



- Discuss with students what is represented by the straight line that they now have. Tell students to determine the total length of the straight line (either by measuring or by computing).
- Have students then re-form their rectangles and state their perimeter. Discuss with students how they were able to determine the perimeter of the various rectangles. Draw some of these rectangles on the board and discuss their perimeters.
- Give each group a different number of pieces of paper (from 5 to 9 pieces). Have each group form a polygon using the pieces of paper that they receive and determine its perimeter.

PLENARY

- Discuss with students:
 - the meaning of the term “perimeter”
 - the steps that must be taken when finding the perimeter of a shape

ASSESSMENT

Have each group present the polygon that it has formed and its perimeter. Discuss these with the class to ensure accuracy.

LESSON 03 ○ ESTIMATING MASS

GRADE LEVEL: Grade 3

DURATION: 1 hour

SPECIFIC OBJECTIVES

By the end of the lesson, students will be able to:

- identify the appropriate unit, kilogram or gram for given measurement situations
- estimate the mass of various items



PREREQUISITE KNOWLEDGE

Students should already:

- know how to read a kitchen scale
- know the definition of mass
- be familiar with the weight of 1 kg

MATERIALS/MANIPULATIVES

Kitchen scales, items to be weighed

CONTENT OUTLINE

The standard unit of mass is gram (g). The estimation of mass is a comparison of the mass of an item to another that is known. The known mass becomes the point of reference to make an estimate.

PROCEDURE

Mental/Oral Starters

Create 5 stations (labelled A – E) in the class with 6–7 items in each station. Place the students in 5 groups and assign a group to each station. One item in each station must be exactly 1 kg; some items must be more than 1 kg and others less than 1 kg. Ask students to order the items in their assigned station in terms of their mass. Encourage students to lift each object that they have in order to estimate its mass. Instruct each group to record the order in which they have placed the items (see Estimate Record Sheet below).

Main Activity

- Keep students in their groups at the stations and discuss the idea of mass, its standard unit of measure and the various instruments (scale, beam balance, etc.) used to measure it.
- Have each group change stations leaving the items behind for another group to order. Once again, they record the order on the capture sheet below. This continues until all the groups

have had a chance to interact with the items in each station and have returned to their original station.

- Use a table on the chalkboard to discuss, verify and correct the orders created by each group. Ensure that there is consensus by using a balance scale where disagreement exists about a particular order.
- Tell students that at each station there is an item with a mass of 1 kg; ask them to identify which item this is. Verify this for students and discuss other items from their experience that weigh about 1 kg.
- Remind students that $1\text{ kg} = 1000\text{g}$ and instruct them to use the 1 kg as a benchmark to estimate the mass of each of the other items at the station. Discuss with students which items are to be estimated in grams and which in kg. Give each group a kitchen scale and allow them to complete a table as follows:

Item	Estimated Mass	Actual Mass

PLENARY

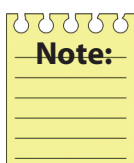
Discuss the results from each station. Centre discussion around the following questions:

- Can you think of examples of items that have mass less than a kilogram/more than a kilogram?
- When is it appropriate to state the mass of an item in grams versus kilograms?

ASSESSMENT

Instruct students to combine various items in their stations to give the following mass (or to come as close as possible)..

- $2\frac{1}{2}\text{ kg}$
- 3 kg
- 3.6 kg



Note:

You may need to change the mass depending on the items used in each station. Items may be reused.

LESSON 04 ○ METRIC CONVERSION

GRADE LEVEL: Grade 4

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson, students should be able to:

- convert from metric unit to another
- explain the relationships among the units having the prefixes centi-, milli-, kilo- and the main unit metre
- use the terms cm, mm, etc. in problem solving activities



PREREQUISITE KNOWLEDGE

Before doing this lesson, students should already have knowledge about:

- a) measuring length using a metre stick:
- b) identifying fractional relationships
- c) identifying different units of measurement
- d) place value

MATERIALS/MANIPULATIVES

Metre strips, metre stick, centimetre rulers, interlocking centimetre cubes/centimetre strips

CONTENT OUTLINE

Length is the distance between two points and it is measured according to some standard or reference. In the metric system, the standard measure of length is the metre. The most common metric units of length used are the kilometre (km), the metre (m), the centimetre (cm) and the millimetre (mm).

These units of length are related as follows:

- 1000 millimetres = 1 metre
- 100 centimetres = 1 metre
- 1000 metres = 1 kilometre

Since one hundred centimetres is equivalent to a metre, then a centimetre is a fraction of a metre.

$\left(\frac{1}{100}\right)$ A decimetre is $\frac{1}{10}$ of a metre and a millimetre is $\frac{1}{1000}$ of a metre.

PROCEDURE

Oral/Mental Starters

A student will be selected to walk from one end of the classroom to the other by taking “giant” steps. The class will make note of the number of “giant” steps taken. The same student will then be asked to walk the same distance by taking “baby” steps. The class will note the number of “baby” steps taken.

The teacher will engage the students in a discussion by asking the following questions:

- i. How many “baby” steps make a “giant” step?
- ii. How many “giant” steps make a “baby” step?
- iii. How many “baby” steps would be equivalent to twice as many/thrice as many “giant” steps?

Main Activity

Each group of 4 or 5 students will be given strips measuring 1 metre, 1 decimetre, and 1 centimetre.

- Students will use the strips to determine the relationships among the pieces.
- Students will use the information obtained to complete the following:
 $__ \text{ cm} = 1 \text{ m}, \quad __ \text{ m} = 1 \text{ cm}$
 $__ \text{ cm} = 1 \text{ dm}, \quad __ \text{ dm} = 1 \text{ cm}$
 $__ \text{ dm} = 1 \text{ m} \quad __ \text{ m} = 1 \text{ dm}$
- Engage students in a discussion about the relationship between the standard unit (the metre) and the other units, emphasizing the meaning of the prefixes.
- Students will be asked to use the strips to measure the heights of the tallest and the shortest person in each group and to state their heights in the form:
 - i. $__ \text{ m}, __ \text{ dm}, \text{ and } __ \text{ cm}.$
 - ii. $__ \text{ m and } __ \text{ cm}$
 - iii. $__ \text{ dm and } __ \text{ cm}$
 - iv. $__ \text{ cm}.$
- Each group will present their findings for class discussion.

PLENARY

Each group will be asked to state one metric relationship observed in the lesson.

ASSESSMENT

In their notebooks, each student will be asked to write each of the following heights

- a) 264 cm
- b) 783 cm

in the forms:

- i. ___ m, ___ dm, and ___ cm.
- ii. ___ m and ___ cm
- iii. ___ dm and ___ cm

LESSON 05 ○ AREA

SUB-TOPIC: Measurement

GRADE: Grade 4

DURATION: 1 hour

SPECIFIC OBJECTIVES

By the end of the lesson, students will be able:

- to measure area using unit squares



PREREQUISITE KNOWLEDGE

Students should already have:

- a) knowledge of area as space covered up by an object

MATERIALS/MANIPULATIVES

Various grids, square tiles

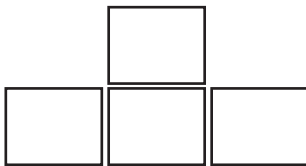
CONTENT SUMMARY

Area refers to the number of square units needed to cover a region.

PROCEDURE

Oral/Mental Starters

Draw a "boat" (shown below) on the board.



To each group of 2 students, distribute two or three 6×6 grids. Persons in each group play against each other by taking turns to colour tiles to create "boats" on the same grid. The person who is able to shade the greater number of "boats" is the winner (use different designs/colours to differentiate between the two players). "Boats" can be turned in any direction but must retain their original design. Allow children to play a few times and count up the number of squares that they shaded in order to determine the winner.

Main Activity

- Give each group of children about 40 square tiles – each tile should fit exactly over a square on the 6×6 grid that students were working with from starter activity. Ask students to say how many square tiles would completely cover the 6×6 grid.

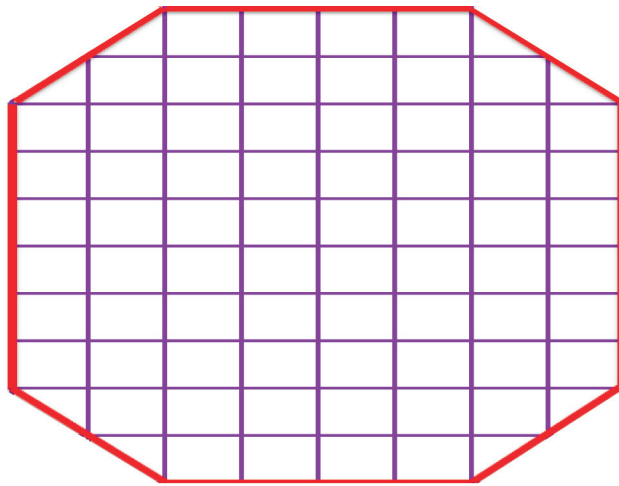
- Discuss students' responses, pointing out that the answer (36 square tiles) represents the area of the 6×6 grid.

Have each pair of students:

- o determine the area of the shaded portion of their grid
- o determine the area shaded in each design
- o the area of the unshaded portion
- Show students a picture of a "car"



- Give each pair of students a few copies of the grid below



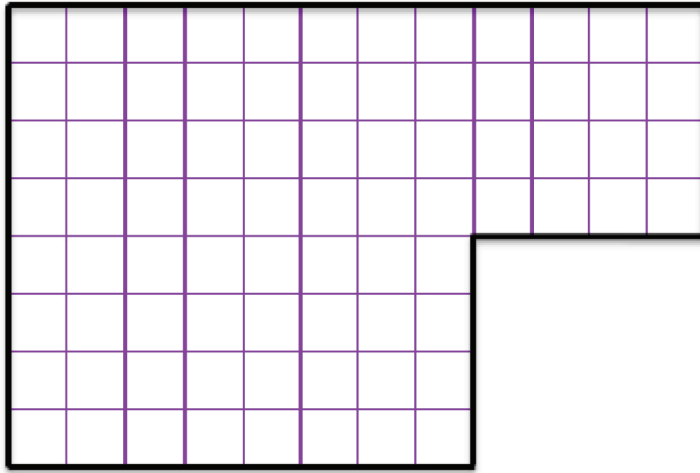
- Tell students that they are to take turns to colour "cars" in an effort to determine who could shade the greater number of cars before running out of space on the grid.
- Discuss the following questions:
 - o What is the area of the octagonal shape?
 - o What is the area of the shaded area of the octagon?
 - o What is the area of the unshaded area of the octagon?
 - o What is the area of each portion shaded in different designs?

PLENARY

Engage students in a discussion about:

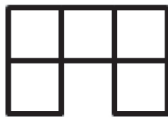
- the meaning of the term area
- the process of finding the area of a shape

ASSESSMENT

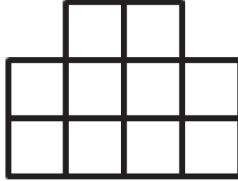


Place students in groups of 5 – 6. Provide each group with a large copy of the grid shown above. Tell them that it represents the floor of a living room and that the squares represent floor tiles. Have students colour the tiles on the living room to indicate where they will place the following pieces of furniture:

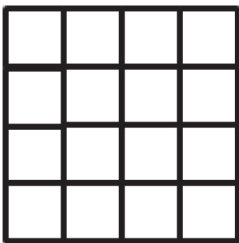
Two chairs



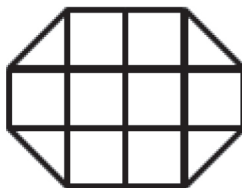
A TV stand



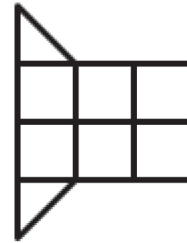
A piece of rug



A centre table



A computer desk



At the bottom of the grid, write the following questions for students to answer:

1. What is the area of the floor of the living room?
2. What is the area taken up by the pieces of furniture?
3. What area is left unoccupied by furniture?

LESSON 06 ○ TELLING TIME MINUTES TO THE HOUR

GRADE LEVEL: Grade 4

DURATION: 45 minutes

SPECIFIC OBJECTIVES

At the end of the lesson, students should be able to:

- read and write time using the minute to hour format



PREREQUISITE KNOWLEDGE

Before doing this lesson students should already have:

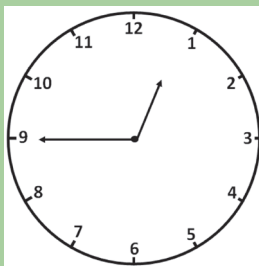
- a) knowledge of telling time on the hour and past the hour
- b) knowledge of the number of minutes in an hour

MATERIALS/MANIPULATIVES

Clocks, worksheets, game cards

CONTENT OUTLINE

There are sixty minutes in an hour. The display of digital clocks is in the format “hour : minute”. The display tells us how many minutes after the hour. However, the time can also be stated in the format “_ minutes to the hour”. By subtracting the number of minutes that have elapsed from sixty we know how many more minutes will pass before the next hour begins. For example, the clock below shows 12:45.



12:45

The time can also be read as fifteen minutes to one.

PROCEDURE

Mental/Oral Starters

Create many pairs of cards with numbers that add up to 60 (such as 32 and 28; 14 and 46). Give each student a card and instruct them to find their partner whose card number when paired with theirs adds up to 60.

Main Activity

- The teacher will start with an analogue clock displaying 3 o'clock. The teacher will turn the hands of the clock instructing students to tell her to stop when the time is closer to 4 o'clock than 3 o'clock. Discuss students' responses, ensuring that they understand that as soon as the minute hand passes 3:30, the time is closer to 4:00. Tell students that any time that is after 3:30 can be stated as ___ minutes to 4.
- A student will be selected to model 3:46 on the clock. The students will be asked the following questions:
 1. What time will it be when the minute hand reaches 12?
 2. How many more minutes will it be before the minute hand reaches to the 12?
 3. How many minutes to 4 o'clock is it now?

The teacher will guide students in counting up to the hour in order to answer the third question.

Each group will be given a worksheet to complete.

They will be asked to supply missing times to match times in column A with those in Column B.

WORKSHEET

GROUP: _____

DATE: _____

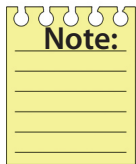
GROUP MEMBERS: _____

Fill in the missing times so that the times stated in Column A is the same as the times in Column B. The first one is already done for you.

	Column A	Column B
1.	12: 47	<u>13</u> minutes to <u>1</u> .
2.	3:51	__ minutes to __.
3.	7: 38	__ minutes to ____
4.	__:__	26 minutes to 9.
5.	__:__	19 minutes to 2
6.	9: 39	__ minutes to __

PLENARY

The class will play a game of “I have __, who has_?” Each student will be given one of the pre-prepared cards such as the ones shown below. The first person will read his/her card. The person holding the card corresponding to the prompt will read his/her card next creating a chain until all cards have been read.



Note: *The cards should not be distributed in seating order as the aim is to have students recognize the times based on the prompt and not simply to read cards based on the order of seating.*

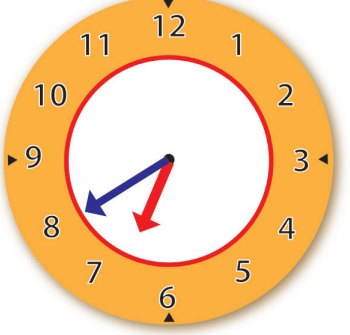
SAMPLE GAME CARDS

<p>I HAVE 3:45;</p> <p>Who has eleven minutes</p> <p>to 6?</p>	<p>I HAVE 5:49;</p> <p>Who has eight minutes to</p> <p>3?</p>
<p>I HAVE 2:52;</p> <p>Who has 24 minutes to</p> <p>9?</p>	<p>I HAVE 8:36;</p> <p>Who has 18 minutes to</p> <p>12?</p>

ASSESSMENT

The students will work in their groups to play a game of “Time Concentration”. Each group will be given a set of cards such as the ones shown below. They will be instructed to place all cards face down. Taking turns they will turn over cards two at a time and match the time with the clock face. If the pair of cards they turn over matches, they will be allowed to keep the pair and turn over another pair. However, if the pair of cards does not match, they will have to replace the cards and wait until it is their turn again. The student with the most pairs at the end of the game is the winner.

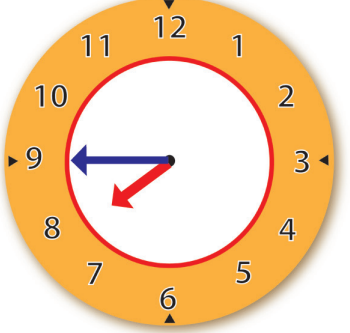
SAMPLE TIME CONCENTRATION CARDS



6:40

An analog clock face with numbers 1 through 12. The hour hand is between 6 and 7, closer to 7. The minute hand is pointing at 8. The time is 6:40.

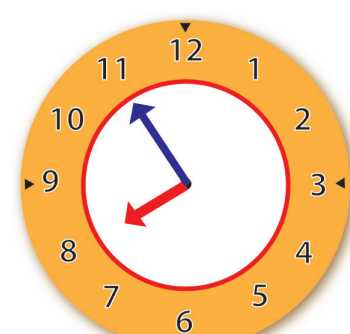
20 minutes to 7



7:45

An analog clock face with numbers 1 through 12. The hour hand is between 7 and 8, closer to 8. The minute hand is pointing at 9. The time is 7:45.

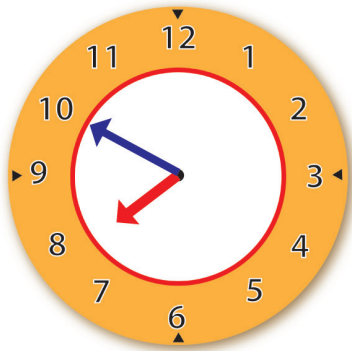
15 minutes to 8



7:55

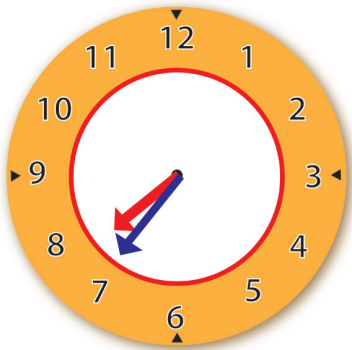
An analog clock face with numbers 1 through 12. The hour hand is between 7 and 8, very close to 8. The minute hand is pointing at 11. The time is 7:55.

5 minutes to 8



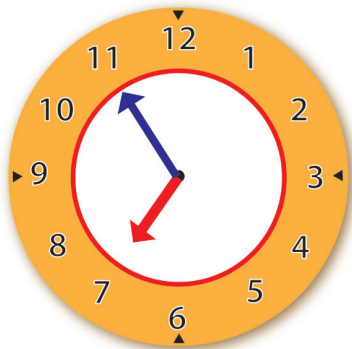
7:50

10 minutes to 8



7:35

25 minutes to 8



6:55

5 minutes to 7

LESSON 07 ○ AREA AND PERIMETER

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES



By the end of the lesson, students should be able to:

- solve problems based on computing the measurement of the area of a rectangular region
- compare and contrast units of length and units of area

PREREQUISITE KNOWLEDGE

Students should already have knowledge of:

- a) length, area, perimeter
- b) how to calculate the perimeter and the area of a given (2-dimensional) figure

MATERIALS/MANIPULATIVES

Square tiles, match sticks, cartridge paper and grid paper

CONTENT OUTLINE

Perimeter is the measurement of the boundary of a figure or area. The measurement inside the object is not considered for perimeter. Perimeter is used in everyday life activities such as calculating the amount of material needed for fencing, waist size, and so on. The perimeter of a circle is called the circumference.

Area is the amount of space inside the boundary of a flat (2 dimensional) object such as a rectangle or a triangle. Area is measured in squared units. Area is used in everyday life by tilers, painters and other skilled workers.

PROCEDURE

Mental/Oral Starters

Students, in groups, will be given five square tiles and asked to arrange them to form the largest possible perimeter. Students will be told that tiles should be joined side-to-side, but should not enclose an open space. Students will be told that tiles should be joined side-to-side, but should not enclose an open space. Discuss the various shapes, drawing students' attention to the fact that while the area of each shape is the same, their perimeters are different.

Main Activity

- Students will be presented with the following problem:
A farmer has a rectangular goat pen which uses 24m of fencing. One night, during a storm the goat pen was destroyed. The farmer wants your help to rebuild the goat pen. What are the possible dimensions of the pen? Remember he has only 24m of fencing. How long or wide should the pen be, so that his goats have the largest area of grass possible to eat?
- Students should use 24 matchsticks (each representing 1 m) to try and create different models of the goat pen, e.g. 1×11 , 2×10 , 3×9 , etc. Students should also draw the models created on grid paper.
- Students will then be guided in creating a table to reflect the following attributes of the models created – length, width, and distance around (perimeter)

Dimensions	Length	Width	Perimeter
1×11	1	11	24

- Students will be asked to determine which model would be best in ensuring that the goats have the largest area of grass to eat. Students will be asked to justify the reason for their selection by sharing the strategy used to arrive at this conclusion – for example, counting tiles or using the formula for area of rectangle.
- Students will then be asked to complete the table by inserting the area of the different models created.
- Students and teacher will then discuss the observation that while the perimeter of each shape remained the same, their areas varied.

Rectangle	Length	Width	Perimeter	Area
1×11	1	11	24	

PLENARY

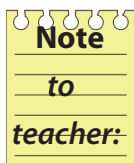
Students will make journal entries in response to the following questions:

- What happened when the perimeter was fixed?
- What do you notice about the dimensions of the goat pen as its area gets larger?

ASSESSMENT

Students (in groups) will be given 12 square tiles or 20 square tiles. Each should represent a rectangular area of grass on a farm.

- What are the possible dimensions of these farms?
- Which possibility will require the most/least fencing?
- What conclusions can be drawn about the farms that required the most fencing?



Note

to

teacher:

This is an extension activity for students to investigate rectangles having a fixed area but different perimeters as the dimensions are altered.

LESSON 08 ○ INVESTIGATING CIRCUMFERENCE OF A CIRCLE

GRADE LEVEL: Grade 6

DURATION: 1 hour

SPECIFIC OBJECTIVES:

By the end of the lesson, students will be able to:

- identify the relationship between circumference and diameter
- investigate the concept of pi (π)



PREREQUISITE KNOWLEDGE

Students should have knowledge of:

- a) parts of a circle
- b) basic units of length

MATERIALS/MANIPULATIVES

String, cord, tape measure, circular cut-outs (these can be constructed by teacher so that they have more precise diameter which represents a multiple of seven), circular objects – for example compact discs, lids etc. (ensure that the centre points of the circular objects are clearly defined), scissors, calculator.

CONTENT OUTLINE

A circle is a plane figure with infinitely many points equidistant from a fixed point called the centre. Circumference is the perimeter of a circle. That is, circumference is the distance around the circle. The diameter of a circle is the chord that runs through the centre of the circle. Pi is the relationship between the circumference and the diameter of a circle. The circumference of any circle is approximately $3 \frac{1}{7}$ times the diameter. The universal formula for circumference is pi multiplied by the diameter.

PROCEDURE

Mental/ Oral Starters

- Using a teacher's compass or string and chalk, draw a large circle on the classroom floor or paved area outside. Allow a few students to walk heel-to-toe along the diameter and record the number of steps. Allow them to now walk along the circular edge. Engage a discussion in terms of estimating the relationship between the circumference and the diameter.
- Ask the question: "What do you think is the relationship between the diameter of the circle and its circumference?" Students can pose a hypothesis: "*I think that the circumference is... the diameter*".

Main Activity

- Place students in groups. Give each group a circular object or a cut-out of different sizes, string (long enough to get the length of a diameter and circumference), a ruler / tape measure.
- Allow students to measure the diameter of their object/cut-out with the string. Students should cut the length of the string which represents the diameter and measure this length with the ruler.
- Allow students to use another piece of string to measure the length of the circumference and cut off this length. Measure the length of string which represents the circumference along the ruler.
- Ask the questions:
 - “Which is greater in length?”
 - “How many times longer than the diameter is the circumference?”
 - “How can we prove this?”
- Allow students to use the length of the string which represents the diameter to measure the circumference, noting the number of times the length of string which represents the diameter can be obtained from the circumference.
- Teacher will guide each group in comparing the remaining piece from the circumference to the length of the diameter. Discuss how many times the remainder could be taken out of the diameter. Guide students into expressing this as a fraction.
- Discuss the following questions:
 - How many times can we get the length of the diameter out of the length of the circumference? (Explain to students that this ratio is called pi)
 - Does this happen for all the circular shapes?
 - Does the size of the circle affect pi?
 - How much of the diameter does the fraction (small piece remaining) represent?
 - Is it half of the length of the diameter?
 - Is it greater/ less than a half?

PLENARY

Discuss the question: What formula can now be used to calculate pi?

ASSESSMENT

Use the relationship between diameter and circumference to estimate the circumferences (in Column Y) that most closely correspond to the given diameters in Column X.

Column X (Diameter)	Column Y (Circumference)
7 cm	29 cm
9 cm	42 cm
11.5 cm	16 cm
3.5 cm	22 cm
13 cm	35 cm
5.2 cm	11 cm

LESSON 09 ○ SCALE DRAWING

GRADE LEVEL: Grade 6

DURATION: 1 hour

SPECIFIC OBJECTIVES:

By the end of the lesson, students will be able to:

- interpret a simple scale drawing and calculate actual distances using the scale of a road map or floor plan



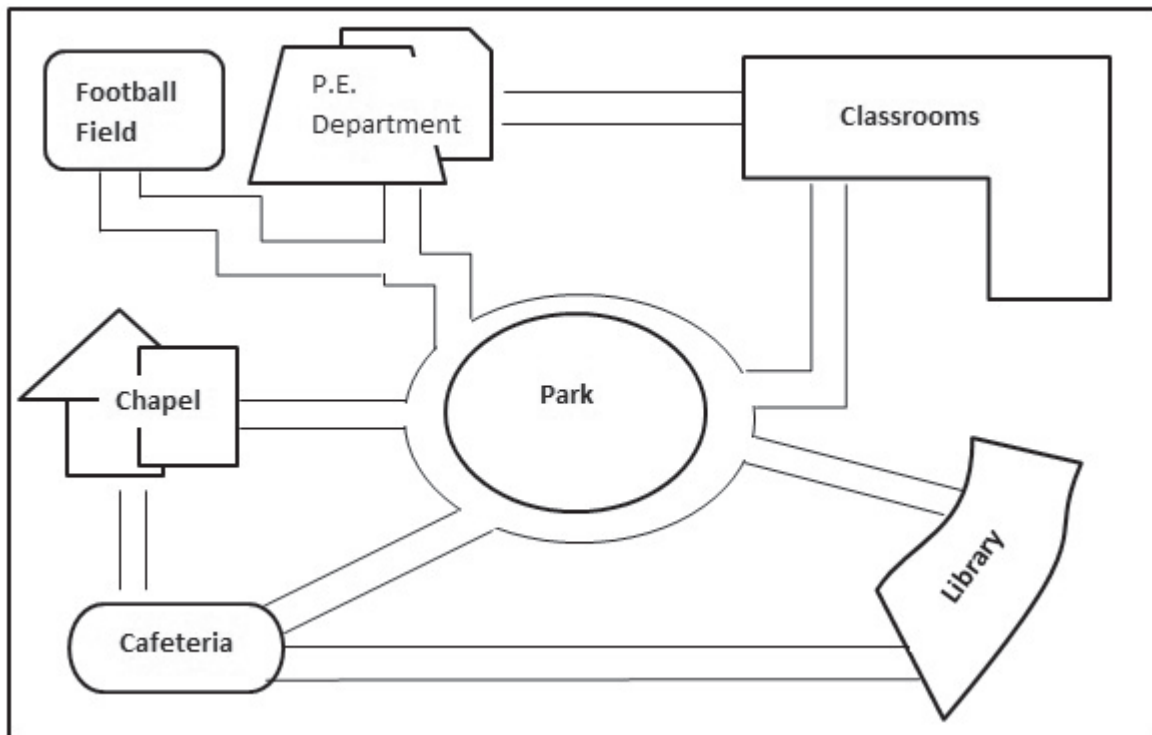
PREREQUISITE KNOWLEDGE

Before doing this lesson students should have knowledge of:

- a) ratio (including metric conversion)
- b) similar shapes
- c) equivalent fractions

MATERIALS/MANIPULATIVES

Copies of a simple map showing a school campus; a sheet of letter sized paper; diagram of three tall buildings of varied sizes; $\frac{1}{2}$ sheet cartridge paper with cm grid and a small 5cm print of a house on it (one per group).



CONTENT OUTLINE

A scale drawing is a drawing of an object/place in which all measurements are changed proportionately. A map cannot be of the same size as the area it represents. So, the measurements are scaled down to make the map of a size that can be used

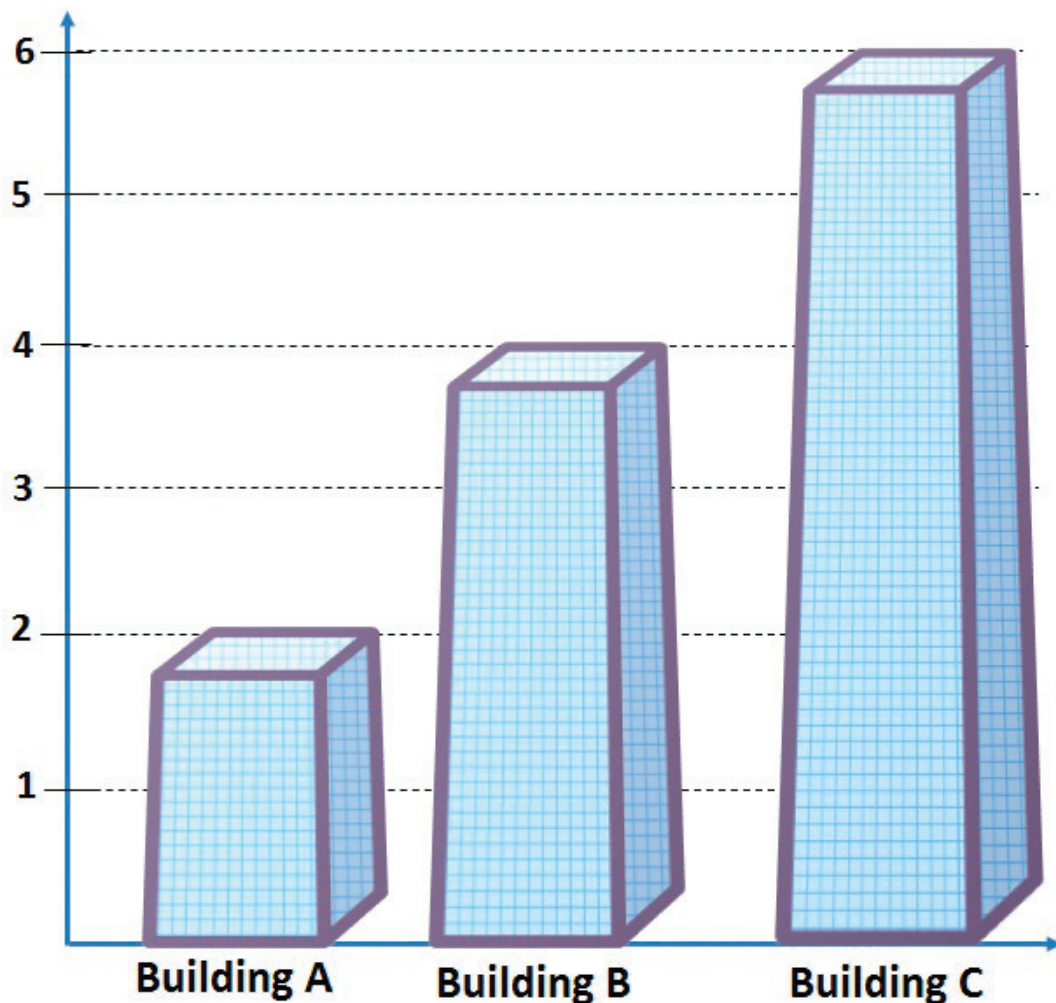
PROCEDURE

Mental/Oral Starters

Students will be shown 4 different sizes of the same photograph. Discuss similarities and differences among the photographs. Teacher should highlight the fact that regardless of the size of the pictures the images are the same.

Main Activity

- Students will be shown the diagram below and asked to tell how many times shorter or taller the different buildings are. Emphasis should be placed on writing in ratio form.
- *Example:* Building B is 2 times as tall as Building A (record it as 2:1)



- Encourage students to use terms such as: two times taller or half as tall. The class will have a discussion on scale drawing (highlight importance of ratio). The discussion should also highlight the fact that objects may also be scaled up.
- The teacher will distribute copies of maps to students in their groups and indicate between which two points they should measure using their rulers (the actual distance between the points will be given to the students).
- The teacher will allow students to use their own method to find out how many times smaller the distance on the map is to the actual distance on the ground (start with scale that is 100:1).
- The teacher will assist students while they work. Using the same map, students will determine the actual distance on the ground between two specified points.

FROM	TO	Ruler Distance	Actual Distance

PLENARY

The class will be engaged in a discussion which highlights the terms “scaling” and “ratios”.

ASSESSMENT

The teacher will give students cartridge paper with the grid and small drawing. Students will be asked to reproduce the diagram on the paper 4 times its present size. Each group will present their finished drawing on the board. The teacher and the students will scrutinize the drawings to see which ones were properly done to the given scale.

GEOMETRY

LESSON 01 ○ SHAPES – TRIANGLES AND RECTANGLES

GRADE LEVEL: Grade 1

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson, pupils should be able to:

- identify and name geometric shapes observed in the environment
- differentiate between triangles and rectangles



PREREQUISITE KNOWLEDGE

Students should already have:

- a) a general idea that all objects have a shape

MATERIALS/MANIPULATIVES

Attribute blocks/cut-outs: squares, rectangles, crayons

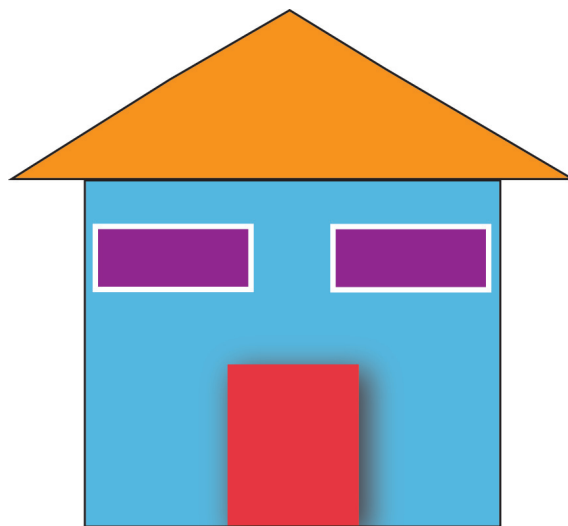
CONTENT OUTLINE

- a rectangle has four sides
- a triangle has three sides

PROCEDURE

Mental/Oral Starters

- Students will be shown a geo-house made of triangles and rectangles. They will be asked to tell what it is. Students will trace their fingers along different parts of the house (roof, door, windows) and describe the shapes formed.



Main Activity

- Students will be given cut-outs of rectangles and triangles in groups. Students will tell whether or not the shapes look like the ones on the house.
- Students will be asked to sort the shapes in two groups.
- Students will give their reasons for placing them in these groups.
- Students will explore the properties of the shapes in each group (by identifying and counting the sides).
- Students will be introduced to the terms “triangles” and “rectangles” to describe the respective groups.

PLENARY

THE SHAPE SONG

(sung to the tune of “Twinkle, Twinkle, Little Star”)

“Terry triangle, look at me, count my sides, there are three”

[make an outline of a triangle in the air]

(Rep.) “Robby rectangle, I have four, two long”

[make a outline of a rectangle in the air]

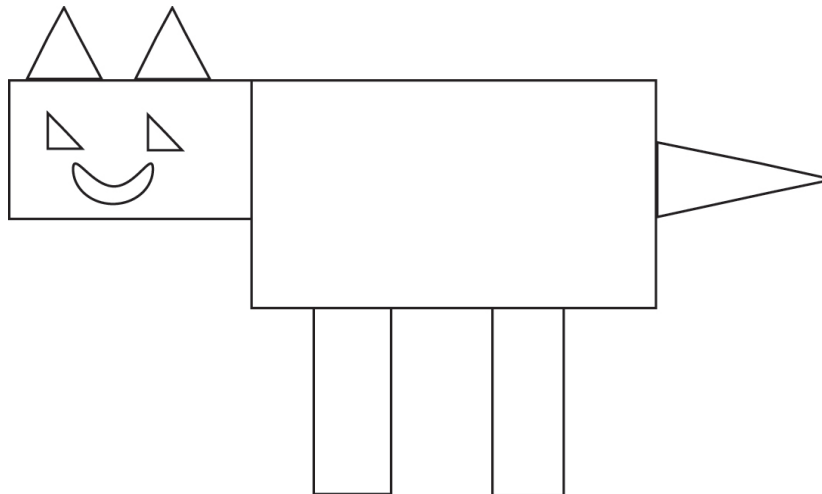
“two short” [make in the air]

“but no more”

[shake head] (Rep.)

ASSESSMENT

Pupils will be given a geo-animal on worksheet and asked to colour the rectangles red and the triangles blue.



LESSON 02 ○ PATHS

GRADE LEVEL: Grade 2
DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of this lesson, students should be able to:

- identify straight and curved paths
- compare paths using the terms “longer than” and “shorter than”
- draw curved and straight paths



PREREQUISITE KNOWLEDGE

Students should already:

- a) be able to identify a point
- b) know how to distinguish between straight and curved lines

MATERIAL/MANIPULATIVES

Map of community, story (“Little Red Riding Hood”), paper tape, strings

CONTENT OUTLINE

A path can either be straight or curved.

Example:

Straight Path _____

Curved Path



PROCEDURE

Mental/Oral Starters

- Students will be shown a map of a community (map attached). They will be asked to identify places on the map and state whether or not these places are in their community.

Main Activity

- Model of map will be created on the floor using strings or tape. Students will be given different errands to run in the community which should be role-played on the map.
- *For example:*
 - Walking from Jenny’s house to the church
 - Walking from Jenny’s house to the mall then to the church

- Students will be asked to use their fingers to trace the different journeys identified on a smaller map of the community given to them in groups. They will be led to understand that another name for the journey is a path.
- Students will then be asked to use their pencils to outline the paths identified. (Efforts should be made to ensure that the paths are both straight and curved.) Students will be asked to identify the ones that are alike and group them together. The terms "straight" and "curved paths" will be used to describe the groups.
- Students will then be asked to look at another map. They will explore different paths to get to a particular destination (for example from point A to C or from point A to B to C) and describe them in terms of straight or curved then say which is shorter or longer.
- Students will also explore paths on the map that take them back to where they started (for example, from home to school to the library, then back home), in addition to other paths that do not take them back to their starting point (for example, from home to the supermarket).
- Students will be asked to say how many straight and curved paths they travelled.

PLENARY

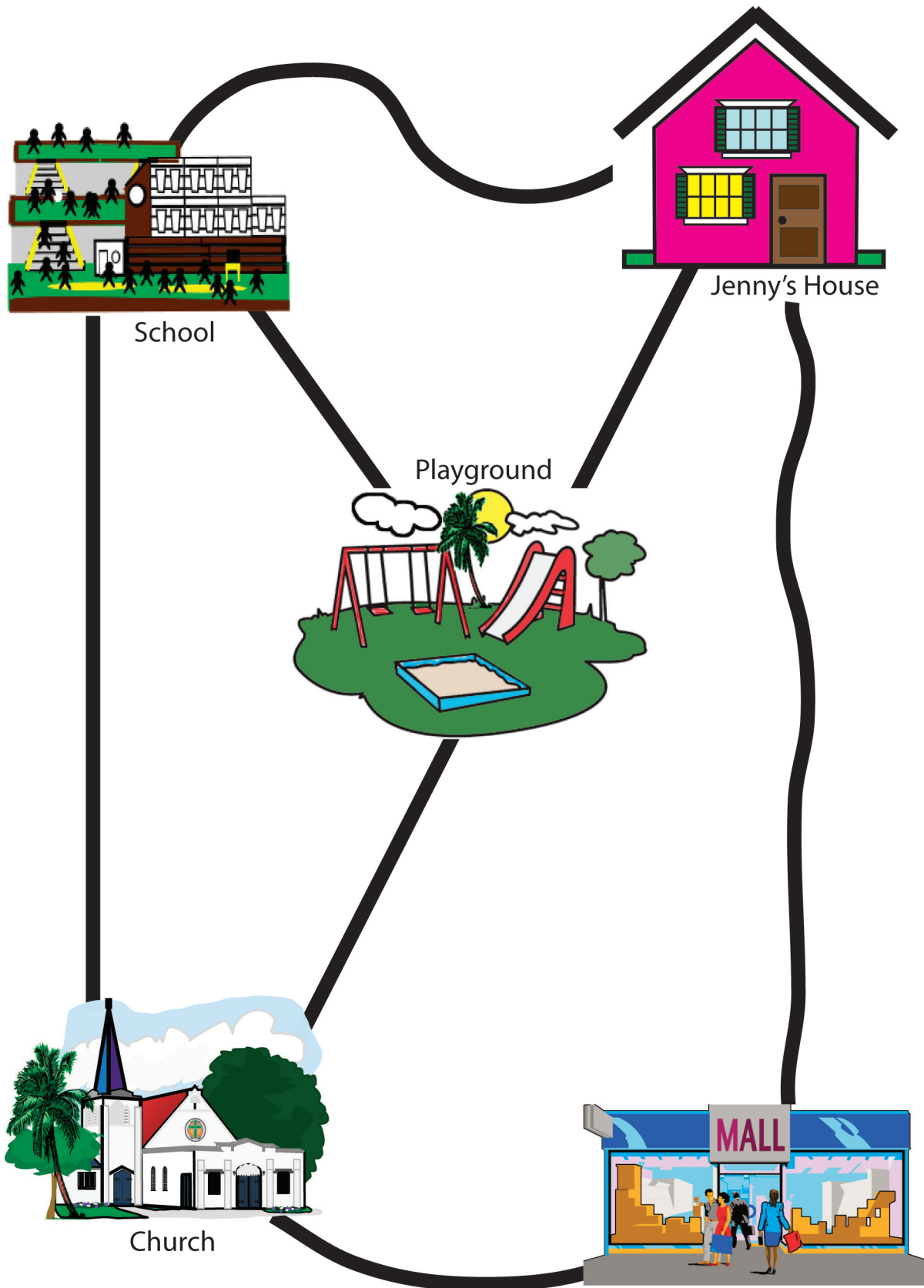
- The class will have a discussion on the differences between straight and curved paths, giving examples of each.

ASSESSMENT

Students will listen to the story "Little Red Riding Hood". They will be asked to identify the places named in the story and then create a map showing the paths identified in the story.

Story: "Little Red Riding Hood"

Little Red Riding Hood loved her grandmother very much. One day, Red Riding Hood decided to visit grandmother who was not feeling well. She thought about what she could take to cheer up her grandmother. She left home and walked along a straight path to the garden. She stopped at the garden and picked flowers for her grandmother. She then travelled around a bend to the bakery to get something sweet for her grandmother. After leaving the bakery she followed the path along the winding river to her grandmother's house. Her grandmother was very excited to see her. She spent the rest of the day with her grandmother then took a straight path back home.



LESSON 03 ○ LINES OF SYMMETRY

GRADE LEVEL: Grade 2

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson, students should be able to:

- explain what is meant by the term symmetry
- recognize the relationship between symmetry and the fraction $\frac{1}{2}$
- demonstrate symmetry by folding
- complete the drawing of shapes that are symmetrical



PREREQUISITE KNOWLEDGE

Students should already know:

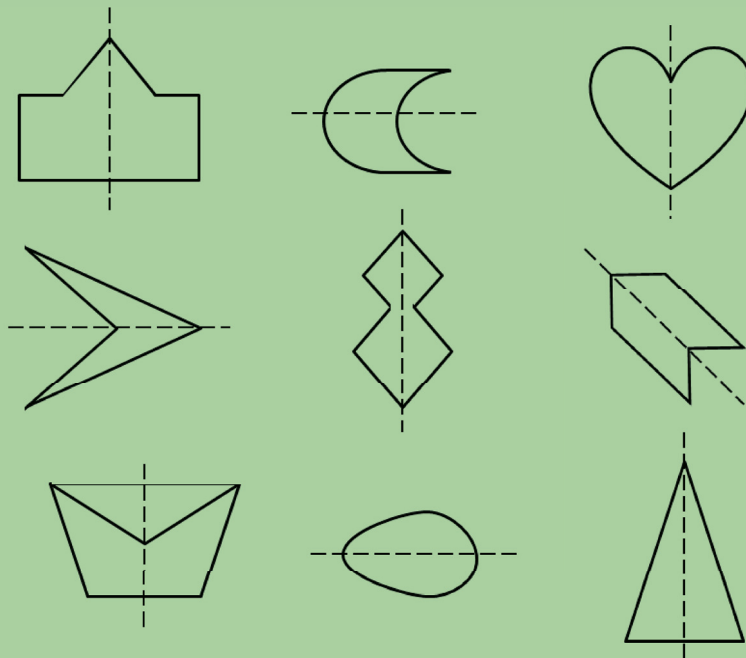
- a) how to divide a plane shape into halves using straight lines and by folding

MATERIALS/MANIPULATIVES

Shape cut-outs, crayons, grid paper

CONTENT OUTLINE

A line of symmetry is a line dividing a shape or object into two halves such that if the shape is folded along this line both halves would match exactly. Lines of symmetry may run in any direction (horizontally, vertically, diagonally).



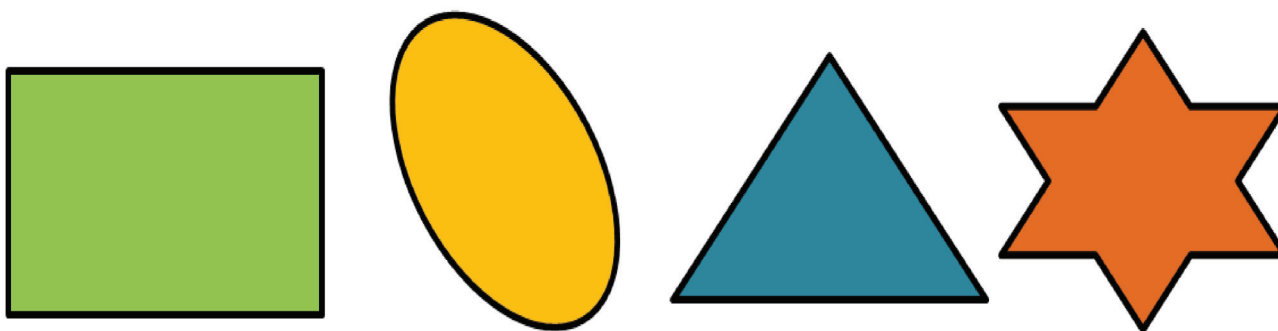
PROCEDURE

Mental/Oral Starters

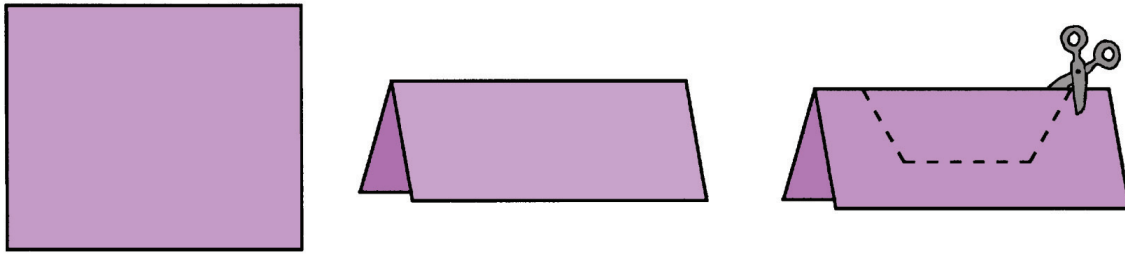
- Students will be asked to fold paper into two halves and then open. They will then be given paint to create a blob and then refold the paper along the crease. Pupils will unfold the paper to reveal the blob. (These could have been created prior to the class to save on time. Dried blobs could then be taken to the Mathematics class.) Pupils will analyse the blobs and tell what they notice about them. The similarity between both sides of the diagram will be highlighted. The word symmetry will be introduced and discussed.

Main Activity

- Students will be given a variety of cut out shapes that all possess lines of symmetry. Examples of these shapes include a square, rectangle, circle, rhombus and oval.



- Students will be asked to fold the shapes into halves so that each half fits exactly over the other. The students will be asked to state what they observe about the parts and what separates them.
- Students will be asked to touch the line that divides the shape.
- Students will then be given both regular and irregular cut-out shapes and asked to fold them to see if they all have lines of symmetry.
- The class will have a discussion on which shapes have lines of symmetry and whether or not all shapes have a line of symmetry.
- Students will be given a sheet of paper and asked to fold it in halves. They will be instructed to draw a shape of their choice from the folded end of the paper. The teacher will demonstrate as well. Students will be assisted in cutting out their shape. Students will unfold the paper to reveal their new shape. Teacher and students will discuss the new shape highlighting the line of symmetry.

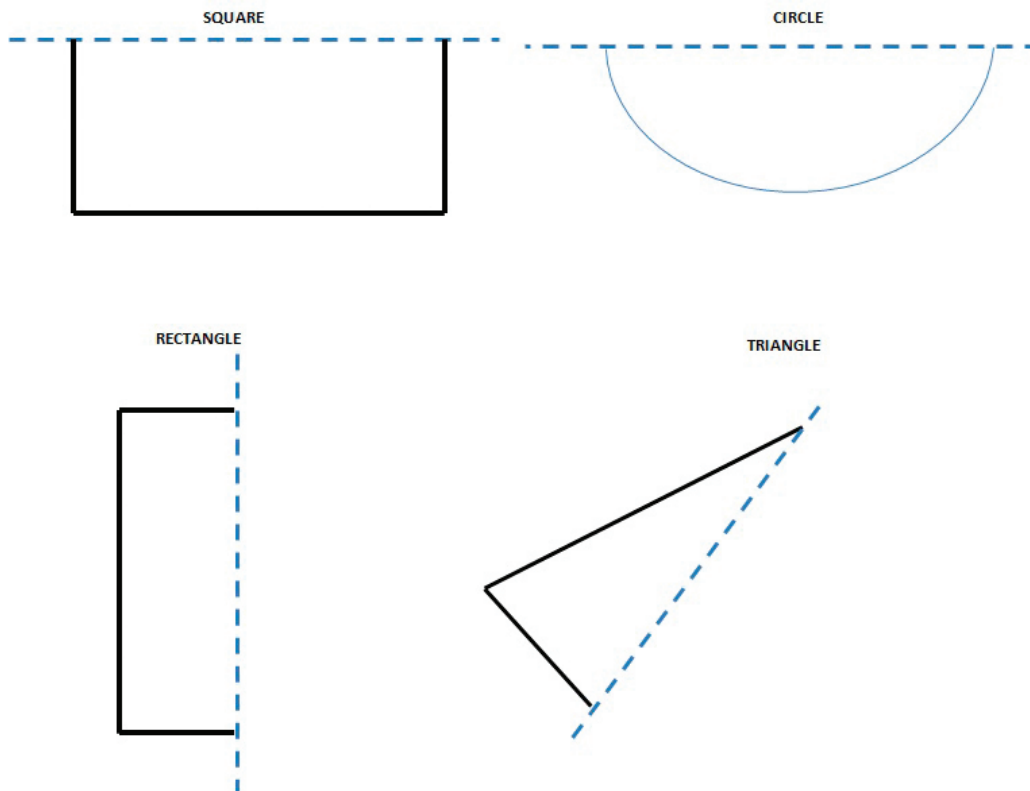


PLENARY

Allow students to explain the difference between the shapes that are symmetrical and those that are not symmetrical. Have students sort the shapes previously given into those that are symmetrical and those that are not.

ASSESSMENT

- Students will be given semi-completed symmetrical shapes on grid paper and asked to complete the drawing of these shapes:



LESSON 04 ○ POLYGONS

GRADE LEVEL: Grade 4
DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of this lesson, pupils should be able to:

- define the term “polygon”
- identify various shapes in the environment that represent polygons
- differentiate between polygons and non-polygons



PREREQUISITE KNOWLEDGE

Students should already have knowledge of:

- a) straight, curved, open and closed paths
- b) line segments
- c) lines
- d) angles and rays

MATERIAL/MANIPULATIVES

Cut-outs of plane shapes, grid paper, pictures, chart showing non-polygons and polygons, play dough, toothpicks.

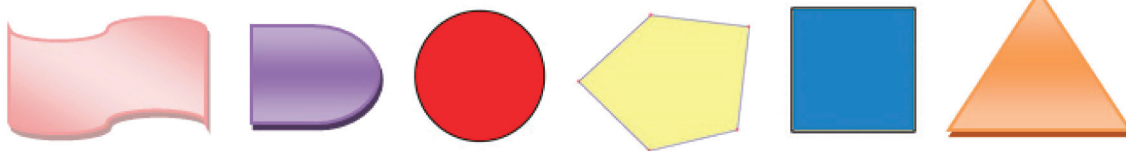
CONTENT OUTLINE

A polygon is a closed plane shape made up of three or more straight-line segments. Polygons are named according to the number of sides and angles they have. Polygons can be found all over the environment – on buildings, walls, vehicles, pictures, among other things.

PROCEDURE

Mental/Oral Starters

- In groups of 4 – 6, students will be given pictures for them to sort (three polygons and three non-polygons).

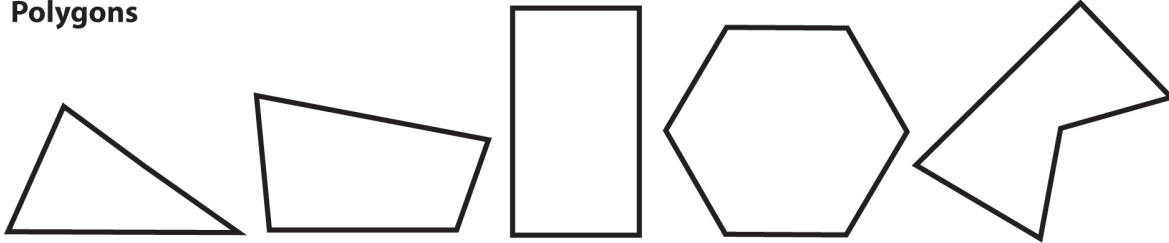


- Each group will report on their method of sorting giving reasons for their answers.
- Students should be guided to see that the given shapes could be sorted as having curves or having all straight sides.

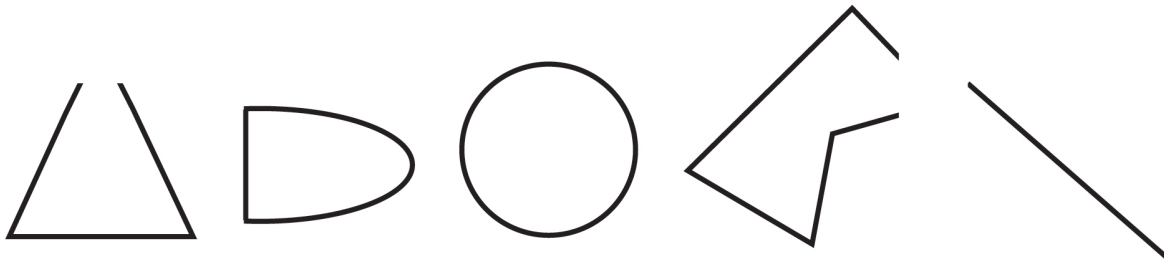
Main Activities

- Students will view a chart showing a set of polygons and a set of non-polygons.

Polygons



Non-Polygons



- Students will be asked to observe the two sets of diagrams and then form a definition for polygons in their own words so that the definition covers all the cases of polygons shown.
- Teacher should place emphasis on the following:
 - polygons are closed
 - polygons are only bound by straight lines
 - reference should be made to the shapes explored in the starter activity
- In their groups, students will identify polygons and non-polygons in given pictures. (Pictures can be taken from newspapers or magazines, e.g. a map of a community or town, pictures of large buildings etc.)
- Students will label polygons "P" and the non-polygons "N"
- In groups, pupils will be given play dough and toothpicks and asked to make polygons with different number of sides.

PLENARY

Essential characteristics of polygons will be summarized through class discussions.

ASSESSMENT

Students will draw two examples of polygons and two examples of non-polygons on grid paper.

LESSON 05 ○ TYPES OF ANGLES

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES



At the end of the lesson, pupils should be able to:

- recognize right angles when drawn or seen in the environment
- identify right angles from different perspectives and orientations
- identify angles less than or greater than right angles

PREREQUISITE KNOWLEDGE

Pupils should already know that:

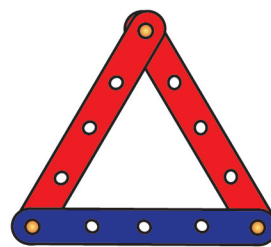
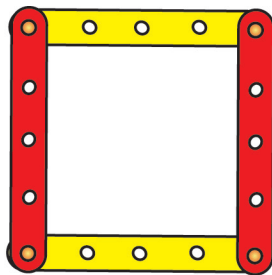
- an angle is formed where two rays or line segments meet
- angle is the measure of the amount of turn
- angles are measured in degrees
- angles can be named by letters example, angle ABC

MATERIALS/MANIPULATIVES

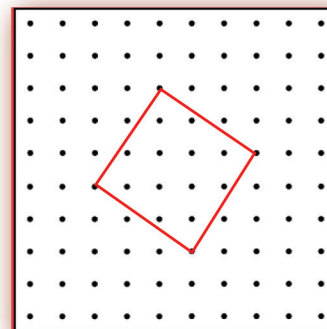
Right angle tester, geo-strips, geo-boards



Square edged paper/square tile used as 90° angle tester



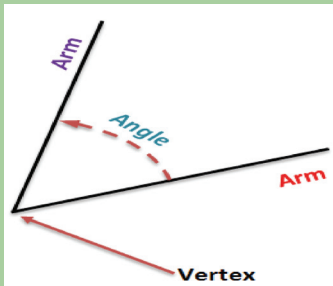
Geo-strips



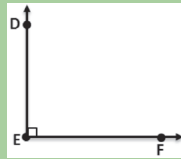
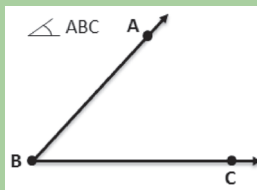
Geoboard

CONTENT OUTLINE

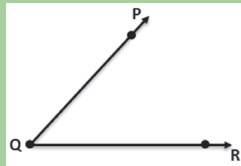
Vertex: A point at which two line segments, lines, or rays meet to form an angle.



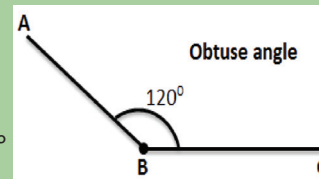
Angles are named by naming a point on each side of the angle with the vertex in between.
e.g.



Right angles measure 90°

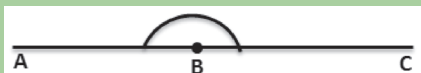


Acute angles measure less than 90°



Obtuse angles measure more than 90° but less than 180°

Straight angles measure 180° and are a combination of two right angles.



PROCEDURE

Mental/Oral Starters

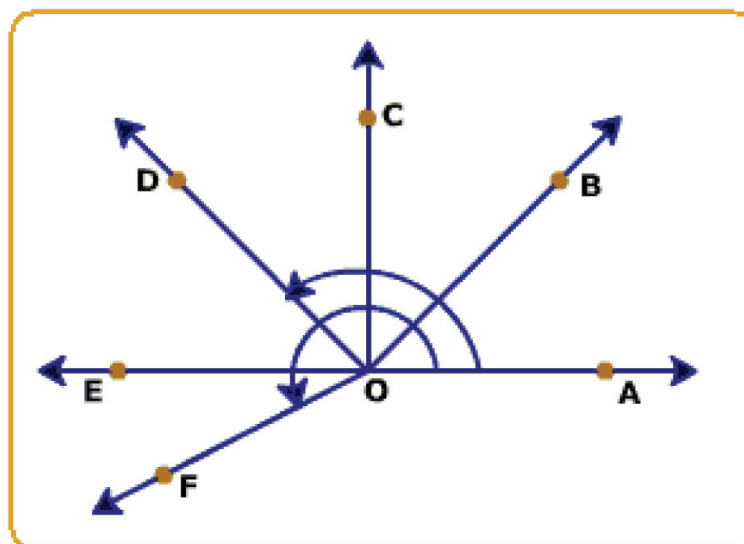
- Pupils will be given a page with drawings of various angle measurements. All the acute angles will be labelled with ABC; all the obtuse angles will be labelled with PQR and the right angles will be labelled with DEF. Students will be told to sort the angles using whatever characteristics they want.
- Discuss with students the differences and similarities within and across the groups formed.

Main Activity

- Ensure that students have grouped the angles using the letters as the common characteristic. Discuss the characteristics/attributes of those angles labelled DEF (the right angles). Explain to students that these angles are called right angles and that they measure 90° .
- Pupils will use the edge of books or angle testers to verify right angles and non-right angle classifications.
- Pupils will be asked to present their right angles in different orientations. Discussion will elicit the fact that orientation does not affect or change the size of the angle.
- Pupils will be asked in groups to use right angle testers made of strips of paper/ geo-strips to find areas in their classrooms that are of right angle measurement. Teacher will verify.
- Pupils will then identify other areas in their environment that form right angles – for example chalkboard corner, wall corner.
- Pupils will be given geo-strips and asked to rotate their geo-strips to form an angle less than a right angle. Use tester to verify. Once this has been done, students will be introduced to the term "acute angle". Pupils will then seek to give angle measurements that are acute, e.g. 40 degrees.
- Pupils will use geo-strips to show angles more than right angles but less than straight angle. Straight angle measurement will be discussed. The term "obtuse angle" will be introduced.
- Pupils will be given a diagram with angles. In groups, they will be asked to identify and name angles as obtuse, acute or right using letter names.

Activity 2:

Look at the diagram and identify the angles in each category listed below.



E.g. Acute: 1. Angle COB

Obtuse _____

Right

Straight _____

PLENARY

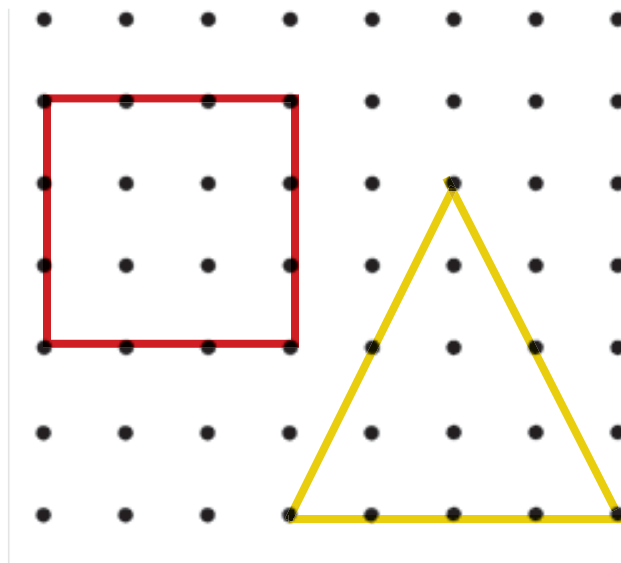
Concepts will be reviewed for students to write definitions for obtuse, right, acute and straight angles.

ASSESSMENT

The students will be placed in groups of 5 and each group given a geo-board. The teacher will ask students to use elastic bands to create shapes on their geo-boards based on descriptions given. For example, create polygons that have:

- 4 right angles
- 3 acute angles
- 2 right angles, 1 acute angle and 1 obtuse angle.

Samples of the first two are shown on the diagram below.



LESSON 06 ○ COMBINING GEOMETRIC SHAPES

GRADE LEVEL: Grade 4

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of this lesson, students should be able to:

- Identify rectangles within a given set of quadrilaterals
- Identify right angle triangles from a given set of polygons
- combine geometric shapes to produce shapes in the environment.



PREREQUISITE KNOWLEDGE

Students should already know how to:

- a) Identify triangles and quadrilaterals by the number of sides
- b) Identify angles

MATERIALS/MANIPULATIVES

Tangram pieces, pictures, Grandfather Tang Story (edited)

CONTENT OUTLINE:

- Polygons are closed shapes bounded by three or more straight lines. A triangle has three sides and three angles while a quadrilateral has four side and four angles. There are different types of triangles and quadrilaterals.

PROCEDURE

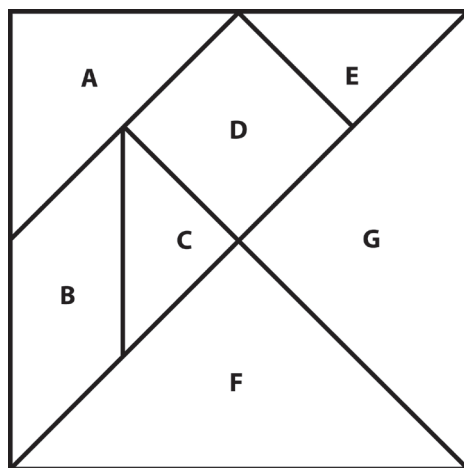
Mental/Oral Starters

The students will be told a part of “Grandfather Tang’s Story” up to the part about the lion. Each time an animal’s name is called the representation of the animal will be placed on the board.

Main Activity

(Pictures attached)

- The representations of the animals will be removed from the board and students will be placed in groups of four.
- They will be shown a picture of the tangram pieces assembled as a square and asked to identify the shape of each piece.



(Triangle – A, C, E, F & G; Square – D; and Parallelogram – B)

- Each group of student will be given a tangram set.
- Students will be asked to put the tangram pieces in groups based on similar properties (most likely groupings: triangles and quadrilaterals).
- Students will be asked to explain their reason for the different groupings.
- The class will have a discussion on the properties of each tangram piece. (Properties of triangle, e. g. 3 sides, 3 angles; properties of quadrilaterals, e. g. 4 sides, 4 angles.)
- Students will be asked to demonstrate how two pieces can be used to form a square (C & E and F & G)
- They will also be asked how many squares they can form or identify from the entire set (4 squares: D, all the pieces combined, C & E and F & G combined)
- Students will be asked to compare the square formed by C & E to D, and to state what they observe. They will be told that shapes that are exactly alike are called congruent shapes.
- They will be asked to identify other congruent shapes in the set. Allow students to place pieces on top of each other to ensure that they are exactly alike (other congruent pieces: C & E and F & G).
- Students will be asked how many shapes they can make using just the two large triangles (triangle, square, parallelogram).
- Students will be asked which animal from the story they like the best. They will be shown the representations of the animals from Grandfather Tang's Story and asked to make it. Different students will be asked to identify the body parts of the animals formed from the congruent pieces.
- Another animal with the pieces outlined will be shown to the students and they will be asked to make it.

- Students will be told the rest of the story.
- They will be shown the rabbit without the outline and asked to make it.
- Different students will be asked to identify the shapes which form the different body parts of the rabbit.

PLENARY

The class will review the properties of and relationship among shapes.

ASSESSMENT

Students will be asked to use any number of pieces from the tangram set to make a shape from their environment. They will discuss the shapes made.

Grandfather Tang's Story

Grandfather Tang and Little Soo were sitting under a mango tree in their backyard. They were amusing each other by making different shapes with their tangram puzzle.

"Let's do a story about animals," said Little Soo.

"Ok," said Grandfather Tang, "I'll go first." So Grandfather Tang arranged his seven tangram pieces into the shape of a bird. "Do you know which bird this is?" he asked Little Soo.

"Wow!" said Little Soo as she looked at Grandfather Tang's duck. "I can make an animal too!" she said as she began to arrange her pieces. "Meow..." she said as she looked at her animal. "Can you tell which animal I made Grandfather?"

"A cat," said Grandfather Tang.

"Now it's your turn, Grandfather Tang". Grandfather Tang thought for a while about the shape he was going to make. Then he said, "I know – I'll change my duck into a goose." So he arranged his pieces and changed his duck into a goose.

Little Soo was so excited when it was her turn; she wanted to make the king of the jungle. "Do you know which animal is the king of the jungle?"

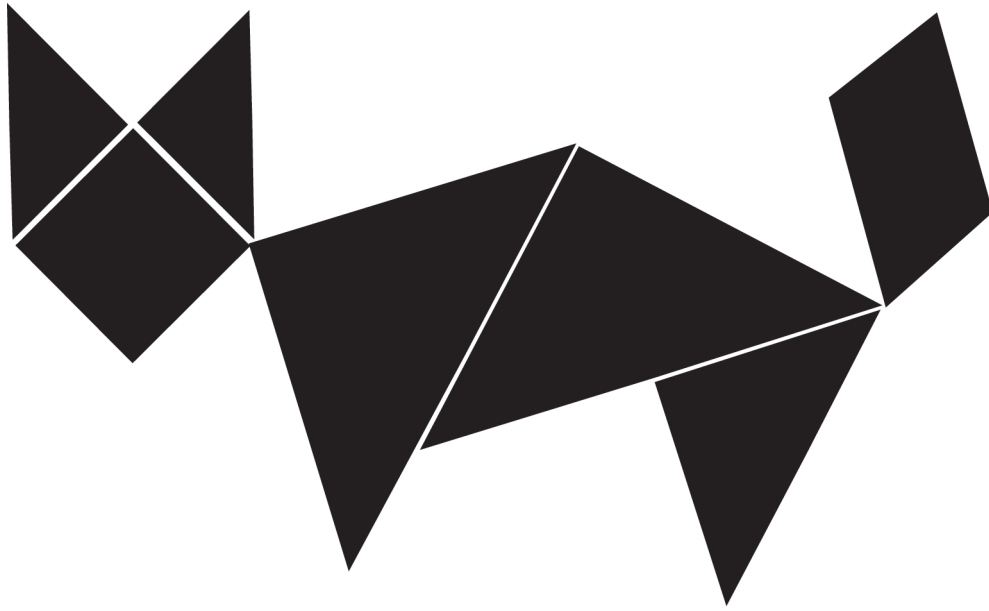
"The lion," said Grandfather Tang

So Little Soo used her seven tangram pieces and made a lion.

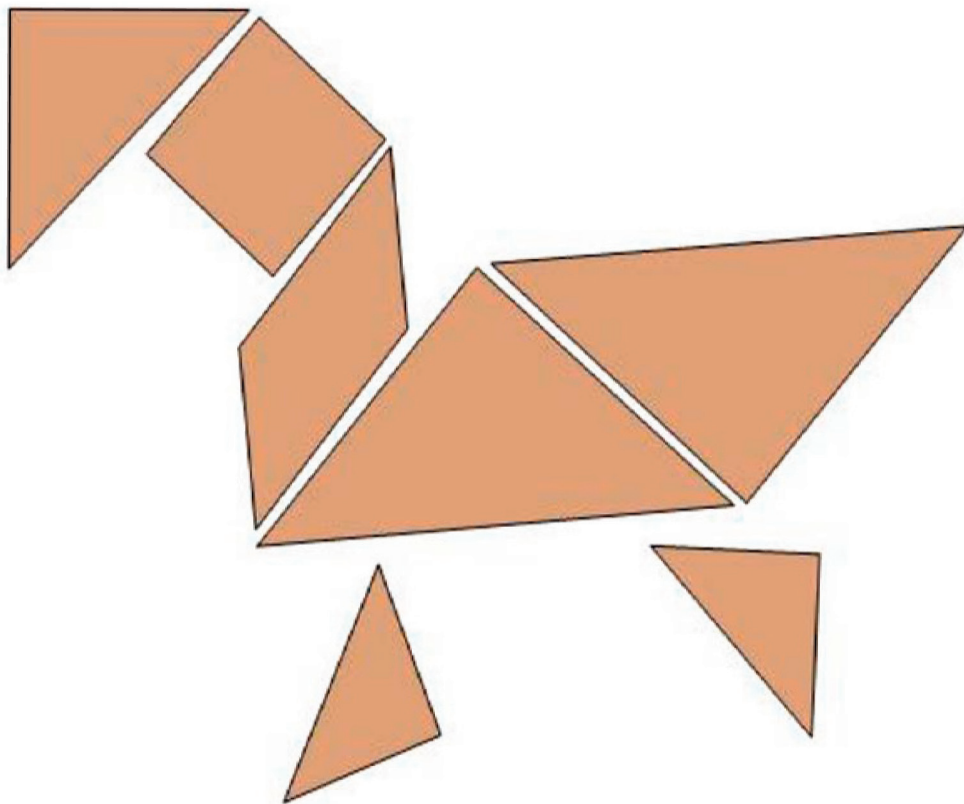
Grandfather Tang was so excited to see the lion. Now, he wanted to see if Little Soo could make a rabbit. So he made the rabbit and asked Little Soo, "Can you make this rabbit?"

Help Little Soo to make the rabbit.

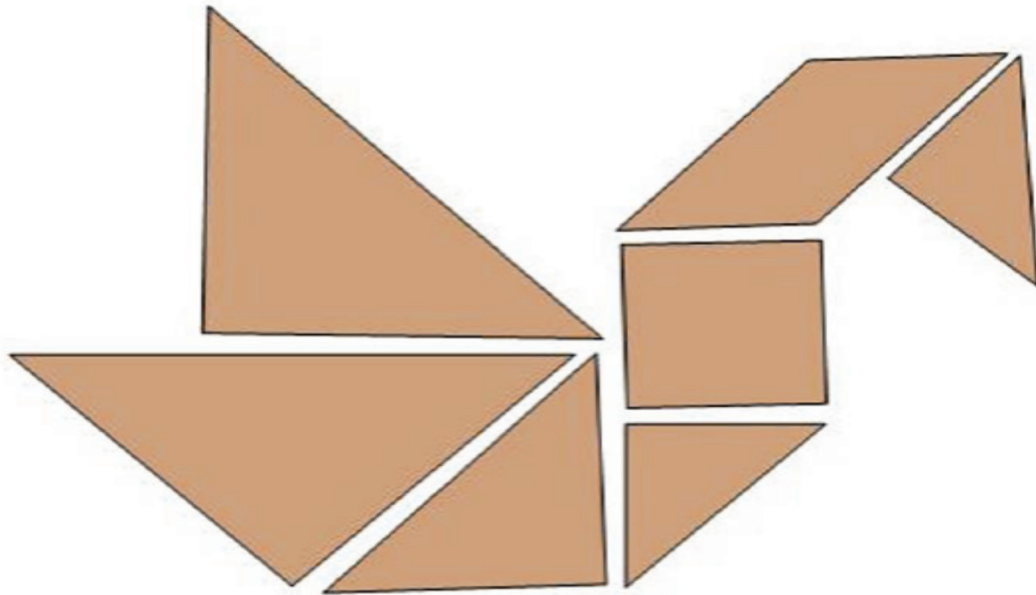
The Cat



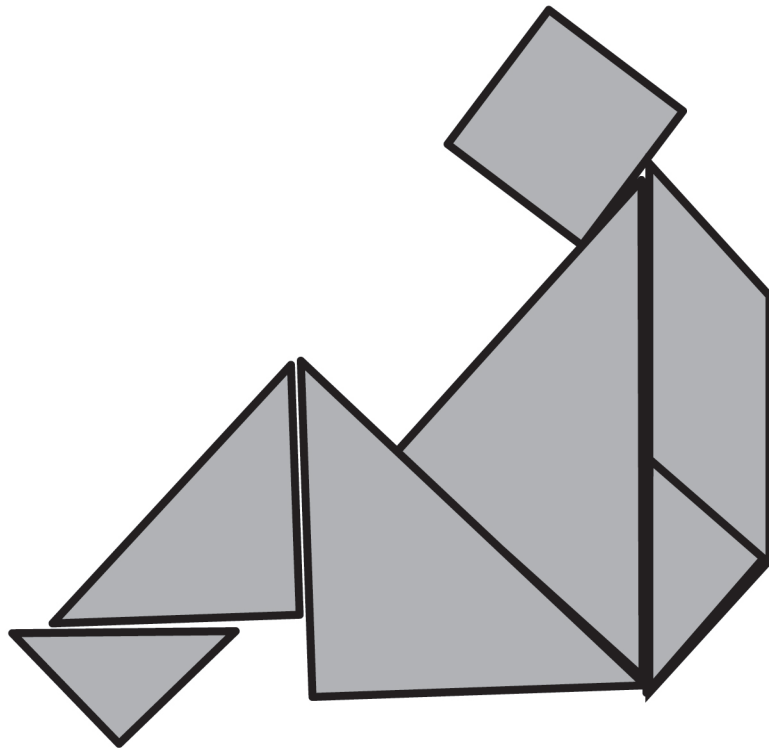
The Goose



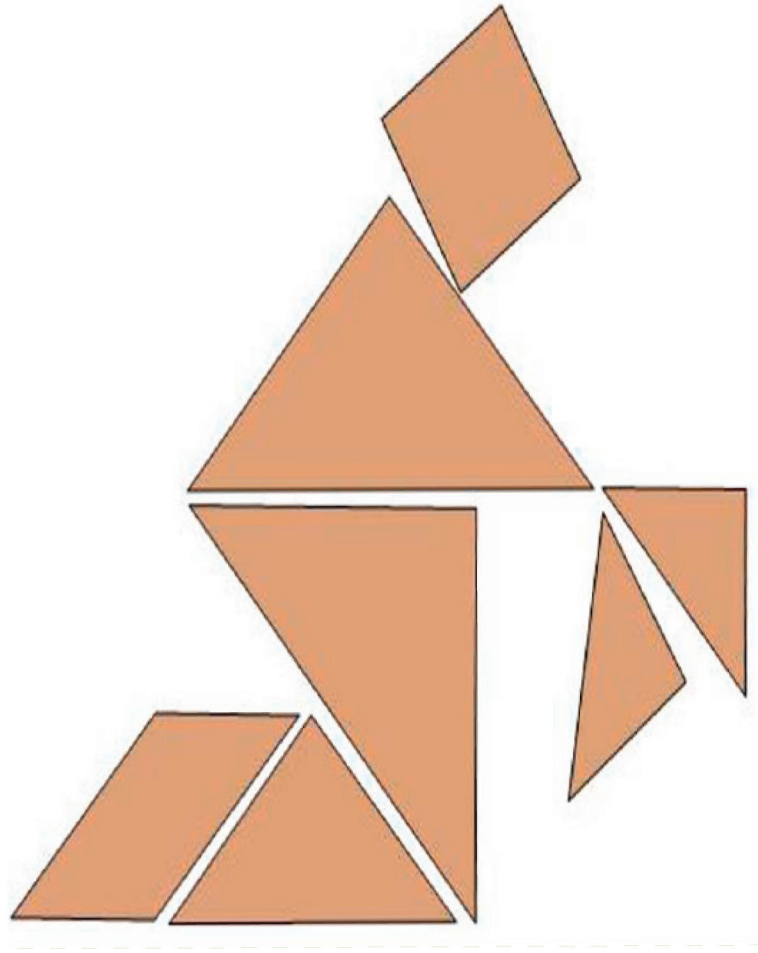
The Duck



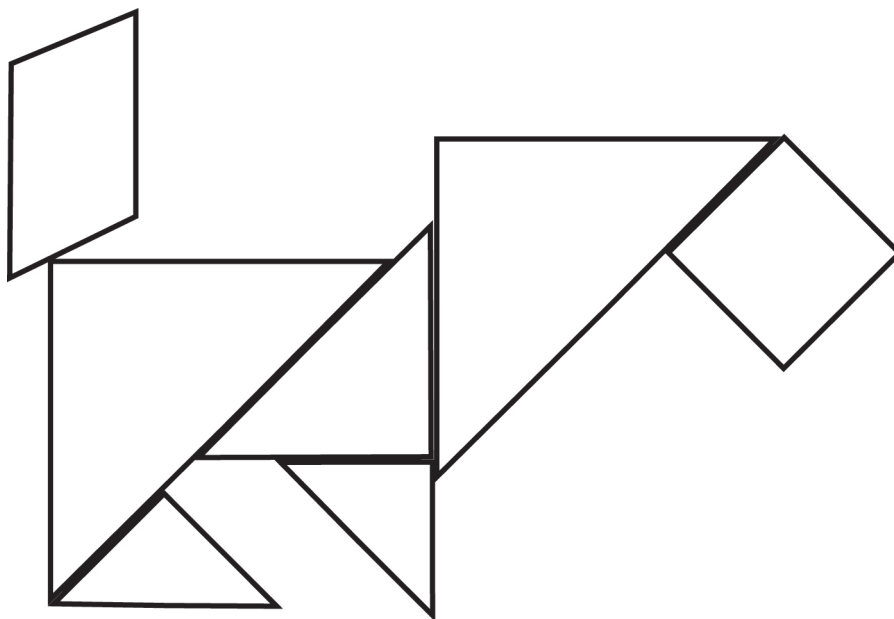
Grandpa Tang



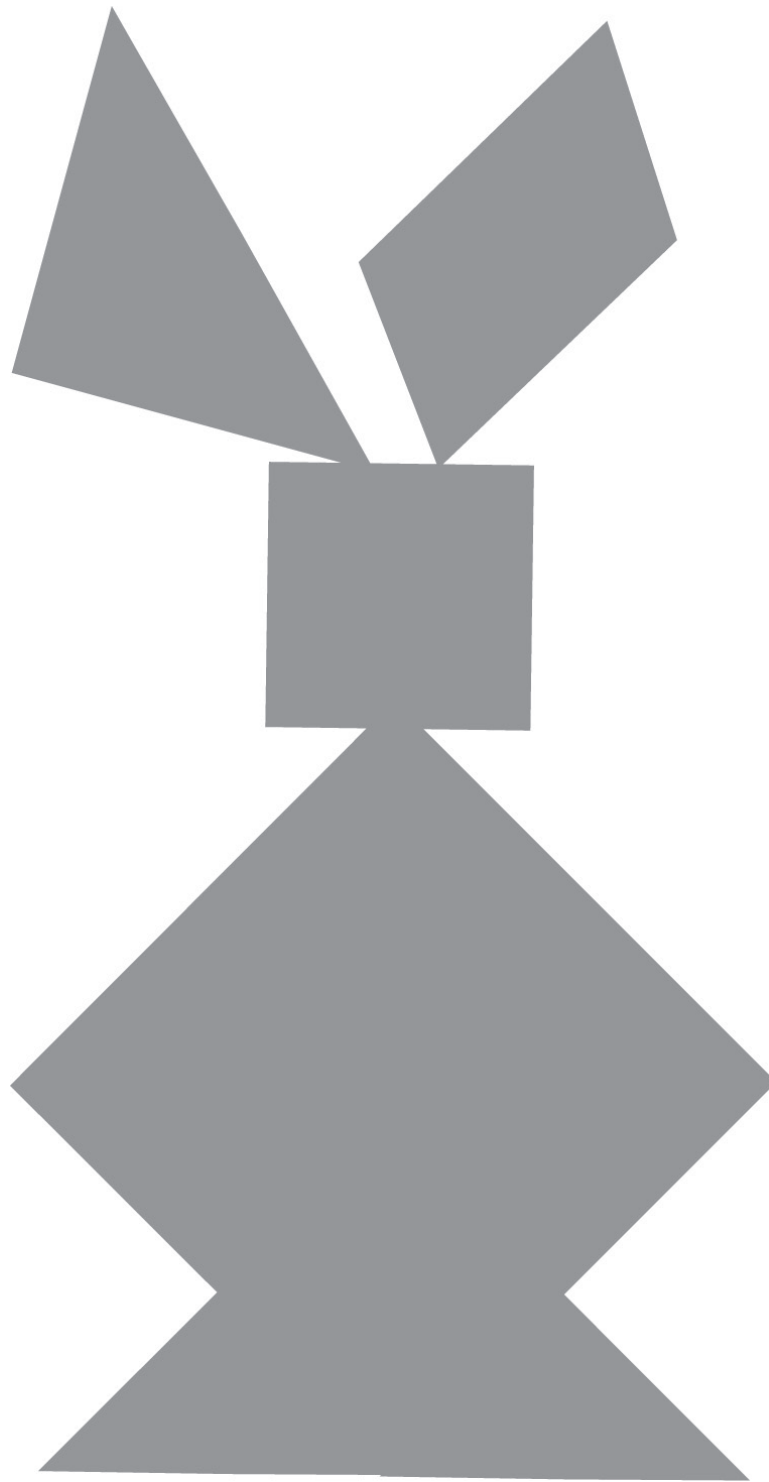
Little Soo

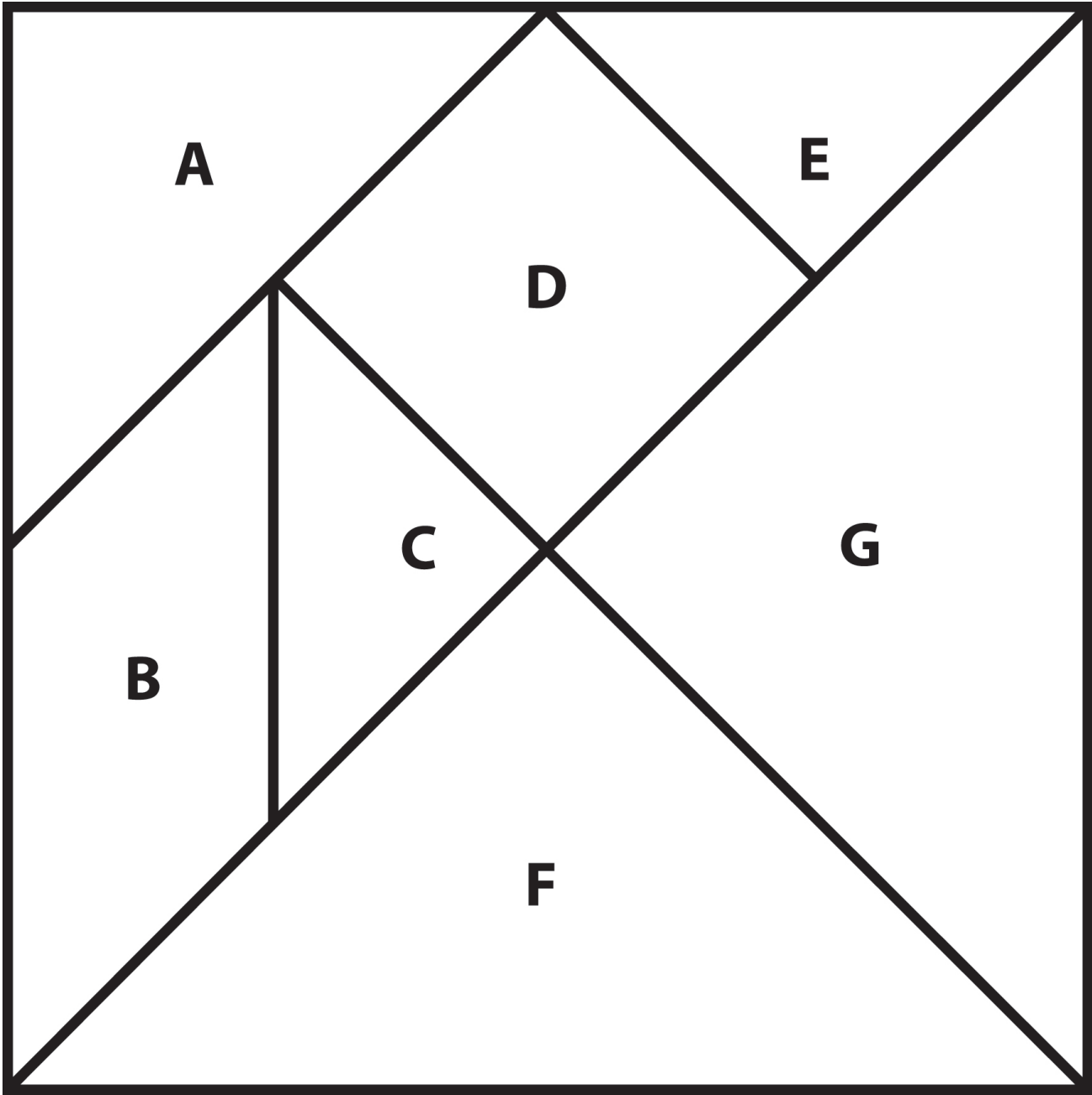


The Lion



The Rabbit





LESSON 07 ○ LINE OF SYMMETRY

GRADE LEVEL: Grade 4

DURATION: 1 hour

SPECIFIC OBJECTIVES

By the end of the lesson, students should be able to:

- explain the concept of line of symmetry
- use paper folding to show line(s) of symmetry
- draw their own shapes to show a variety of lines of symmetry and identify those lines



PREREQUISITE KNOWLEDGE

Students should already know how to:

- a) divide a plane shape into halves and quarters using straight lines and by paper folding

MATERIALS/MANIPULATIVES

Pictures, scissors, grid papers, plain papers,

CONTENT OUTLINE

A line of symmetry is a line dividing a shape or object into two halves such that if the shape is folded along this line both halves would match exactly.

PROCEDURES

Mental/Oral Starters

- Students will be shown some drawings that represent half of some known objects.
For example:



- Students will be asked to tell what they think the complete pictures represent. They will be asked to complete the pictures.

Main Activity

- Students will be given some pictures (plane shapes and others) to fold in halves.



- a) Could all the halves be matched exactly after folding?
 - b) Could you create halves by folding along the diagonals?
 - c) Which shapes create symmetrical halves when folded along the diagonal?
- Students and teacher will then discuss their observations as the paper folding is used to highlight the concept of line of symmetry through the use of examples (those folded so that the halves match) and non-examples (those that cannot be folded in halves, or those which when folded do not give halves that match). It should be highlighted that not all halves are symmetrical but all symmetries show halves.

PLENARY

Students make journal entries to highlight essential points in the lesson.

ASSESSMENT

In groups, students will be given letters of the alphabet and asked to complete the table below.

Letters that show symmetry	Letters that can be cut into halves but which do not show symmetry	Letters that cannot be cut into halves

A B C D E F

G H I J K L

M N O P Q

R S T U V W

X Y Z

LESSON 08 ○ IDENTIFYING RECTANGLES

GRADE LEVEL: Grade 4

DURATION: 1 hour

SPECIFIC OBJECTIVES



At the end of the lesson students should be able to:

- measure and compare the length of sides of quadrilaterals
- identify rectangles in a given set of quadrilaterals
- identify the properties of a rectangle

PREREQUISITE KNOWLEDGE

Students should know that:

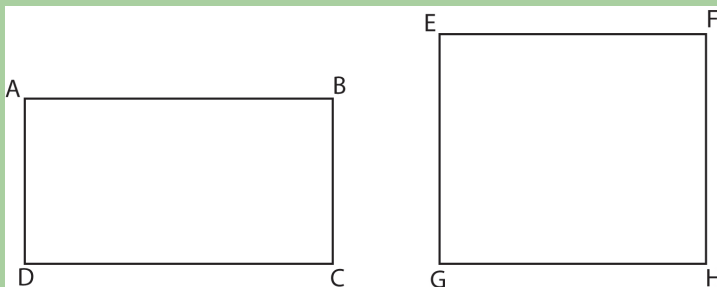
- a quadrilateral has 4 sides
- parallel lines run in the same direction and are the same distance apart; these lines never meet
- a right angle measures 90°
- a vertex is the common end point of two or more rays or line segments
- a line segment is a part of a line
- a right-angle tester can be used to identify right-angles in quadrilaterals

MATERIALS/MANIPULATIVES

Worksheet with a given set of numbered and labelled quadrilaterals, right-angle tester (paper or cardboard with a 90° vertex), ruler

CONTENT OUTLINE

A rectangle is a polygon with four right angles and with opposite sides that are parallel and equal in length. .



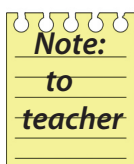
PROCEDURE

Mental/Oral Starters

- Review prerequisite by doing the 'I SPY' activity. Let students identify things/places in the classroom that are:
 - (i) quadrilaterals
 - (ii) right angles
 - (iii) parallel lines
 - (iv) line segments
 - (v) vertices

Main Activity

- Place students in groups of four; give each group a worksheet with a right-angle tester and rulers (see below).
- Students will be asked to use what they were given to complete the table (see below).
- Teacher will guide the students to:
 - (i) use the right-angle tester to determine if the angles are right-angles
 - (ii) measure the sides to find out if they are equal in length
 - (iii) record findings on chart
 - (iv) complete chart
- The class will have a discussion based on what was recorded in the table.
- The following questions could be used to guide the discussion:
 - (i) Are all quadrilaterals rectangles?
 - (ii) Is a square a rectangle?
 - (iii) What is special about the square?

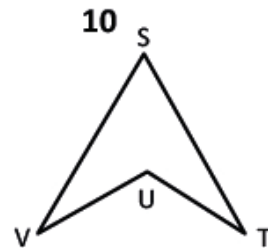
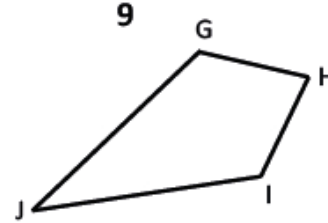
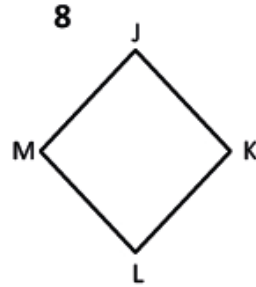
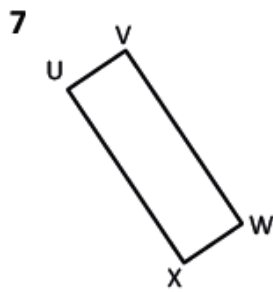
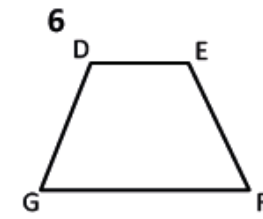
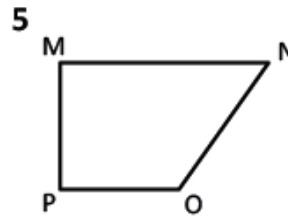
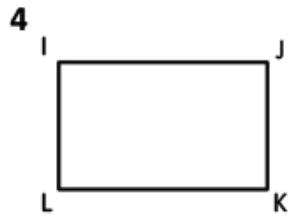
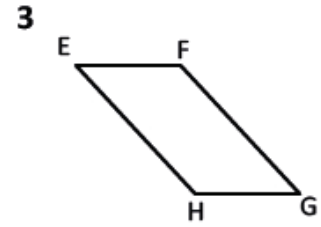
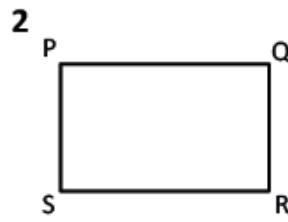
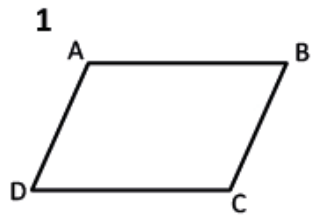


Students could be allowed to do the activity with straws and play dough. Give them different lengths of straws and ask them to measure and cut them to make different rectangles using the play dough to hold the vertices.

PLENARY

Students will write the description of a rectangle in their notebooks using the properties from the chart.

WORKSHEET
Quadrilaterals



- Complete the table by ticking those properties that are true for each quadrilateral.

PROPERTIES	1	2	3	4	5	6	7	8	9	10
Four right angles										
Two pairs of parallel sides										
Parallel sides that are equal										

- Write the numbers for each quadrilateral that has all three properties on the space below.

_____ has all three properties. They are rectangles.

LESSON 09 ○ SUM OF ANGLES IN TRIANGLES

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson pupils should be able to:

- identify angles in polygons
- determine the sum of angles in triangles
- calculate the missing angle in a triangle



PREREQUISITE KNOWLEDGE

Students should already have knowledge of:

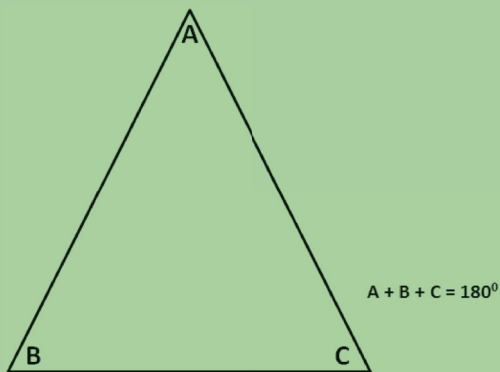
- a) how an angle is formed
- b) how to classify angles
- c) how to estimate and measure angles

MATERIALS/MANIPULATIVES

Markers, crayons, protractors, cut outs of triangles of various sizes

CONTENT OUTLINE

A polygon is a plane shape made from three or more line segments. Examples of polygons include triangles, quadrilaterals and pentagons. The sum of the interior angles of a triangle is 180° .



PROCEDURE

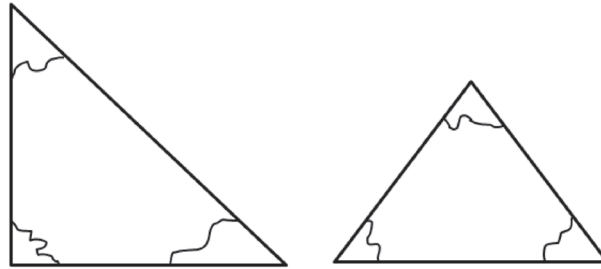
Mental/Oral Starters

Lesson will be introduced through discussion about the different types of angles. Pupils will be asked to tell the different types of angles and give relevant examples of each in degrees (acute,

obtuse, right angled, straight and reflex). The definition of an angle will also be explored with the teacher stressing the magnitude of a straight angle.

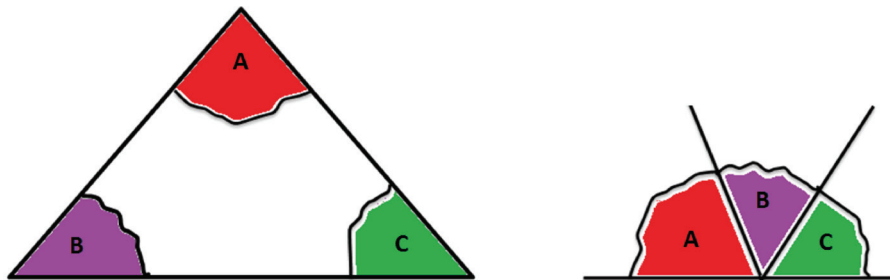
Main Activity

- Pupils will be paired and given triangles of different sizes and types. Pupils will identify their angles by highlighting them with a marker or crayon; different colour for each angle.



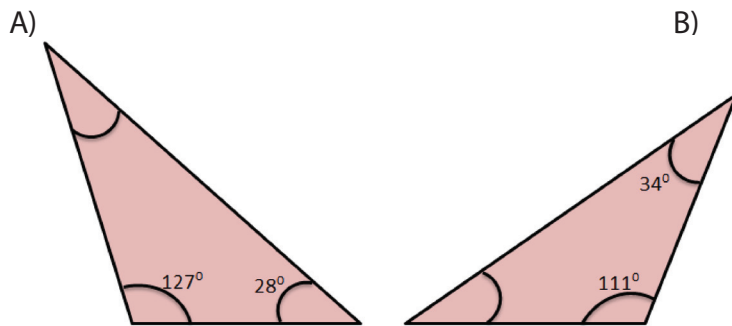
Triangles

- Pupils will be instructed to tear off each angle (corner) of the triangle and fit the vertices together. They will tell what type of angle is formed and its measurement in degrees. (Teacher will allow pupils to make the association between a straight angle and the sum of angles in a triangle by observing that the pieces form a straight line which is 180 degrees.)
- A protractor will be used to confirm measurement. Students and teachers will discuss their findings. This process will be repeated for the various sizes and types of triangles.



- At the end of this activity, pupils should realize that the size and type of the triangle does not affect the sum of the angles.
- Students will determine the size of the third angle in a triangle given the size of the other two angles.

Examples:



PLENARY

Pupils and teacher will discuss the significant pointers of the lesson with pupils making generalizations about the sum of angles in triangles.

Highlights for discussion

- Relationship between sum of angles in triangle and a straight angle
- Pupils deducing that the size of triangles does not affect the sum of their interior angles

ASSESSMENT

- Pupils will be given various types of triangles (scalene, isosceles and equilateral) with one unknown angle. Students will be asked to determine the size of the unknown angle in each triangle.

LESSON 10 ○ REGULAR AND IRREGULAR POLYGONS

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson pupils should be able to:

- investigate the properties of regular/irregular polygons in the environment
- model regular/irregular polygons using play dough and straw



PREREQUISITE KNOWLEDGE

Students should already know how to:

- a) Identify polygons by the number of sides
- b) identify angles and estimate their sizes

MATERIALS/MANIPULATIVES

Dotted paper, play dough, match sticks/straws, protractor and ruler, cut-outs

CONTENT OUTLINE

- Polygons are closed shapes bounded by three or more straight lines. Regular polygons are those that have all sides of the same length and all angles measuring the same. On the other hand, irregular polygons have sides of differing lengths and angles of differing measure.

PROCEDURE

Mental/Oral Starters

- The class will sing the polygon song (see song at the end of this lesson).

Main Activity

- The class will have a discussion on the names and general properties of polygons in the song.
- Students will be placed in groups of four. Each group will be given a set consisting of 6 different types of polygons (3 regular and 3 irregular polygons). Make the three regular polygons red and the three irregular polygons blue. (Polygons should be of similar size to reduce the likelihood of students classifying them as big and small).

- Instruct students to sort polygons into two groups based on their colours. Tell students to investigate each group to look for
 - similarities within each group
 - differences between the groups
- Guide students into realizing that all angles and sides for each polygon in one group are the same and that angles and sides of each polygon in the other group are different. A definition of regular polygons and irregular polygons will be explored with students.
- Students will look around the room (or the teacher may choose to take the students outside) to identify regular and irregular polygons where possible. The class will discuss the polygons found.
- Each group of students will be given dotted paper and asked to draw examples of regular and irregular polygons.
- Each group will present and discuss their drawings.

PLENARY

The class will review the properties of regular and irregular polygons and write all the differences discovered in a table to be kept in their books or as a journal entry.

ASSESSMENT

- Each group will be given play dough and varied lengths of match sticks/straws. Students will be asked to make models of regular and irregular polygons (from 3-sided to 12-sided polygons). Samples from the different groups will be displayed in the math corner.
- Regular polygons will be made with same length straws while the irregular polygons will be made with different length straws.

“Polygon Oh” (sing to “Chi-chi-bud-o” tune)

Polygon oh, name by the number of sides

Polygon oh, name by the number of sides

Triangles, triangle has 3 sides

Quadrilaterals, quadrilateral has 4 sides

Pentagons, pentagon has 5 sides

Polygon oh, name by the number of sides

Polygon oh, name by the number of sides

Hexagons, hexagon has 6 sides

Heptagons, heptagon has 7 sides

Octagons, octagon has 8 sides

Polygon oh, name by the number of sides

Polygon oh, name by the number of sides

Nonagons, nonagon has 9 sides

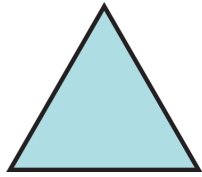
Decagons, decagon has 10 sides

Polygon oh, name by the number of sides

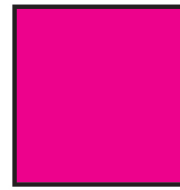
Polygon oh, name by the number of sides

Polygon oh...

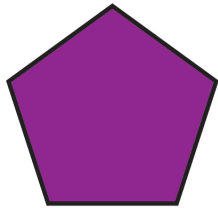
Examples of Regular Polygons



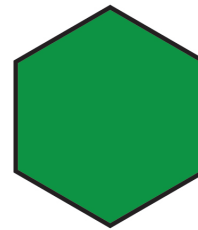
Triangle



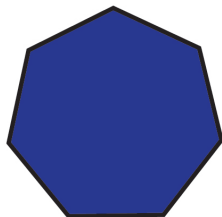
Square



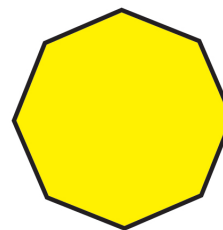
Pentagon



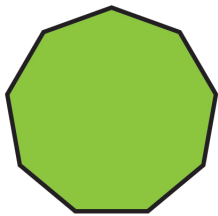
Hexagon



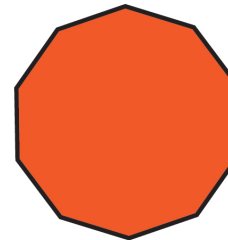
Heptagon



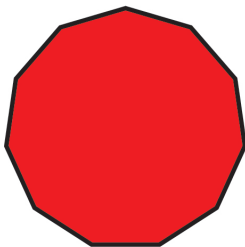
Octagon



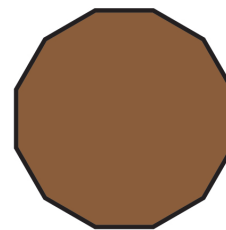
Nonagon



Decagon

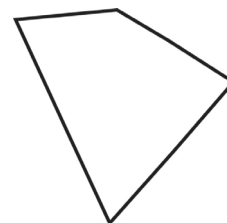
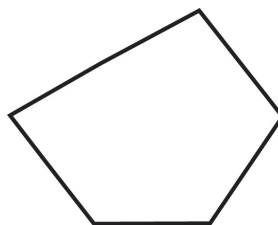
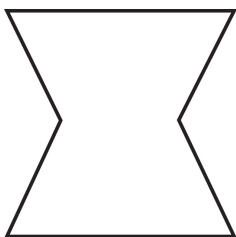


Hendecagon



Dodecagon

Examples of Irregular Polygons



LESSON 11 ○ INTRODUCTION TO SOLIDS

GRADE LEVEL: Grade 6

DURATION: 1 hour

SPECIFIC OBJECTIVES

Students should be able to:

- identify characteristics of solids (prisms & pyramids)
- sort a variety of objects from the environment according to common characteristics
- give the different classifications of solids



PREREQUISITE

Students should already have knowledge of:

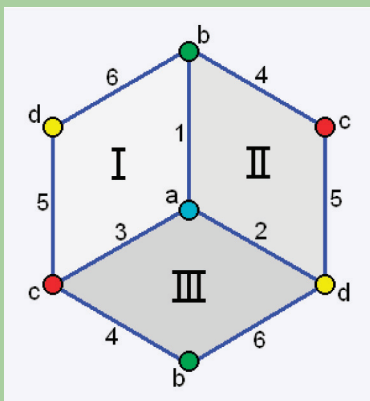
- a) the properties of various plane shapes

MATERIALS/MANIPULATIVES

Toothpaste box, dice, soap boxes, constructed solids

CONTENT OUTLINE

- **Solids** are three-dimensional shapes.
- A **prism** is a solid, with two parallel faces called bases. The other faces are always parallelograms. The prism is named by the shape of its base.
- A solid is a **pyramid** if it has 3 or more triangular faces sharing a common vertex. The base of a pyramid may be any polygon.
- An **edge** is formed where two faces meet.
- A **vertex** is the point where three or more faces meet.



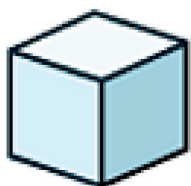
Example of a solid

coloured circles (letters): vertices
coloured lines (numbers): edges
roman numerals: faces

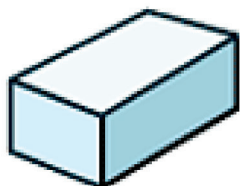
Names of solids



sphere



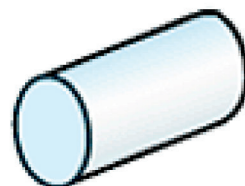
cube



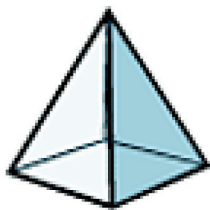
cuboid



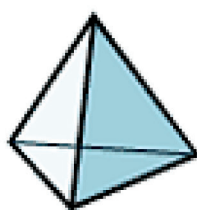
cone



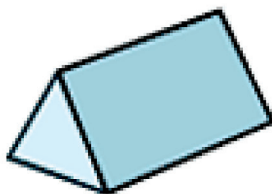
cylinder



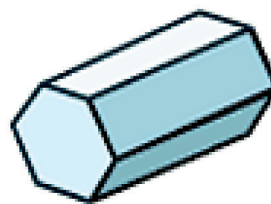
square-based
pyramid



triangular-
based
pyramid



triangular prism



hexagonal prism

PROCEDURE

Mental/Oral Starters

Pictures of plane shapes, e.g. rectangle, square, pentagon, equilateral triangle, etc., will be shown to students. Students and teacher will review the names and discuss the properties of each plane shape.

Main Activity

- Have students sort solids into groups based on similarities. Students will justify their reasons for the groupings, e.g. those that can stack and those that can roll.
- As pupils supply their reasons for grouping, a discussion will be held in order to arrive at an explanation of each grouping of solids.

- Students will be introduced to the terms “pyramids” and “prisms” to describe the groups identified.
- Pupils will be asked whether there is any solid that could not fit into any of the above-mentioned groups. These solids will be discussed.
- Pupils will look at solids and then identify any similarities or differences among them – for example: How are the cube and the cuboid similar? How are they different?
- The similarities and differences highlighted will be used to introduce students to the terms used to describe the characteristics of the solids such as edge, vertex, the number of faces and the properties of their faces. (*Allow pupils to trace along edges, rub the faces and point to vertices of these solids.*)
- This will be used to explore properties of other solids such as the triangular prism, the square pyramid, etc. Students will describe them in terms of number of faces, edges, vertices, properties of their faces.
- Pupils will discuss the cone and the cylinder. (*Examples of questions for discussion: Do they have vertices, edges? How many faces?*)
- Ask pupils to identify examples of cube, cuboid and other solids in their environment.

PLENARY

A solid created from toothpicks and play dough will be used to emphasize the properties of a solid such as edges, vertices, etc.

ASSESSMENT

- Pupils will use the solids used throughout the lesson to complete the table, on the following page, in small groups.

Name of Solid	Number of faces	Number of edges	Number of vertices	Other facts
Cube	6	12	8	All the faces are square based
Cuboid (Rectangular Prism)				
Triangular Prism				
Triangular pyramid				
Square-based pyramid				
Cone				
Cylinder				



STATISTICS AND PROBABILITY

LESSON 01 ○ SELECTING OUTCOMES: CERTAIN, IMPOSSIBLE, MAYBE

GRADE LEVEL: Grade 1

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson, students should be able to:

- explain in their own words the terms certain, impossible, maybe /likely
- discuss everyday occurrences as being certain, impossible, or likely
- state at least one example of each type of outcome



PREREQUISITE KNOWLEDGE

Students should be:

- a) familiar with these words: "can", "may", "must", "cannot", "sure", "never"
- b) able to recite the days of the week and the months of the year in order

MATERIALS/MANIPULATIVES

Blank word card (to write students' supplied words), word cards, strips with activities, outcome trees, baseball and ring

CONTENT OUTLINE

- The chance of something happening may be described as: certain, impossible or maybe.
- When an event is certain it can also be described as something that must happen
- When an event is said to be a possibility it can be described as something that may or may not happen
- When an event is said to be impossible it can be described as something that will never or cannot happen.

PROCEDURE

Mental/Oral Starters

Teacher will display a ring to the class, and allow students to briefly observe and describe it. The teacher will take up the ring in one hand and put both hands closed behind him or her. Students will be asked to tell which hand the ring is in, in each of the following situations:

Selecting process (at all times students must select at least one of the two hands):

1. Teacher will put both hands forward (palms closed) for students to select (may be in either hand).
2. Teacher will put both hands forward (one with palm open) for student to select (must be in closed hand).
3. Teacher will place ring on the table for students to see then place hands forward for students to select (cannot be in any hand).

Main Activity

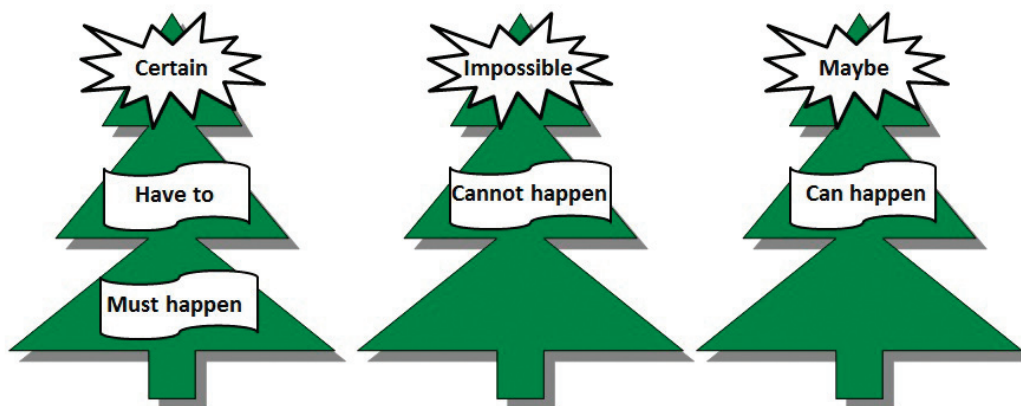
Step 1

- Teacher will emphasize the key words used in sentences/phrases (example: can/may, must, cannot) and write them on word cards. Students will explain their understanding of the key words.
- Teacher will explain that when they were selecting the hand that had the ring their statement tells the chance of the event occurring. Teacher will introduce the words **certain**, **impossible** and **maybe** by asking questions such as:
 1. When were you **certain** that you had selected the hand that had the ring? So when you are "certain" you are _____? (sure)
 2. Was there any time when it was **impossible** for the ring to be in a hand? So if the event is "impossible", it means that it _____? (cannot happen)
 3. When did you have to guess that **maybe** the ring is in a particular hand? "Maybe" suggests that you are _____? (not sure, uncertain)

Step 2

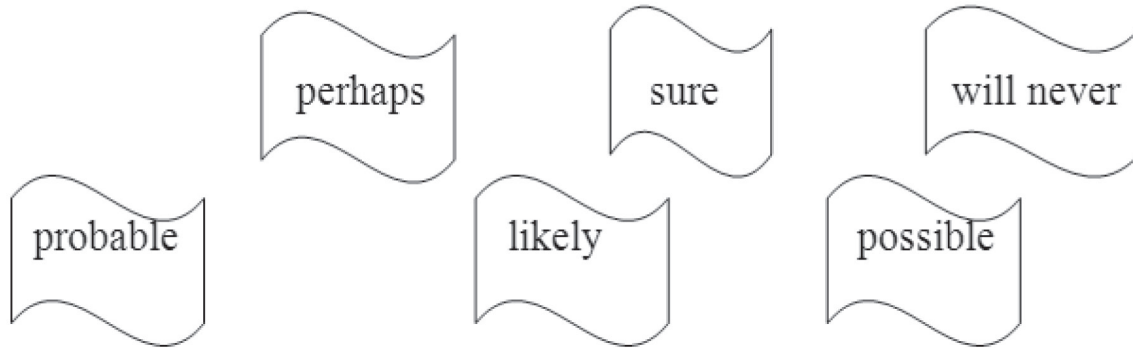
- Create a synonym word tree for key words. Use words supplied by children to create the trees.
- Students will place word cards on the appropriate tree.

Example



Step 3

- Teacher introduces other words for students to examine their meanings and place them on the outcome synonyms word tree.



Step 4

- Students will give examples of occurrences which are **certain, impossible** and or **likely**. (Teacher will list the examples under the respective trees.)
- Teacher will then present situations for students to tell the chance of occurrences in terms of **certain, impossible** or **maybe**.

Examples:

- a) the chance of Wednesday coming before Monday in the same week
- b) the chance of getting a six on a single toss of a die
- c) the chance of March coming before May in the year
- d) the chance of getting a head on a single toss of a coin
- e) the chance of getting a tail on a single toss of a die
- f) the chance of getting rain on an overcast day
- g) the chance of selecting a number from a number box with the numbers 1 2 3 4 5 6

PLENARY

Catch and tell

Teacher will throw ball to students for them to catch and tell either

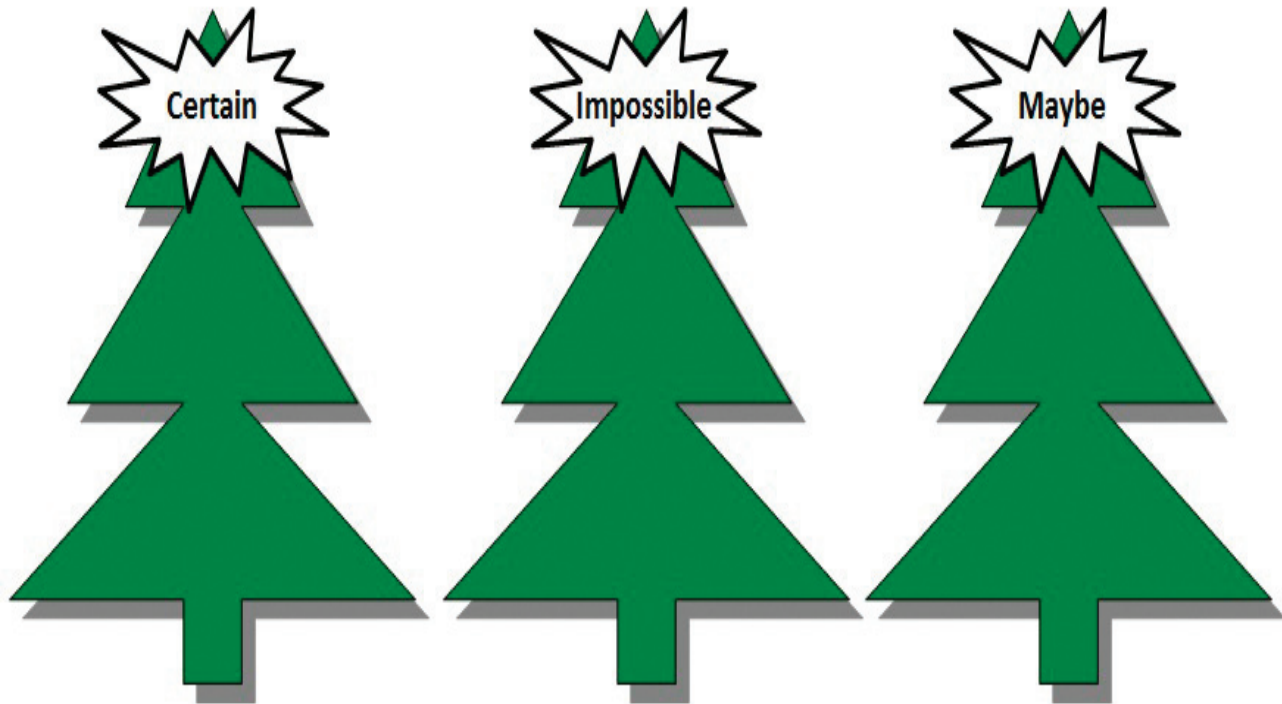
- i) synonym words for the "chance" word stated (e.g. maybe – **likely**) or
- ii) the chance of an event occurring (e.g. to select a boy from a group of all girls – **impossible**)

ASSESSMENT

Students will select activities written on strips of paper, read them then paste them on the appropriate "event tree".

Example:

- a) Selecting a boy from a grade one class of 10 girls and 4 boys
- b) Selecting Sunday as the first day of the week
- c) Selecting Tuesday as the third month of the year



LESSON 02 ○ CONDUCTING PROBABILITY EXPERIMENTS AND RECORDING OUTCOMES

GRADE LEVEL: Grade 3

DURATION: 1 hour

SPECIFIC OBJECTIVES



At the end of the lesson students should be able to:

- conduct probability experiments and record outcomes (e.g. tossing coin, rolling dice, spinning spinners, etc.)
- predict outcomes of experiments involving the tossing of a die, etc.
- compare predictions with outcomes of experiments

PREREQUISITE KNOWLEDGE

Students should already be able to:

- a) record scores by tallying
- b) identify graphs as a means of representing data
- c) use expressions such as “likely”, “unlikely”, etc.

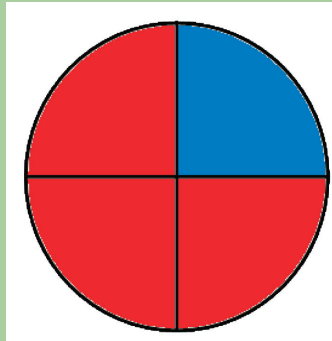
MATERIALS/MANIPULATIVES

Spinners, worksheet, counters (two or more different colours), coins, dice, pictures of different weather conditions.

CONTENT OUTLINE

Probability measures the **likelihood** or the **chance** of something happening or that an event will occur. It compares the number of favourable **outcomes** with the number of **possible outcomes**. In some situations, some outcomes are equally likely to occur while in other situations some outcomes are **more likely** to occur than others. For example:

- If you flip a coin there is a probability/chance that it will land on its head or tail. Both outcomes are **equally likely** to occur.
- If a circle is divided into four equal parts but 3 parts out of the 4 parts are red and one part is blue, it is **more likely** for a spinner to land on a red part than a blue part.



PROCEDURE

Mental/Oral Starters

- Place 10 counters in a bag – 6 red, 3 blue and 1 yellow.
- Allow at least 15 students to choose a counter from the bag, identify which colour they have and replace it.
- Make a tally of the colours chosen. Without showing students the content of the bag discuss the question “**Which colour counter occurs most in the bag?**”



Main Activity

- Students will be placed in groups of 3 or 4 and given the following experiments to do and will record the results. (Each group will conduct one experiment only but share findings with other groups.)

Activity One

Flip a coin

- Make predictions about the number of times the coin will land on its head or tail when flipped 30 times.

	Prediction	Result (Tally)	Number
Heads 			
Tails 			

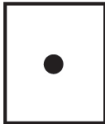

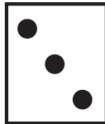
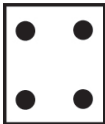
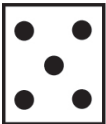
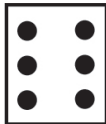
b) Based on data collected, answer true or false to the following statements:

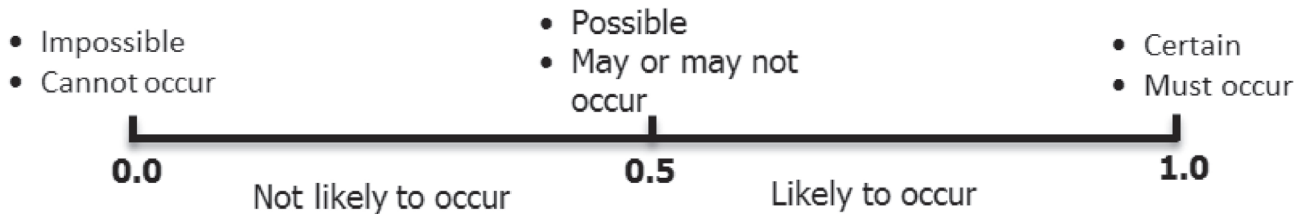
- i. The coin is more likely to land on heads than on tails _____
- ii. The coin is equally likely to land on heads as on tails _____
- iii. The coin is less likely to land on heads than on tails _____

Activity Two

Toss a die

Make predictions about how many times each number on the die will be rolled if the die is rolled 42 times. Record the predictions within the groups.

Side						
Tally						
Number						

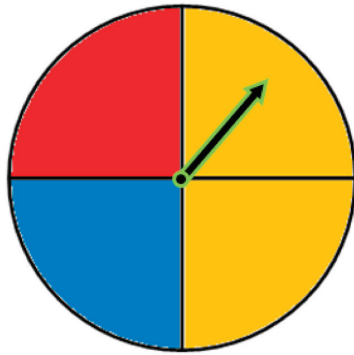


PLENARY

Students will define terms used in the lesson and give examples of each.

ASSESSMENT 1

- Pupils will use the form below to make predictions regarding the colour on which the arrow is most/least likely to land.



Predictions

The arrow is most likely to land on _____ I think so because _____ _____
The arrow is least likely to land on _____ because ____ _____
The arrow is equally likely to land on _____ because _____ _____

- Spin the arrow 24 times and record your results below.

Actual outcomes

Arrow lands on	Tally	Number
Blue		
Red		
Yellow		

- Students will be engaged in a discussion of the actual outcomes:
 Which was most frequent and why?
 What might influence the outcomes?

LESSON 03 ○ PICTOGRAPHS

GRADE LEVEL: Grade 3

DURATION: 1 hour

SPECIFIC OBJECTIVES



At the end of the lesson, students will be able to:

- read and interpret information given in a pictograph
- solve problems using the information given in a pictograph

PREREQUISITE KNOWLEDGE

Pupils should already:

- a) be able to count to 100
- b) know how to arrange things in a sequence
- c) be able to tally
- d) know how to use tables

MATERIALS/MANIPULATIVES

Grids, worksheet, punched coloured paper, glue, pictures, magazine and newspaper sections.

CONTENT OUTLINE

Data is another name for information. This may be recorded/represented in different ways. A pictograph is one such way that shows data using pictures or symbols. A key must be used to show the number of items that each picture or symbol represents. All graphs must have titles.

PROCEDURE

Mental/Oral Starters

- Play ring game with students: *"Those who were born in January skip around..."*
- As they enter the ring, teacher records the number of persons born in each month on a table, using tally.

Main Activity

- Teacher asks pupils to tell the number of students born in selected months:
 - how many students were born in September?
 - how many more students were born in August than in June?
 - how many students were born in April and July together?
 - which month had the greatest/least number of birth month celebrants?
- Use the tally sheet to create a pictograph similar to the one shown below





Key: ● = 2 students

Month	Number of Students
January	● ● ● ◐
February	●
March	●
April	● ● ●
May	● ◐
June	● ●
July	●
August	● ●
September	●
October	● ◐
November	●
December	● ● ● ●

- Examine the pictograph above and discuss the following questions:
 - a) What is the graph showing?
 - b) The title – can you make a title for the graph? Why does it need a title?
 - c) The symbols used – do you think that they are appropriate?
 - d) The key – what does it tell?

Students will be placed in groups of 5. Give each group a copy of the incomplete pictograph (shown below). They will be told to complete the graph based on the information given.

Title: Number of Marbles found in Students' Bags

Name of Student	Number of Marbles
	
	
	
	



2 marbles

1 marble

Mark has more marbles than *Paul*. *Pam* has fewer than *Paul*. *Carl* has the fewest of the four.

Students will present and discuss solutions for problem solving activity.






PLENARY

After discussing the main elements of a pictograph, each student will write two things that they have learnt about pictographs in their math journal.

ASSESSMENT

Students will interpret information on a pictograph showing favourite fruits eaten by Grade 3 students at a school in Jamaica.

Title: Favourite Fruits Eaten by 3rd Graders

NAME OF FRUIT	NUMBER OF STUDENTS
apple	
mango	
pineapple	
banana	
Key  = 3 students	

Questions:

- Which fruit is most popular among grade three students?
- Which fruit is least popular among grade three students?
- How many more students prefer apple than pineapple?

LESSON 04 ○ SAMPLING AND POPULATION

GRADE LEVEL: Grade 4

DURATION: 45 minutes

SPECIFIC OBJECTIVES

At the end of this lesson students should be able to:

- explain the idea of "sample" as a fraction or subset of a population
- explain the concept of "population" as it relates to statistics
- identify the population as the universal set in any given problem situation



PREREQUISITE KNOWLEDGE

Students should have knowledge of:

- a) sets, subsets, and fractions

MATERIALS/MANIPULATIVES

Coins, picture showing example of sampling, clippings of population polls cut out from newspaper/magazine.

CONTENT OUTLINE

Sometimes it is not possible to test everyone/everything in a group in which an investigation is being conducted because the group is too large. It therefore becomes necessary to take a small group from the large group for the investigation. This small group is known in statistics as a **sample**. The overall group is called the **population**.

PROCEDURE

Mental/Oral Starters



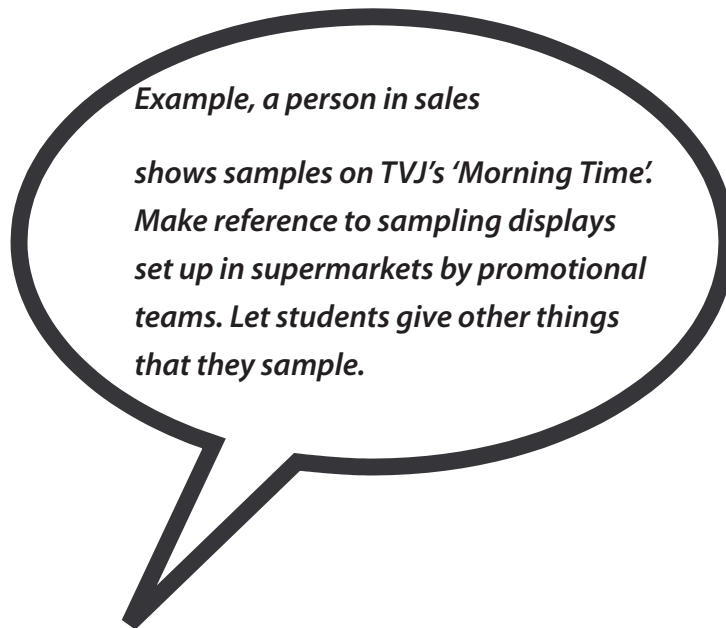
Source: Djet Layne (2010)

Display picture for class to discuss the role of sampling in purchasing guineps or other suitable food items. Discuss such questions as:

- How do you know if guineps are sweet before actually buying them?
- Will tasting one fruit tell how the others taste? Would tasting five of the fruits give an idea of the taste of the others? Why?

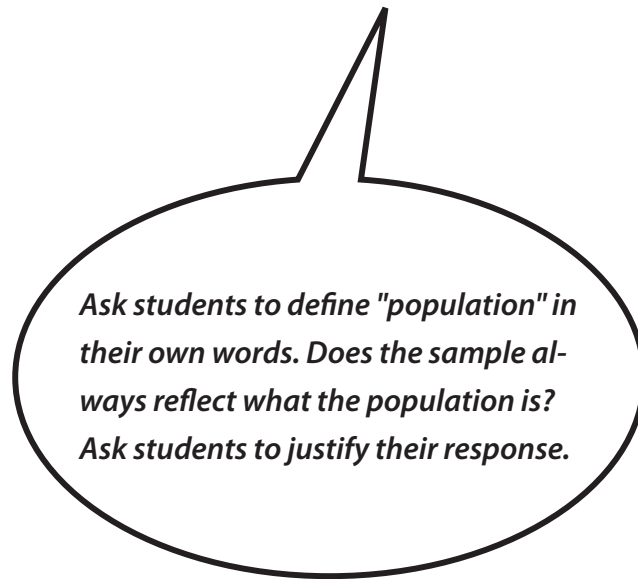
Main Activity

a) Students will talk about other instances when sampling is used



b) Students will be asked to explain in their own words what they understand by the term "sample".

c) Teacher will use the afore-mentioned examples to initiate a discussion of the term "population".



● Students will be placed in 4 groups with each group carrying out a different task. Each group will determine a suitable sample to answer the questions below. Students' description of their samples should include *the number of persons in the sample; the characteristics of their sample: age, grade level, gender, etc.*

Group 1 – Which of the following is the school's favourite TV show?

- Hannah Montana
- iCarly
- Sponge Bob
- Avatar

Group 2 – What do girls in the school prefer to wear in their hair?

- Ribbons
- Bubbles
- Bandoos
- Clips

Group 3 – Which activity do boys in the school enjoy most?

- Playing marbles
- Playing cricket
- Playing video games
- Reading

Group 4 – What is the favourite ice cream flavour of persons in the school?

- Chocolate
- Cookies and Cream
- Grapenut
- Strawberry

PLENARY

Use results to discuss the relationship between sample and population.

ASSESSMENT

Teacher writes scenarios comprising samples and populations on strips of paper and distributes to the groups. Each group will be asked to share the scenario(s) given and identify the sample and the population.

Example: A shoe manufacturer wants to donate football boots to the football team of Maggie Primary School. The shoe sizes of five boys were taken to determine what size shoes to send.

LESSON 05 ○ MEASURE OF CENTRAL TENDENCY – MEAN

GRADE LEVEL: Grade 4

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson students should be able to:

- find the mean of a set of data
- solve problems based on mean



PREREQUISITE KNOWLEDGE

Students should already be able to:

- a) apply the four basic arithmetic operations

MATERIALS/MANIPULATIVES

Counters, number cards

CONTENT OUTLINE

Mean is a measure of central tendency. It is sometimes referred to as average.

This is calculated by finding the sum of all the numbers in the set and dividing the sum by the number of elements added.

PROCEDURE

Mental/Oral Starters

- Three students will be asked to stand at the front of the class. Twelve counters will be distributed to the students as follows 2, 4, 6.
- The 3 students will be asked to share the counters equally among themselves (*Expected result:* each student will have 4 counters).
- Students will be asked to explain how they share the counters equally.

Main Activity

- The starter activity will be repeated with nine counters distributed to the students as follows 1, 2, 6.
- Students will again be asked to explain how they got their answer.

- Other students in the class will be asked if there are other ways they could share the counters equally.
- Students will be placed in groups of 3 to 5 depending on the class size. The total number of counters distributed to the group should be a multiple of the number of students in the group.
- Each member of the group will be given a bag/container with counters. For example:
 - counters in a four-member group could be distributed as follows: 4, 4, 7, 1
 - counters in a three-member group could be distributed as follows: 5, 0, 7
- The groups will be asked to share their counters equally among the members of the group.
- Each group will explain to the class how they shared their counters.
- The teacher will help the students to recognize that they put all their counters together then shared them equally. The teacher will inform students that the equal share is known as the mean.
- Each group member will be given a number card.
- Students will be asked to find the mean of the numbers given in their group.
- Each group will display their numbers on the board and write the mean beside them.
- The class will have a discussion where they will realize that the mean of the numbers is larger than the smallest number and smaller than the largest number.
- Students will work individually to find the mean of the following numbers:

(a) 5, 12, 4

(b) 9, 20, 5, 6

(c) 10, 7, 2, 5, 6

PLENARY

The class will have a discussion to review the process that can be used to find the mean of a set of numbers.

ASSESSMENT

Students will be asked to write six different numbers that have a mean of:

(a) 8

(b) 6

LESSON 06 ○ BAR GRAPH

GRADE LEVEL: Grade 4

DURATION: 1 hour

SPECIFIC OBJECTIVES



At the end of this lesson students will be able to:

- present at least one set of data using a bar graph
- read and interpret a bar graph giving no fewer than two but not more than five statements about the data presented
- convert at least one pictograph into a bar graph

PREREQUISITE KNOWLEDGE

Students should be able to:

- a) collect and organize data using tables
- b) represent data on a pictograph
- c) interpret information from a graph

MATERIALS/MANIPULATIVES

Bag filled with four coloured squares, strips of squared paper

CONTENT OUTLINE

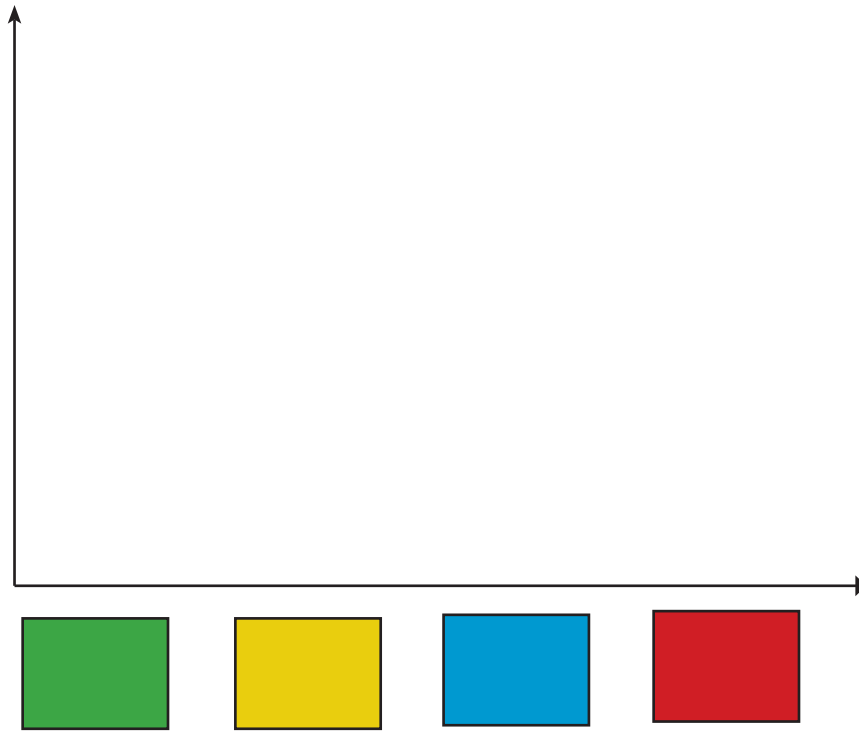
Data is another name for information. A bar graph is one of the methods used to represent data. Information is shown on the graph as a series of bars. The bars can be vertical or horizontal. The height or length of each bar represents the amount of data shown. The data represented on each bar is shown on the horizontal axis. Bar graphs can also be created with information given from a pictograph.

PROCEDURE

Mental/Oral Starters

Building Towers. Students are invited to select their favourite coloured Post-it note from the teacher's desk. Each post-it note will be of same size.

Teacher draws an empty set of axes as shown below and places colour coded labels below the horizontal axis.



Students take turns to paste their post-it notepaper, in line with the selected colour, above the horizontal line so as to form a tower. No overlapping is allowed. Teacher assists students to ensure bar representing tower is created above each label.

Main Activity

- The teacher and students will discuss the representation of the data as arranged in the coloured bars.
- Students will be guided into interpreting the information on the graph, using the following questions:

What does this graph show?

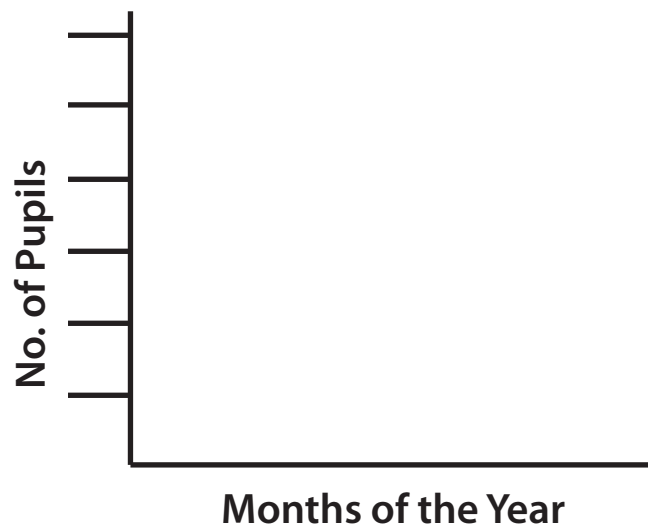
Which colour was picked by the most students?

Which colour was picked by the least number of students?

- Pupils will participate in the ring game – “All those who were born January skip around...”
- One child will record of the number of children born in each month in a table as shown below.

Month	Number of Children with Birthdays
January	
February	

- Students and teacher will discuss how they could present the information on a bar chart.
- Pupils will be presented with a bar chart frame on cartridge paper (the axes drawn). Discuss an appropriate title for representing the data. Label the axes using an appropriate scale.












- Distribute rectangular strips of paper (with height of 50 cm and width of 5 cm) to students grouped according to their birth months.
- Instruct students to cut their strip of paper to represent the number of persons in the group. Tell them to use a height of 5cm to represent each group member.
- Allow each group to paste their strip of paper on the axes to create a bar chart.
- Each student will write at least two statements about the bar chart constructed.

Example of statement:
Most children were born in
_____.

- With the assistance of the teacher, students will discuss how they could convert a pictograph into a bar graph. The teacher will guide the students into extracting the information (in table form) shown by the pictograph below.

After-School Club Membership

Hobby Club		
Writers' Club		
Chess Club		
Art Club		
Drama Club		
Science Club		
Sports Club		
Math Club		 = 2 persons

PLENARY

In groups, pupils are asked to write statements about two things they learnt from the lesson.

ASSESSMENT

Create a bar graph using the information extracted from the pictograph above.

Days of the Week	No. of Students late
Hobby Club	6
Writers' Club	6
Chess Club	7
Art Club	8
Drama Club	8
Science Club	10
Sports Club	12
Math Club	18

LESSON 07 ○ MEASURE OF CENTRAL TENDENCY – MEDIAN

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson students should be able to:

- find the median of a set of data
- solve problems based on median



PREREQUISITE KNOWLEDGE

Students should be already be able:

- a) to apply the four basic arithmetic operations

MATERIALS/MANIPULATIVES

Counters, number cards, tape measure

CONTENT OUTLINE

Median is measure of central tendency. The median value of a set of numbers is the middle number when they have been placed in ascending or descending order. If there is an even number of members in the set, the median is found by calculating the average or mean of the two middle values after they have been placed in ascending or descending order.

PROCEDURE

Mental/Oral Starters

- Place a chair at the front of the class and ask a student to sit in it. Ask 6 students to stand beside the one seated – 3 on either side. Discuss the position of the one seated – draw students' attention to the fact that
 - a. this child is in the 4th position
 - b. the 4th position is in the middle
 - c. there are 3 persons on either side
- Ask 4 other persons to join the 7 already at the front of the class and to ensure that the person seated is still in the middle. Discuss the formation. Explore other possibilities such as:
 - Suppose 3 students are added to the left of the seated child but only 2 are added to his/her right – would the seated child still be in the middle?
 - Suppose, instead, the second person on the left of the seated one was sitting on the chair – can you now arrange the students around him/her to so that he/she is in the middle?

Main Activity

- Students will be placed in groups of seven and/or nine (depending on the class size).
- Students will be asked to arrange themselves in their groups in ascending or descending order based on their height.
- Teacher will tell the class that the student in the middle represents the median height of the group. From this, a discussion about the median will be conducted and its properties will be outlined.
- Each group of students will be given a tape measure and asked to arrange themselves in ascending or descending order based on the length of their arms.
- The groups will be rearranged to form groups of 8 or other suitable even number.
- Students will use tape measure to measure the distance around the waist of group members and record the measurements.
- Students will then be asked to find the median value of the measures now that there are 8 members in the group.
- Students will then be asked to explain how they got their answers.
- The teacher will help students to recognize that when the set of numbers for which the median is to be found has an odd number of members then the numbers are arranged in ascending or descending order and the number in the middle is the median.
- However, when the set of numbers for which the median is to be found has an even number of members then the numbers are arranged in ascending or descending order and the mean of the two middle values are found which would be the median.

For example:

In the set 24, 44, 45, 32, 12, 25, 50, 42 ---- 12, 24, 25, **32, 42**, 44, 45, 50

$$\text{Then the median is } \frac{32 + 42}{2} = \frac{74}{2}$$

The median is = 37

PLENARY

- Remaining in groups of four, students will use tape measure to measure the length of group members' feet (shoe size) and find the median length of group members' feet (shoe size).
- Students will be asked to explain how they arrived at their answers.
- The class will have a discussion to review what was done in the lesson.

ASSESSMENT

Students will work individually to find the median of the following numbers:

- a. 5, 12, 4, 6, 9, 8, 1, 16, 20
- b. 9, 20, 5, 6, 23, 21, 12, 14
- c. 10, 7, 2, 5, 6, 50, 51, 52
- d. 24, 25, 26, 31, 30, 24, 0, 5, 25, 32

LESSON 08 ○ CONSTRUCTING QUESTIONNAIRES

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES

Students should be able to:

- discuss the importance of questionnaires in data collection
- develop questionnaires containing no less than 3 questions and use them to collect data from classmates about a given topic/situation



PREREQUISITE KNOWLEDGE

Students should already have:

- a) knowledge of various types of questions
- b) definition and purposes of questionnaires
- c) knowledge of formulating questions suitable for interviews

MATERIALS/MANIPULATIVES

Sample questionnaire, paper (graph paper), chalkboard/flip chart

CONTENT OUTLINE

Questionnaires are instruments used in data collection. They contain questions that require answers about a particular person, place, thing or situation. Questions should be clear and simple. Everyone participating in the survey should be asked the same questions. Questionnaires may be made more user-friendly by giving multiple choice options.

PROCEDURE

Mental/Oral Starters

1. Students will be asked how they would find out the following information about students in the class:
 - name
 - address
 - date of birth
 - mode of transportation to school

Possible responses would be: by going to each student and asking the questions individually, checking their books, looking at their identification cards.

2. The teacher will then engage students in a discussion about the time it would take to complete such a task and to say if there was a more efficient way in which this could be done. Teacher will tell students that a questionnaire could be used to get the information from students.
3. Pupils will be asked to give their definition of questionnaires, after which the teacher will further guide them in refining their definition.

Main Activity

Pupils will be given a sample questionnaire (shown below).

Date: _____

Please circle the correct information

Sex: Male Female

Age: 10 – 14 years old 15 – 19 years old 20 – 24 years old

1. Do you travel by public transport?

Yes No *(if no, go to question 3)*

2. If yes, what sort of public transport do you take?

Bus Route Taxi Chartered Taxi

3. How much does your transportation cost per week?

Less than \$50 \$50 – \$99 \$100 – \$150 More than \$150

4. Would you accept a free ride on a public transportation if you were offered?

Yes No Maybe

Thank you for your help with this survey

Other topics for questionnaire include favourite TV program, sport, etc.

- What do you think the designer of the questionnaire wanted to find out?
- Do you think it is a clear and simple questionnaire? Give reasons for your answers.
- How could the above questionnaire assist in collecting data? Give reasons for you answer.

Teachers will engage pupils in a discussion and activity

- Pupils will discuss the purposes of a questionnaire
- Each group will create a questionnaire to find out information on one of the following issues:
 - what students like to eat for lunch
 - students' favourite past time/activity
 - students' favourite subject
 - students' favourite TV show
 - how students intend to spend their summer holidays
- The teacher will guide discussion on the appropriateness of the students' questions by asking probing questions, such as:

Are the questions clear?

Do the questions ask specifically for the information needed?

Is there more than one answer to the questions?

Can you think of any other question to ask?

PLENARY

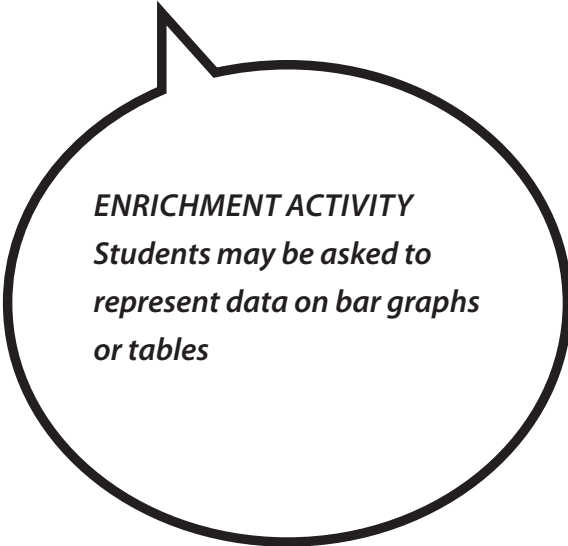
Pupils will be given an activity in which they will select items which would not be suitable for particular questionnaires. For example, in conducting an interview to determine their classmates' preference for a particular extracurricular activity.

- 1) What is your favourite colour? _____
- 2) Do you like sports?
[] Yes [] No
- 3) Do you participate in any extra curricular activities or after-school programme? (If yes, name the activity.)
[] Yes _____ [] No
- 4) What will be your age on your next birthday? _____

Ask students if they think that names should be placed on questionnaires. Students will give reasons for their answers.

ASSESSMENT

- In groups of 3 or 4 design a questionnaire to find out what pupils in your year group do on a Friday night (no less than 3 and no more than 5 questions).
- Exchange your questionnaire with another group. Assess each other's questionnaires and make suggestions for improvement.
- Use your questionnaires to collect data from another group of pupils.
- Write a brief statement in your math journal telling why questionnaires are important in data collection.



ENRICHMENT ACTIVITY
Students may be asked to represent data on bar graphs or tables

LESSON 09 ○ TYPES OF GRAPH (PICTURE, LINE, BAR, PIE)

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES



At the end of the lesson, students should be able to:

- discuss the appropriate use of various tables and graphs
- solve problems in which data are given by means of a graph or diagram

PREREQUISITE KNOWLEDGE

Students should be able to:

- a) construct and interpret line graph, pictograph, bar chart and pie chart
- b) identify graphs by their names – for example, pictograph, circle graph, pie chart, bar graph

MATERIALS/MANIPULATIVES

Samples of different types of graphs, “work cards”, paper strips, glue, sheets of paper, crayons, graph sheets, cartridge paper

CONTENT OUTLINE

Various graphs and diagrams such as pictographs, line graphs, bar charts, and pie charts, can be used to represent statistical data.

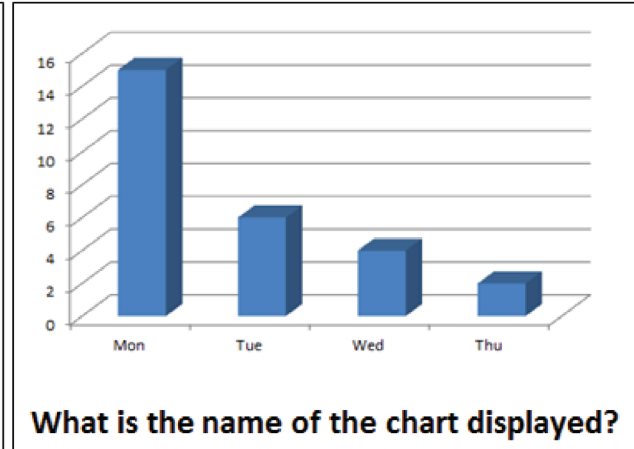
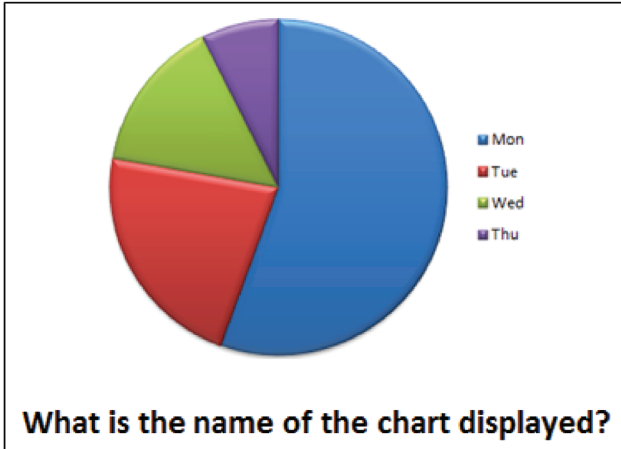
- On a line graph, data is represented by a series of points connected by line segments. Each point represents the frequency of the data.
- On a bar chart, information is shown on the graph as a series of bars. The bars can be vertical or horizontal. The height or length of each bar represents the frequency of each category of the data.
- On pictographs, data is represented using pictures or symbols. A key is used to explain the meaning of symbols used.
- Pie charts are circular graphs on which the frequency of each category of data is represented as sectors of a circle. The relative frequency of each category is reflected by the area of each sector.

PROCEDURE

Mental/Oral Starters

The teacher holds up work cards for students for them to answer displayed questions in groups. The group to supply the most correct answers after a specified time will be the winning group.

Sample of work cards



Days of the week	Number of students late
MON	
TUE	
WED	
THU	

What is the name of the chart displayed?

Main Activity

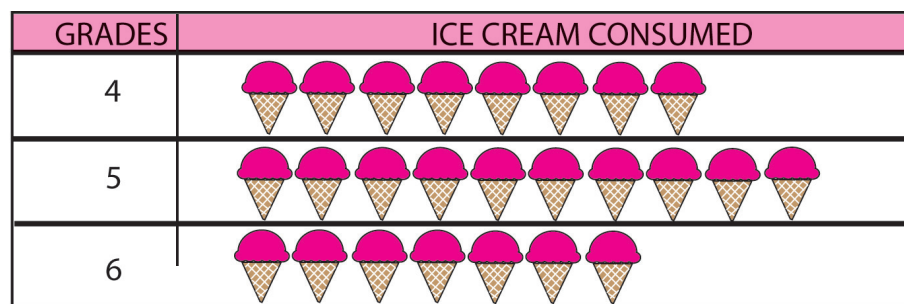
- Students will remain in groups. Each group will be given the different graphs below to observe and discuss. Each group will be given a sheet of paper (Sheet 1) labelled 'First Information' and will be asked to write as many points as they can with regard to the graphs given. This will include similarities and differences among the graphs and information that can be gained from the graphs.
- Pupils will then be given another sheet of paper (Sheet 2) titled 'Guided Information' for them to answer the guided questions.
- **Guided Questions**
 - What is the purpose of the graphs?
 - Which grade consumed the least amount of ice cream?
 - Can you identify the graphs by their names? Write the names of the graphs given (e.g. line graph, bar graph, etc.)
 - Which graph gives the information more readily? Give reasons for your answer.
 - How does Graph 1 differ from Graph 2?
 - How much more ice cream did Grade 4 consume than Grade 6?
 - Which grade consumed the most ice cream?
 - What is the total number of ice cream cones consumed by all three grades?


(Teacher will collect Sheet 2 and sign off at the end of students' final point)

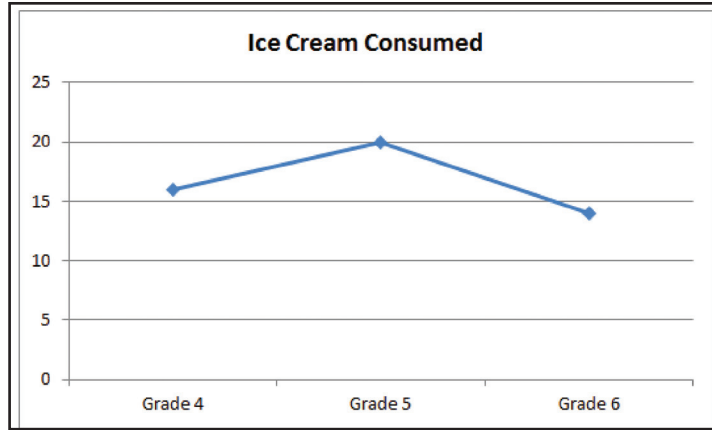
- The four graphs below will be displayed for students to identify by name. The advantages and disadvantages of each graph will be discussed. Information represented will be discussed as well as the appropriateness of graphs used (giving reasons).

Graph 1

Ice cream consumed by students of Grades 4, 5, and 6 at Moore Primary School

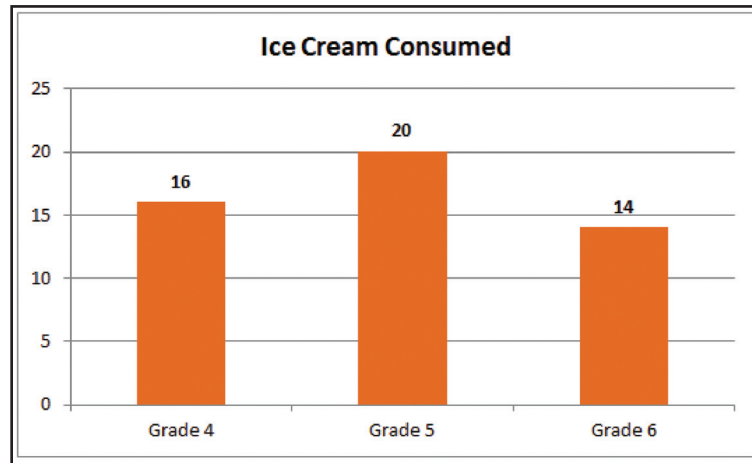


Key  = 2 ice creams



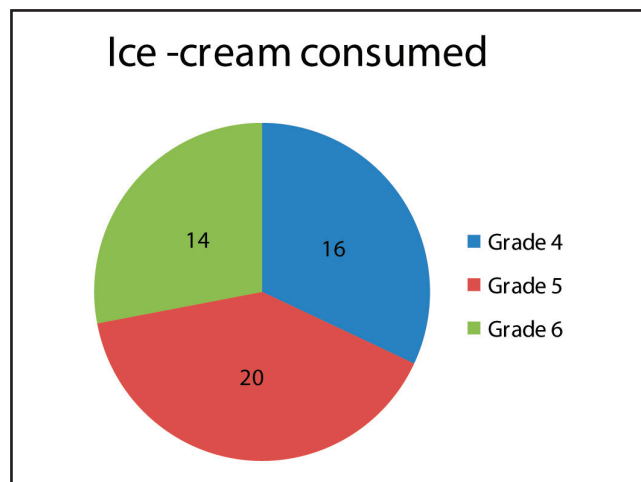
Graph 2

Ice cream consumed by students of Grades 4, 5, and 6 at Moore Primary School



Graph 3

Ice cream consumed by students of Grades 4, 5, and 6 at Moore Primary School



Graph 4

Ice cream consumed by students of Grades 4, 5, and 6 at Moore Primary School

- Student groups will share with each other by reading the information on Sheets 1 and 2 (*First Information/ Information*). The class will engage in the necessary calculations and observations in order to verify the information supplied.
- Pupils will tell various places where they have seen the different graphs being used and their purposes.

PLENARY

Each group will make 2 points that they learned from the lesson.

ASSESSMENT

Students will be placed in 3 groups. Each group will be given a scenario to select, and will present the information on the appropriate graph.

1. *Number of students who were late for school each day*

Monday	5
Tuesday	8
Wednesday	13
Thursday	7
Friday	9

2. *Company's profit for 6 months (January–June 2010)*

Jan.	\$40,000	April	\$30,000
Feb.	\$60,000	May	\$50,000
March	\$50,000	June	\$70,000

3. *School population (Grades 1–6)*

Grade 1: 35 students	Grade 4: 30 students
Grade 2: 40 students	Grade 5: 35 students
Grade 3: 45 students	Grade 6: 30 students

Group members will present their graphs (which will include reading information from the graph and stating why that type of graph was considered appropriate as well as the challenges they would encounter if the other two options were used).

LESSON 10 ○ USING DATA TO MAKE PREDICTIONS AND INFERENCES

GRADE LEVEL: Grade 6

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of lesson, students should be able to:

- collect data using experiments and/or interviews
- analyse data and make at least 2 inferences and draw conclusions based on data collected and activity done in class



PREREQUISITE KNOWLEDGE

Pupils should already:

- a) be able to read and interpret information on tables and graphs
- b) have knowledge of money and decimals

MATERIALS/MANIPULATIVES

Children's Own newspaper, worksheets with tables, cartoon

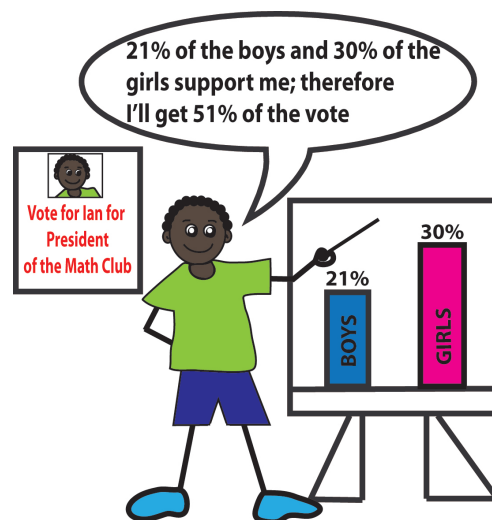
CONTENT OUTLINE

Statistics is a very helpful research tool that enables researchers to gather enough data to make inferences for business, government decisions and even personal choices. For example, statistics may be used to determine if a new product is doing well, which new products or services are needed, or even if a drug or treatment has had any positive effect.

PROCEDURE

Mental/Oral Starters

- Teacher presents a cartoon to students on statistics involving making predictions.
- What information can you get from the cartoon?
- Is it possible to predict a win? Explain.



Main Activity

- Discuss the use of statistics as a tool used to make predictions or draw conclusions in our everyday lives:
 - Is it possible to observe data on graphs and make predictions? Explain.
 - Talk about some simple predictions (introduce other synonyms for predict) that we can make –about weather, exam results, etc. – in our daily activities, based on collected data.
 - Students give examples of using statistics to make inferences – *for example*, the number of students who buy lunch at the canteen in a given week.
 - Review key words such as data, survey, population, sample.

Task

- Students will be told that a jewellery store owner wants to use fancy letters as the design for pendants. He has asked the class to help him carry out the survey. The teacher will mount on the board a pre-prepared chart with students' names and initials (sample shown below).

Students' names	Initial – Christian name	Initial – Surname	Initial preferred for pendant
Joe Black	J	B	
Peter Carter	P	C	
Jennifer Clarke	J	C	

- The teacher will poll students to determine which initial they prefer for the pendant and use the result to complete the table.
- Which initial is the most common for Christian names – vowels or consonants? _____
- Which is the most common for surnames – vowels or consonants? _____
- Which is more preferred for the pendant: first letter of Christian name or first letter of surname? _____
- Is there a letter of the alphabet that was not used? _____

- From the data you have gathered, **complete** the following table:

Title: *Preferred Letters for Pendants*

Preferred letter for pendant	Number of students
Vowels	
Consonants	

What advice could you give this businessperson about making pendants and their selling price?

Explain _____

PLENARY

Write a letter telling your best friend how studying data can be useful in our daily lives.

ASSESSMENT

Discuss findings from students' research on the task above.

ENRICHMENT ACTIVITY

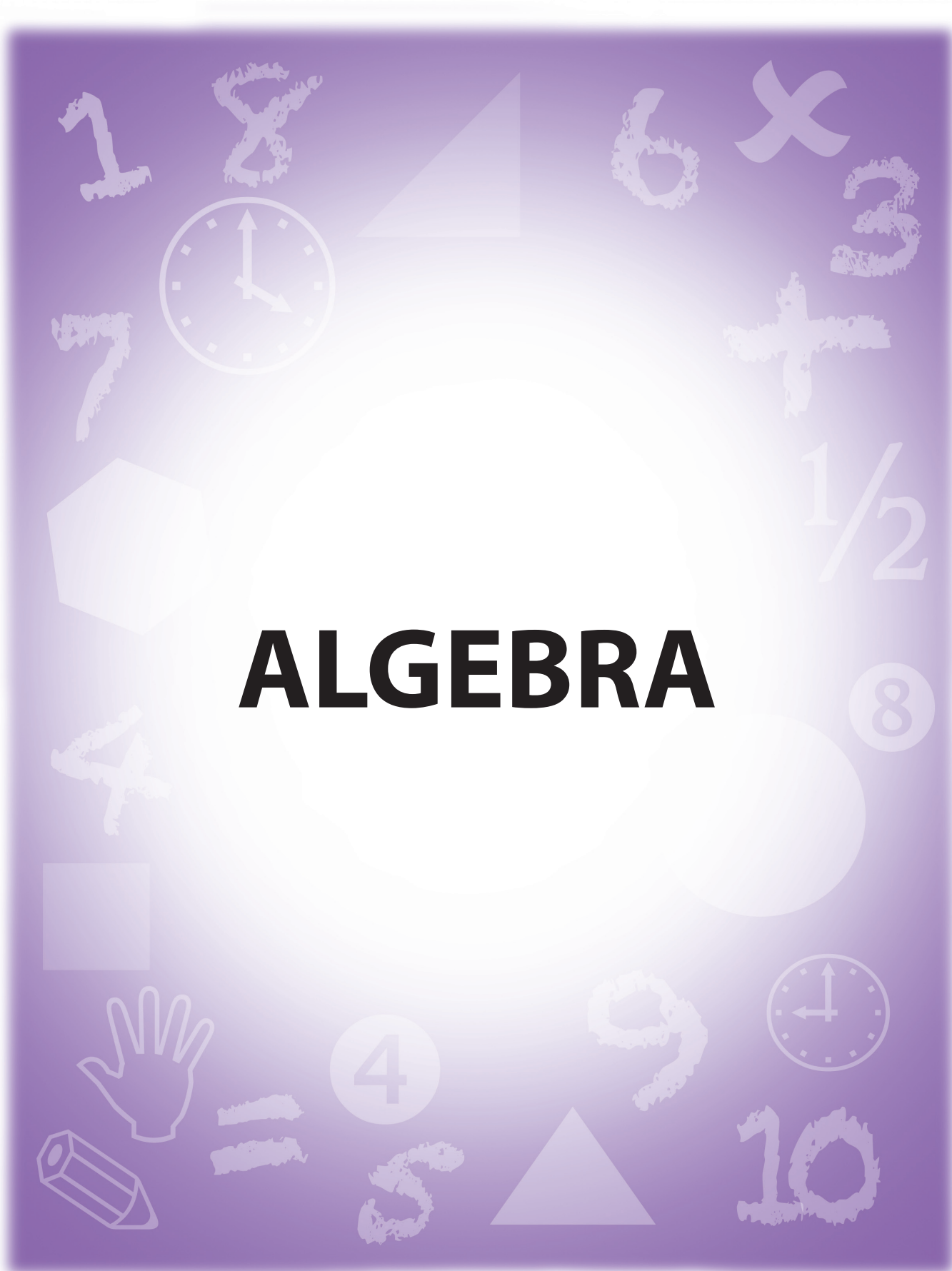
Students will be given the following table for analysis and discussion:

Title: *Gasoline Prices at a Major Gas Station Kingston, 2000–2010*

YEAR	PRICE PER LITRE (L) OF GASOLINE
2000	\$56
2001	\$58
2002	\$61
2003	\$66
2004	\$67
2005	\$67.50
2006	\$71
2007	\$76
2008	\$83.50
2009	\$98
2010	\$105

Task

- Analyse the data in the table. Draw one conclusion from the data.
- Based on your conclusion, can you make a prediction about the future price of the gasoline?



ALGEBRA

LESSON 01 ○ IDENTIFYING ADDENDS IN ADDITION PROBLEMS

GRADE LEVEL: Grade 2

DURATION: 1 hour

SPECIFIC OBJECTIVES

By the end of the lesson, students will be able to:

- supply the missing addend or sum in an addition sentence
- use the inverse relationship between addition and subtraction



PREREQUISITE KNOWLEDGE

Students should already be able:

- a) to count from 1 to at least 20
- b) to solve problems which involve the use of addition and subtraction

MATERIALS/MANIPULATIVES

Counters, counting-on frames (see template under **Main Activity** below), blue and red crayons/markers, 2-sided number cards (with a different single digit number written on each side)

CONTENT OUTLINE

If either the addend or sum in an addition sentence, such as $6 + 2 = 8$, is missing we can determine its value by using algebra. Additionally, if we know that $6 + 2 = 8$, then we can supply the missing number in either of the two number sentences below:

$$8 - 2 = \underline{\quad}$$

$$8 - 6 = \underline{\quad}$$

A variable is any symbol, representing a number as yet unknown.

PROCEDURE

Mental/Oral Starters

Before the class starts, place about 10 counters in a non-transparent box. This box is going to be called a “magic-box”. The teacher starts with the magic box on the table and explains to students that a magic box changes things that are placed inside it. So, if 2 things are placed inside it, then more or less than 2 may come out.

With students watching, place a few counters in the magic box (ensure that students know the number of counters that have been placed in the box) and then after a “flourish”, remove a few more counters than were placed in the box. Discuss with students what “magic” the box did to the counters – how did it change the number of counters that were placed in the box?

Ideally, use counters of the same colour and basic design and dimensions. Do this a few more times, ensuring that students understand the notion of “more than”, each time model “counting on” from what was placed in the box to what was taken out.

Main Activity

- Place students in groups of 2 and give each group a set of:
 - 2-sided number cards (each group getting cards with different numbers, and no more than 5 cards)
 - counting-on frames (one for each number card)
 - blue and red markers/crayons (one of each colour)
- Model how to use the number cards and counting-on frames
 - by selecting a number card and showing students the smaller of the 2 numbers written on the card (for example, 5)
 - by drawing a large counting-on frame on the board and using the blue marker/chalk to colour the first 5 blocks of the counting-on frame



- by showing students the larger number written on the other side of the card (for example, 8)
- by asking students, “What number do you add to 5 to make it 8?”
- by counting on from the 5 blocks already shaded, saying “6...7...8”, and pointing to an empty block each time
- by using the red marker/crayon/chalk to colour the 3 blocks to which you have pointed



- Review the equation modelled on the number card/counting-on frame by writing the following on the board:

$$5 + \underline{\quad} = 8$$

- Use the completed counting-on frame to discuss the answer to this and, below it, write

$$5 + 3 = 8$$

(Ideally, use the same colours to write the equations as were used to colour the counting-on frame)

- Invite students to use their counting-on frames to model their number cards. Instruct them to write both the incomplete number sentences as well as the completed ones.
- Monitor groups to ensure that they are using their cards correctly and shading their frames.
- After the groups are finished with this task, discuss how the frames could be used to show subtraction, using the completed frame on the board.

- Count the total number of squares coloured (to get 8) and then count how many are blue (to get 5). Write below the frame

$$8 - \underline{\quad} = 5$$

- Count the number of red tiles with students to determine the answer. Write below the frame

$$8 - 3 = 5$$

- Ask students to make up subtraction equations using their completed frames.

PLENARY

Identify a space on the wall of the classroom and ask each group to place one of their completed number frames there. Each completed number frame should include both the addition equations and the subtraction equations. Discuss the meaning/use of the dash in each number sentence.

ASSESSMENT

Give each student blank number frames and ask them to colour the frames to represent equations like the example below and write the corresponding subtraction equations.

$$2 + \underline{\quad} = 10 \quad \text{and} \quad 10 - 2 = \underline{\quad}$$

Counting-on frames

LESSON 02 ○ USING ALGEBRA TO DESCRIBE RELATIONSHIPS

GRADE LEVEL: Grade 3

DURATION: 1 hour

SPECIFIC OBJECTIVES



During the lesson, students will:

- solve “if __ then __” examples which associate repeated addition with multiplication – for example, “if $n = 6$, then $2 \times n = \underline{\quad}$ ”
- use simple algebra in problem solving
- use symbols to represent numerals in mathematical sentences

PREREQUISITE KNOWLEDGE

Students should already be able to:

- a) find what the number n represents when n replaces an addend, a sum or a product
- b) construct simple tables using numbers to represent items
- c) solve problems using information given in a table

MATERIALS/MANIPULATIVES

Cut-outs of “stick” man and jump rope (template provided below), masking/mounting tape

CONTENT OUTLINE

Relationships between variables exist when pairs of values are related in the same way as other pairs of values. These relationships can be described algebraically by assigning variables to represent “any quantity” of one variable and writing expressions to describe general rules. In this way, algebra can be used to predict values not observed as yet.

PROCEDURE

Mental/Oral Starters

Pre-prepare a set of cards with matching pairs of algebraic addition and multiplication sentences – one half of each pair of cards will have a repeated addition sentence (such as $a + a + a$) and its corresponding half will have the equivalent multiplication sentence ($3a$). Issue these cards randomly to the class – give each child one card (or, in a large class, give one card to each pair of students). Give students a few minutes to find their partners. You may choose to write related words on the back of matching cards to aid students (for example, ‘BUN’ on the back of $(3 a)$ and

'CHEESE' on the back of $(a + a + a)$. After students have found their partners, discuss the relationship between the number sentences on a matching pair of cards.

Main Activity

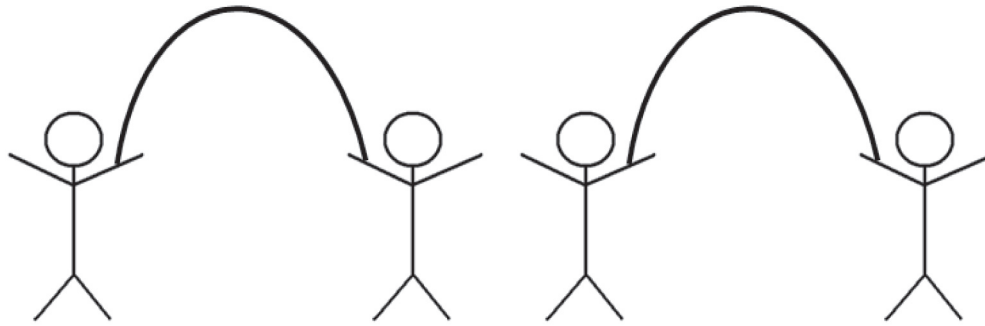
- Invite volunteers to come to the board and make a model of the two students turning a skipping rope.
- Models on the board should be created by mounting 2 stick men and one jump rope as shown below:



- Discuss with students the number of persons needed to turn 1 skipping rope. Draw a table on the board with column headings "number of ropes" and "number of persons" and complete it as follows:

Number of ropes	Number of persons
1	2
2	
3	
4	
5	
6	

- Ask another volunteer to come to the board and paste another cut-out of 2 stickmen and a jump rope as shown below.



- Ask students to record this in their tables. Have students continue pasting cut-outs of stickmen and ropes until about 5 or 6 ropes (10 or 12 persons) are on the board. Ensure that students complete their table as each pair is added.
- Arrange students in groups of 5 and without placing more cut-outs on the board, take the students through the following tasks:
 - Complete their table for up to 10 ropes.
 - Discuss how students were able to complete their tables – did they add 2 (vertically) or did they multiply by 2 (horizontally)? Ensure that all the tables have been completed correctly, as below.

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

- Ask students to describe the relationship between the number of ropes and the number of students; allow them to use full sentences if they choose – do not insist on n sentences. Ask questions (as necessary) such as:
 - Do you see a relationship between the 1 and the 2, the 2 and the 4, the 3 and the 6 and so on?
 - If I know how many ropes there are, what do I do to know how many persons are turning them?
 - How many persons does it take to turn one rope? For each new rope how, many more persons are needed?
- Working with the model on the board, have students use repeated addition to show that 3 ropes need $2 + 2 + 2$ persons. Discuss ways in which this can be written. Guide students into using 3×2 as a way of writing the repeated addition problem.
- Repeat this for 4, 5 and 6 ropes, if necessary. To further guide students into seeing the relationship between ropes and number of persons, you may summarise for students by writing
 - If 3 ropes are used then 2×3 persons will be needed
 - 4 ropes need 2×4 persons
 - 5 ropes need 2×5 persons
 - 6 ropes need 2×6 persons
- Now, ask students to say how many persons will be needed when there are n number of ropes (you can revert to the format: n ropes need $___ \times ___$ persons).
- Finally, discuss the solution to the question: "How many persons are needed to turn 18 skipping ropes?" Model the following solution for students:

If $n = 18$, then $2n = 2 \times 18 = 36$

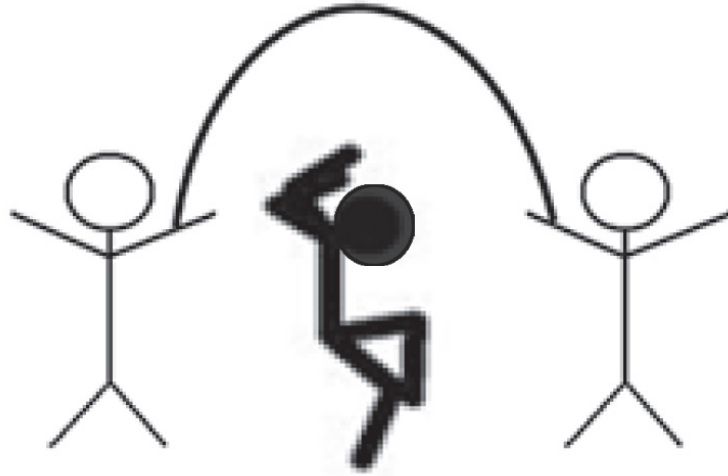
Therefore, 36 persons are needed to turn 18 skipping ropes
- Ask students to tell you how many persons are needed if number of ropes (n) =
 - 20
 - 28
 - 35

PLENARY

Discuss the table of results that students would have obtained so far. Explore and resolve any questions that students observe about patterns in the table. For example, discuss the fact that there are only even numbers in the second column.

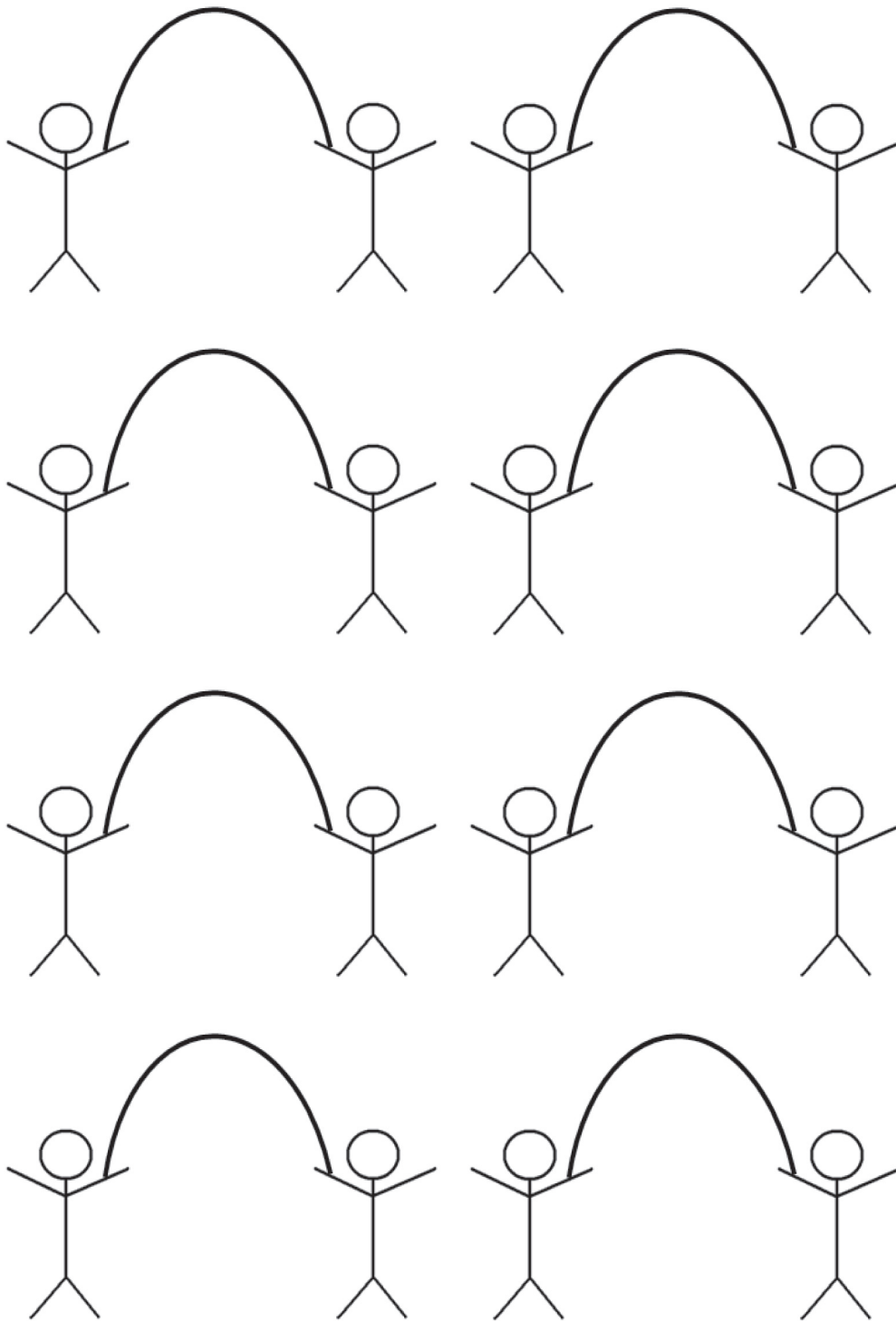
ASSESSMENT

Suppose a “jumper”



- i. What would be the relationship between the number of ropes and the number of persons?
- ii. How many persons would be needed if there were 19 skipping ropes?

Stickmen/Jump Rope – Template



LESSON 03 ○ *N*-SENTENCES

GRADE LEVEL: Grade 3

DURATION: 1 hour

SPECIFIC OBJECTIVES



By the end of the lesson, students will be able:

- to find what the number n represents when n replaces an addend, a sum or a product

PREREQUISITE KNOWLEDGE

Students should already have:

- a) an understanding of the four basic operations
- b) an understanding of the role of the equal sign
- c) an understanding of the unit of weight

MATERIALS/MANIPULATIVES

Balance scale, algebra work card, unlabelled weights, labelled weights (100g, 200g, etc.) and cards with equations

CONTENT OUTLINE

Variables are symbols that take the place of numbers. They are used to represent quantities or values that vary or change. Algebra allows for patterns to be recognized, extended and generalized. For example, the generalization that $a + b = b + a$ tells us that $83 + 27 = 27 + 83$ without computing the sums on each side.

PROCEDURE

Mental/Oral Starters

Ask 12 volunteers to stand in front of the class. Give each volunteer a single-digit number on a card. Instruct students to organize themselves into groups of 3 such that each group has a true addition or subtraction number sentence. Allow the rest of the class to judge whether the number sentences are correct. Could students be reorganized to ensure that more/most/all students are used?

Main Activity

- a) Students will be placed in groups and each group will be given a balance scale and unlabelled masses. They will be questioned about what they think will happen to the balance if equal/unequal masses are placed on either side.
- b) Using the labelled masses students will conduct exploration to determine the different masses that create a balance. They will then write equations to represent balanced situations.

For example, $500\text{g} = 100\text{g} + 100\text{g} + 300\text{g}$

- c) Students will be given cards with equations where a variable will be used to represent a missing mass. Using a similar activity conducted in b), above they will find the missing mass to complete the equation.

For example, $400\text{g} = 50\text{g} + 100\text{g} + N\text{g}$, What does N represent?

- d) Students will be given a worded problem. Through guided discussion and teacher's help, they will generate a number sentence with an appropriate symbol to represent the unknown variable. *For example, John had 5 marbles. He got some more from his brother, Mathew, and he now has 8. How many marbles did he get from his brother?*
- e) Using the number sentence " $5 + N = 8$ ", students will use marbles to find the solution.
- f) Students will be asked to model and solve the following worded problem:

Clara has some sweets and her sister gave her 8 more and now she has 17 sweets. How many did Clara have at first?

PLENARY/ASSESSMENT

Students in their groups will write two-worded problems and exchange with other groups to solve. Each group will share its number sentence and solution with the class.

LESSON 04 ○ USING ALGEBRAIC IDEAS TO SOLVE PROBLEMS

SUB-TOPIC: n -sentences Involving multiplication and division

GRADE LEVEL: Grade 3

DURATION: 1 hour

SPECIFIC OBJECTIVES

By the end of the lesson, students should be able to:

- find what n represents, when it replaces a product or a factor in a multiplication or division sentence select or write the appropriate n -sentence in a problem situation



PREREQUISITE KNOWLEDGE

Students should know:

- a) how to write algebraic expressions
- b) the four basic operations and their inverses

MATERIALS/ MANIPULATIVES

Calculators

CONTENT OUTLINE

N -sentences can be used to describe patterns and also to describe observed mathematical relationships. Using a variable allows us to make generalizations. Substituting known values into variables allows us to find answers to specific situations.

PROCEDURE

Mental/Oral Starters

Engage the students in the activity “broken keyboard”.

The keyboard on Joni’s computer is not working properly. If she types a word and then presses the *Enter* key, a new word is created. Below are some examples of this.

- a) ‘**Bit**’ becomes ‘**Bite**’
- b) ‘**Star**’ becomes ‘**Stare**’
- c) ‘**Hid**’ becomes ‘**Hide**’
- d) ‘**Bath**’ becomes ‘**Bathe**’

What rule is the *Enter* key following in changing the words that she types? How would the computer change ‘**Rip**’? What did it change to get ‘**Quite**’?

Main Activity

- Tell students that when Joni enters a number on her broken keyboard, another one is displayed according to a certain rule.
- Discuss the relationship between the number entered and the number displayed in the table below:

Number entered	Number displayed
1	2
2	4
4	8
5	10
7	14

- Discuss questions such as:
 - What rule is the computer/keyboard following?
 - Is the rule the same for all numbers entered?
- Ensure that all students can describe the rule before asking them to predict the number displayed when the following numbers are entered:
 - 12
 - 15
 - 19
- Finally, ask students to write an expression for the display if n is entered.
- Discuss with students how they would find the number entered if the displayed number is 20. Ensure that students appreciate the need for reversing the process (dividing by 2).
- Ask students to use the rule they have observed to say what number would have been entered in order for the displayed number to be:
 - 18
 - 36
 - 40

- Allow students, in groups of 2, to attempt the other broken keyboard task below:

Instructions:

Figure out the rule that the broken keyboard is following and use it to fill in the spaces occupied by question signs

Number entered	Number displayed
2	8
5	20
7	?
8	32
9	?
?	44
n	?

Discuss students' solution. Ensure that students are able to describe how to find the displayed number as well as the number entered.

PLENARY

With the use of the following examples, discuss the relationship between multiplication and division in n sentences:

- $3n$ and $n \div 3$
- $5n$ and $n \div 5$
- $8n$ and $n \div 8$

ASSESSMENT

Have students remain in their groups of 2. Each student in each group will make up 2 broken keyboard problems for their partner to solve.

LESSON 05 ○ CREATING ALGEBRAIC EXPRESSIONS

GRADE LEVEL: Grade 4

DURATION: 1 hour

SPECIFIC OBJECTIVES

- During the lesson, students will write n-sentences to represent problems



PREREQUISITE KNOWLEDGE

Students should be able to:

- identify numbers from 1 to 100 proficiently
- express simple sentences and worded problems as algebraic expressions

MATERIALS/MANIPULATIVES

Dice, large hundred chart for display (sample shown below); cut-outs of parts of hundred boards (see below)

Hundred 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



CONTENT OUTLINE

Algebraic expressions can be used to describe relationships between two quantities. Once we know the relationship between the two quantities then we can determine the value of one quantity as long as we know the other.

We do this by substituting known values into expressions.

PROCEDURE

Mental/Oral Starters

Decide on a number relationship (such as 4 more than a number) that will be modelled using number cards. Ask 2 volunteers to come to the front of the class. Give a number card to each student – each card has a different number, with one number being 4 more than (or 4 less than) the other. Ask 2 more volunteers to come to the front of the class and give them 2 number cards with different numbers but the same relationship. Do this about 4 or 5 times each time modelling the same relationship using different pairs of numbers. For the 6th pair of students, give one child a number card and ask the class to say what card would be given to the other student. Do this for a few more pairs of students – alternating between having the class determine the number on the second card and the number on the first card. Eventually, discuss the relationship that exists between the pairs of numbers.

Main Activity

- Display a large hundred chart. Introduce students to the hundred chart by asking questions such as
 - How many rows and columns does it have?
 - What do you observe about the last/first digit of each number in each column?
 - What is special about the numbers in the last column?
- Use the hundred chart to explore relationships. Ask students to look at the hundred chart and describe what is special about numbers that are immediately above or under each other. Focus their attention on two numbers if needed – for example, 45 and 55.
- Discuss this with students and ensure that students realize that there is a difference of 10 between the two numbers – the number at the bottom is 10 more than the number at the top.
- Hide the hundred chart and ask students to say what numbers would be immediately under the following numbers on the hundred chart:
 - 21
 - 37
 - 76

- Show the students the hundred chart again and discuss their answers. Highlight the idea of "adding 10" to each number in order to identify the one below it. If necessary, write on the board:
 - Top number = 21, bottom number = $21 + 10$
 - Top number = 37, bottom number = $37 + 10$
 - Top number = 76, bottom number = $76 + 10$
- Now ask students to write which number would be below n on the hundred chart. Point out that n could be *any* number on the chart.
- Ask students to discuss what number would be above/below n on the hundred chart. Ensure that students use the expressions $n + 10$ and $n - 10$ to describe this relationship.
- Repeat the previous steps looking this time at the relationship between numbers along a diagonal. For example the relationship between 22 and 33, or 33 and 42.
- Using the number 54 (or any other suitable number) as a reference point, and using n to represent 54, ask students to write relationships between 54 and all numbers surrounding it in a 3×3 square (as shown below):

43	44	45
53	54	55
63	64	65

That is, write the relationship between

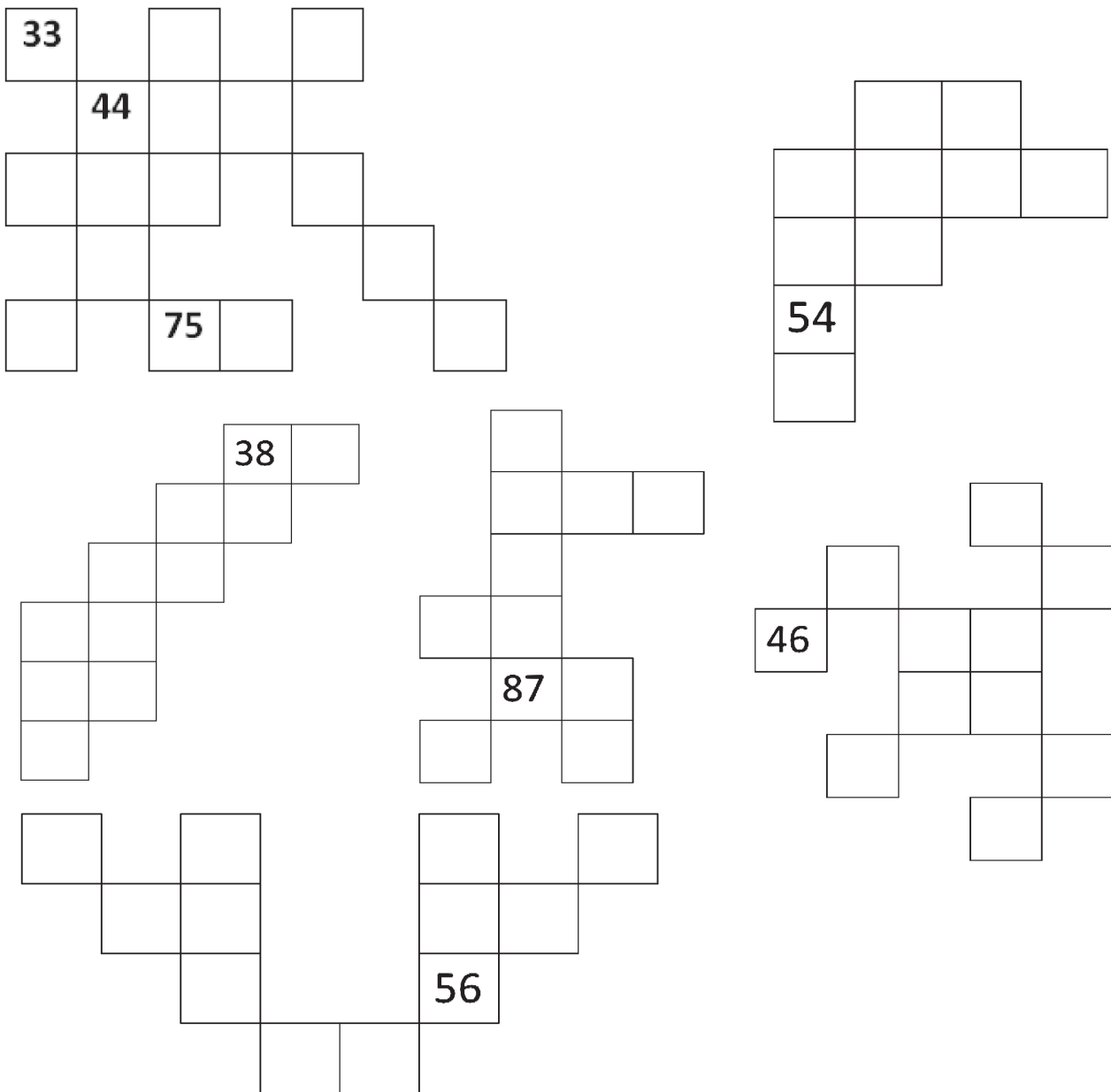
- 54 and 64 ($n + 10$)
- 54 and 44
- 54 and 55
- 54 and 53
- 54 and 65
- 54 and 63
- 54 and 43
- 54 and 45
- Ensure that students check their relationships in at least one other 3×3 square.

PLENARY

Discuss and verify students' algebraic expressions that describe the various relationships on a 3×3 grid of the hundred chart.

ASSESSMENT

Place students in groups of about 5 or 6 students. Give each group a large drawing of a cut-out of a segment of a hundred chart (preferably on cartridge paper). Explain to students that the cut-out is a part of a hundred chart, but some numbers are missing. Tell them to complete the chart by putting in the missing numbers. Six sample cut-outs are shown below.



LESSON 06 ○ GENERATING NUMBER PATTERNS

GRADE: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES



By the end of the lesson, students should be able to:

- generate number patterns
- identify rules governing generated number patterns and express them algebraically

PREREQUISITE KNOWLEDGE

Students should be able to:

- a) express simple sentences and word problems as algebraic expressions
- b) recognize simple number patterns particularly those dealing with the multiplication operation

MATERIALS/MANIPULATIVES

At least 60 counters (30 of one colour and 30 of another)

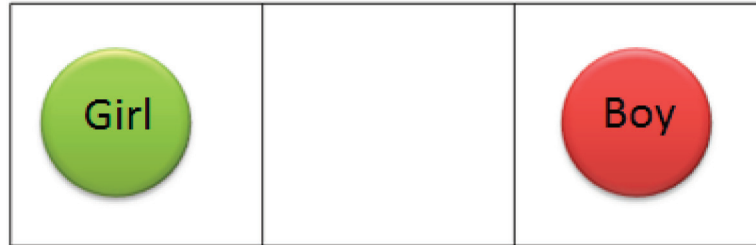
CONTENT OUTLINE

Algebraic expressions can be used to describe relationships between two quantities. Once we know the relationship between the two quantities then we can determine the value of one quantity as long as we know the other. We do this by substituting known values into expressions.

PROCEDURE

Mental/Oral Starters

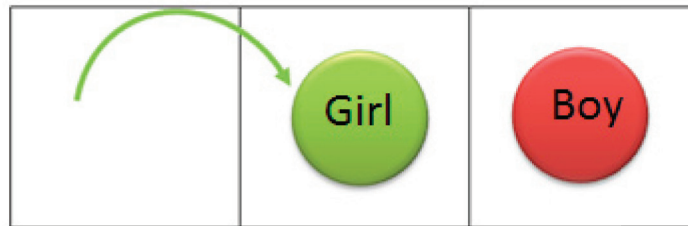
Two volunteers will be selected to model the following problem with the assistance of the class. A boy and a girl sit on chairs separated by 1 chair.



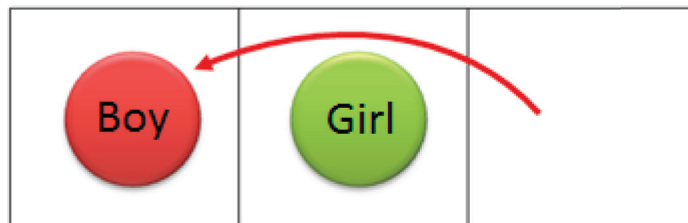
What is the minimum number of moves needed for them to switch places following these rules?

- A person can either move onto an adjacent chair or "jump" over an adjacent person (of any gender) to the vacant chair immediately beyond him or her.
- Persons can move in one direction only – they are not allowed to turn back.
- At all times, a person must be on a chair.

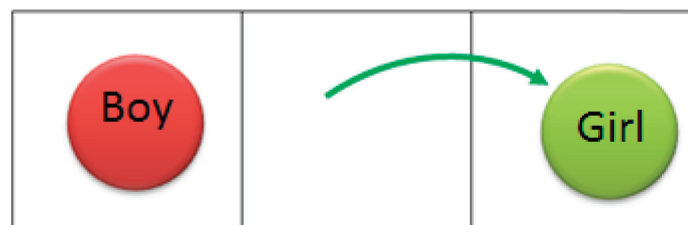
Move 1



Move 2



Move 3



Main Activity

- As a class, determine the minimum number of moves needed for 4 students (2 on each side) to exchange places (see model solution below).
- Discuss the attempts made by the students by asking them
 - to talk about the strategies they used
 - say how they are sure that no fewer moves could have been used
- Tell students that a minimum of 15 moves are needed for 3 girls and 3 boys to exchange places. Ask 6 volunteers to demonstrate how this is done. Allow the class to help them.
- The teacher will place students in groups and give each group a pre-prepared table as shown below (Table 1). From here, students will be asked to predict, or work out using counters, the minimum number of moves needed for 8 persons – 4 on each side – to exchange places and to complete the table up to the point where 6 persons are on each side.

Table 1 – Exchanging places	
Number on each side	Minimum number of moves
1	3
2	8
3	
4	
5	
6	

- Ensure that all tables are completed correctly up to this point (as shown in Table 2 below).

Table 2 – Exchanging places (solution)	
Number on each side	Minimum number of moves
1	3
2	8
3	15
4	24
5	35
6	48

- If students are having challenges completing the table, guide them by asking questions such as:
 - a. By how much does the minimum number of moves increase in each case?
 - b. Is it a constant number? What is special about the numbers by which it increases in each case?
 - c. Can you use this to predict the minimum number of moves for other cases?
- After students have completed their tables, ask them to say the minimum number of moves if there are 36 on each side.
- Discuss why this is a difficult question to answer. Ask them to explore the relationship between the number on each side and the minimum number of moves required. If necessary, ask guiding questions such as:
 - d. What are some of the operations you can perform on 1 to get 3?
 - e. Is there a similar operation that can be performed on 2 to get 8?
 - f. Look at the other corresponding pairs. Is this true for all pairs?
- On the board write
 - 1 is multiplied by 3 to get 3
 - 2 is multiplied by 4 to get 8
 - 3 is multiplied by ___ to get 15
 - 4 is multiplied by ___ to get 24
 - 6 is multiplied by ___ to get 48
 - 9 is multiplied by ___ to get ___
- Can you write a sentence that describes the relationship between numbers on each side and the minimum number of moves?
- If you let n represent the number on each side, can you write an algebraic expression for the sentence you wrote?
- Hence, by what number will 36 be multiplied to get the minimum number of moves?
- By what numbers will the following numbers be multiplied?
 - g. 19
 - h. 25

PLENARY

Discuss the various solutions that the groups came up with. Ensure that the relationship is clearly understood.

ASSESSMENT

(See continuous assessment checklist below)

Continuous Assessment Checklist

Date: _____

Group: _____

Group Members: _____

	Yes	No	Comment
1. Were students able to model the various problem scenarios?			
2. Was there evidence of logical reasoning in student discussions?			
3. Were students able to complete table correctly?			
4. Were students able to describe relationships in words?			
5. Were students able to describe relationships algebraically?			
6. Could they apply relationships observed to solve for unknown cases?			
7. Were students engaged in the problem solving process?			
8. What strategies were used to complete the table?			

LESSON 07 ○ SUBSTITUTING VALUES INTO EXPRESSIONS

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES

By the end of the lesson, students should be able to:

- use algebraic sentences in solving word problems
- demonstrate the principles of substitution in simple expressions and formulae



PREREQUISITE KNOWLEDGE

Students should already be able to:

- a) add and subtract proficiently
- b) explain what a variable is

MATERIALS/MANIPULATIVES

Templates for magic square (provided below), deck of algebra cards (see sample template below)

CONTENT OUTLINE

Substitution is the process of replacing symbols or variables with numbers.

PROCEDURE

Mental/Oral Starters

Pre-prepare a deck of 5 pairs of cards. One card in each pair will have an algebraic equation (such as $a + b = 5$) and the other card will have values for a and b , which when substituted into the equation make it true (in this case, $a = 3$ and $b = 2$ or vice versa). Arrange students into groups; shuffle the deck and give to students and ask them to find the matching pairs. Create a deck for each group or repeat a few decks with some groups. *(A sample deck is found at the end of the lesson)*

Main Activity

- a) Tell students that a magic square is a number grid in which the sums of the numbers in each row, column and diagonal are equal. This common sum is called the magic number. Give each group a magic square template with one number, say 13, in the centre of the square. Explain to the students that when completed correctly they will have a magic square but in order to see the magic square they must use the secret code.

b) Place the following chart on the board with the secret code.

$x - z$	$x + z - y$	$x + y$
$x + y + z$	x	$x - y - z$
$x - y$	$x + y - z$	$x + z$

- c) Tell students that the letters x , y and z represent three numbers. Ask students to look at their templates and tell you what the value of x is on their template (*value is 13*).
- d) Supply values for y and z and instruct the students to substitute these values into the secret code to complete the magic square (*note that the sum of y and z must not exceed 13*).
- e) Give each group a new template with another value of x in the centre. Guide students in selecting values for y and z , telling them that we need numbers whose sum is less than the value of x , that is, if x is 11, $y + z$ should be less than 11.
- f) Allow each group to complete their magic squares using their secret code.
- g) After each group has created at least 3 squares, ask them to write an expression to state the relationship between the magic number for each square they have created and the value of x in each square.
- h) Hence, predict the magic number for a square where
- a) $x = 24$
 - b) $x = 17$
 - c) $x = 21$
- i) Predict the value of x , for a square with a magic number of
- a) 84
 - b) 87
 - c) 138

PLENARY/ASSESSMENT

Have each group create a magic square that they share with another group, without sharing with them the values for x , y and z . Each group is to figure out the values for x , y and z that were used by their classmates to create the square that they got.

Magic Square Template

$z =$ _____ $y =$ _____ $z + y =$ _____ $x =$ _____

Magic Number = _____

Sample Deck

$a + 2b = 9$	$a = 1, b = 4$
$3a - b = 5$	$a = 5, b = 10$
$4a + 2b = 12$	$a = 2, b = 2$
$3a - 5b = 13$	$a = 6, b = 1$
$3a = 2b$	$a = 4, b = 6$

LESSON 08 ○ SOLVING SIMPLE EQUATIONS

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES

By the end of the lesson, students should be able to:

- find “n” in an open mathematical sentence using addition or subtraction with or without the use of brackets



PREREQUISITE KNOWLEDGE

Students should know:

- a) how to express simple sentences and worded problems as algebraic expressions
- b) the four operations and their inverses

MATERIALS/MANIPULATIVES:

Beam balance, weights

CONTENT OUTLINE

An equation represents a balance of two mathematical expressions.

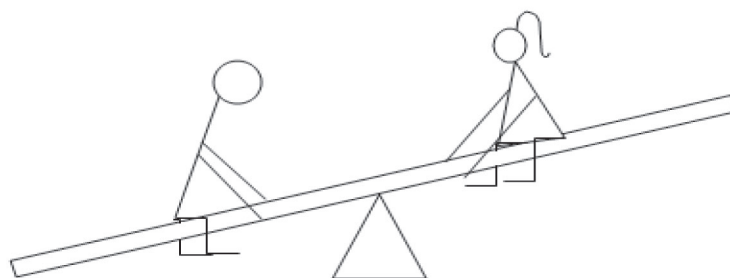
To maintain this balance, any operation done on one expression must also be done on the other.

We can use this idea to solve for unknown values in an equation.

PROCEDURE

Mental/Oral Starters

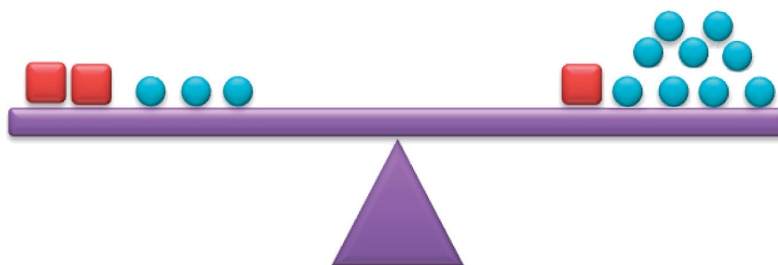
Students will be engaged in a discussion about two students on a see-saw balance as shown in the picture on the following page.



Main Activity

- The teacher will place different combinations of unit weights and another “unknown” weight on either side of the balance so that balance is attained. For example, in the diagram below

● represents the unit weight and ■ represents the unknown weight



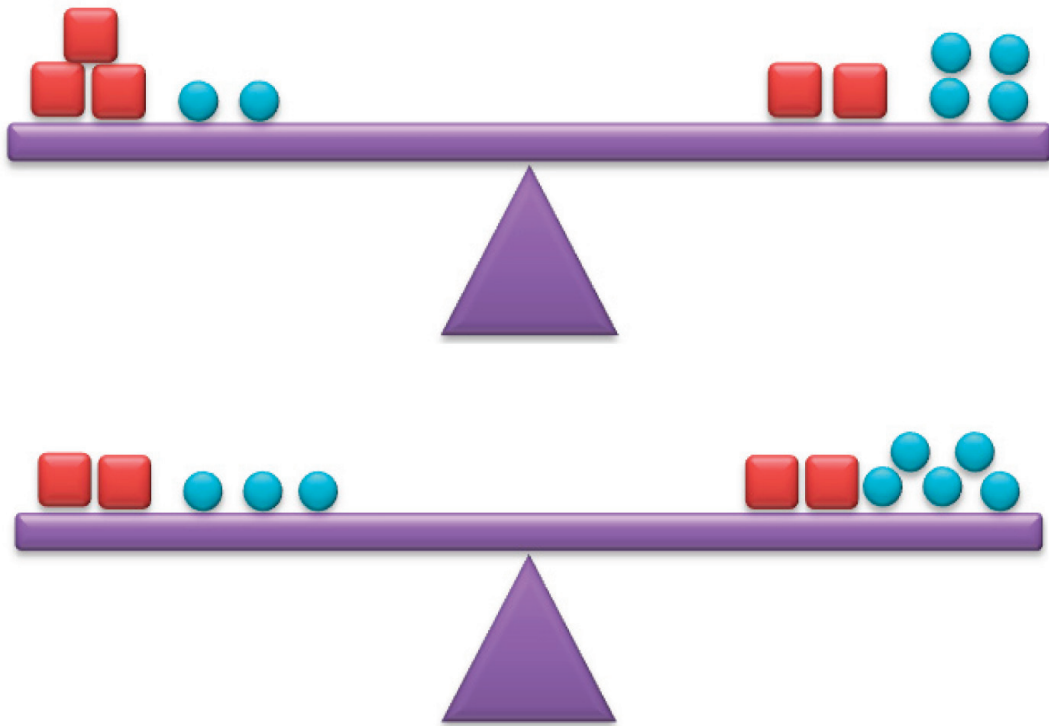
- The students will be guided to write an equation to describe the balanced weights. In our example: $2x + 3 = x + 9$
- Individual students will be asked to add or remove weights from both sides of the balance, maintaining balance. Students will be required at each adjustment to write an equation to describe the new situation modelled.
- The students will be divided into groups at the teacher’s discretion. Each group will then be given a balance and a set of marked/known weights and a few unknown.
- Each group will be asked to try to create a balance situation using at least one of the unknown weights. They will be asked to write an equation to describe the modelled situation.
- The students will be asked to use the weights provided to determine the value of the unknown in terms of the unit weights by adding or removing weights so that balance is maintained.
- The students will be asked to record on a sheet of cartridge paper, mathematical sentences for each step that they took.

PLENARY

Each group will be asked to explain how they found the value of the unknown, using their cartridge paper as a guide.

ASSESSMENT

Each group will be given two pictures of different equations modelled and asked to determine the value of the unknown in each situation.



LESSON 09 ○ CREATING ALGEBRAIC EXPRESSIONS

GRADE LEVEL: Grade 5

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson, students should be able to:

- use substitution in solving word problems
- generate algebraic sentences to solve problems



PREREQUISITE KNOWLEDGE

Students should already be able to:

- a) simplify algebraic expressions

MATERIALS/MANIPULATIVES

Boxes, counters

CONTENT OUTLINE

Algebra is used to make general statements that are not limited to one particular value. In situations where any value is possible, using a variable to replace a number is ideal. Performing computation with the variable, in ways similar to how operations on numbers occur, allows us to say what would happen to any value that is chosen.

PROCEDURE

Mental/Oral Starters

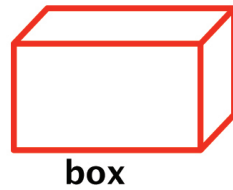
Ask students to think of a whole number and perform the following instructions:

- Add 7 to the number
- Double the answer
- Subtract 4
- Divide the number by 2
- Subtract the original number

Teacher will reveal a card on which 5 (the number students are expected to obtain) was already written. After displaying the number teacher will engage students in a discussion to determine how the teacher was able to guess the correct number.

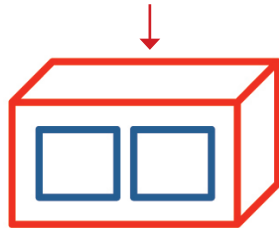
Main Activity

1. Students in groups of 5 or 6 will be given at least 30 counters and two boxes.



2. Model the steps with students as follows:

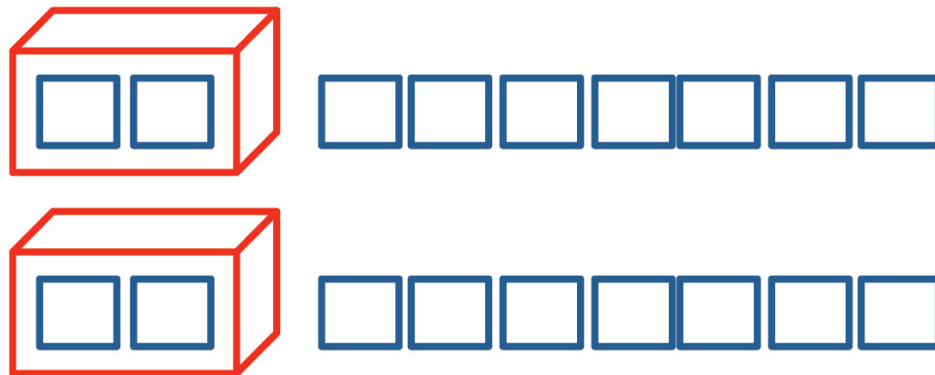
- a) Think of a number (shown by placing tiles in the box – here, 2 tiles are shown in the box for illustrative purposes)



- b) Add 7 to it (shown by putting 7 tiles beside the box)



- c) Double the answer (shown by placing 2 counters in another box and adding 7 more counters)



d) Subtract 4 (remove 4 of the counters)



e) Divide the answer you have now by 2 (remove half the counters and 1 of the boxes)



f) Subtract the original number (remove the box which represents your original number)



g) Only 5 counters are left

3. Do a few more think-of-a-number problems with students (*two sample problems are outlined below*). In each case, ask students to model the steps using their tiles and boxes.

Think of a number 1

- Think of a number
- Add the next consecutive number to that number
- Add 7
- Divide the answer by 2
- Subtract the original number

Think of a number 2

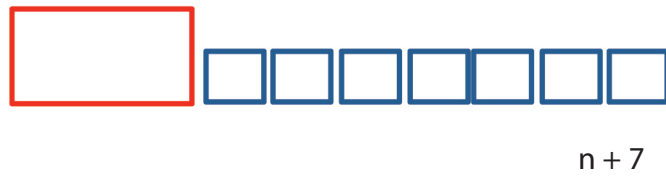
- Think of a number
- Add 3 to it
- Multiple the answer by 2
- Subtract 4
- Double it

- Add 4
 - Divide by 4
 - Subtract the original number
4. Ask students to use a letter to represent the rectangle (which represents the unknown number) and to write down the number of tiles/counters in each step. This is modelled below:

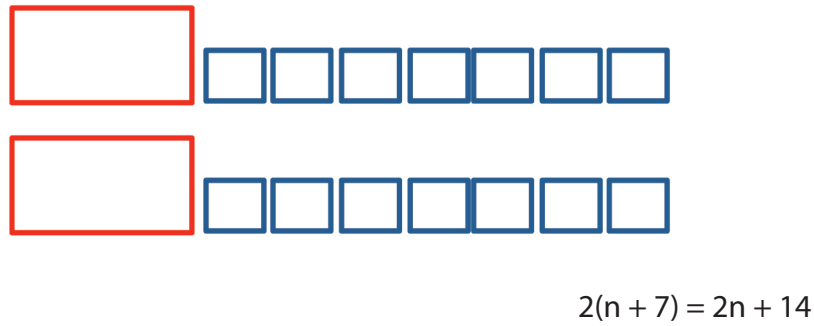
Think of a number



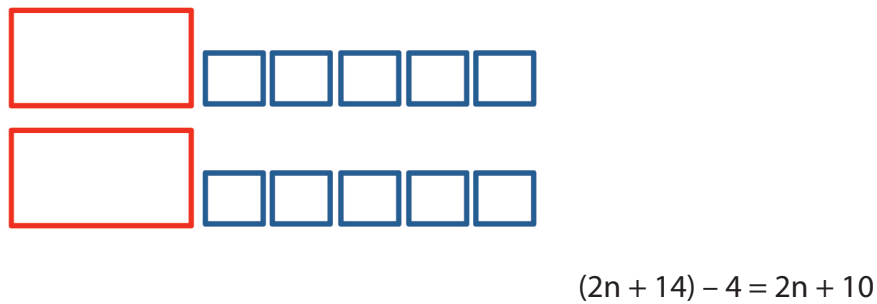
Add 7 to it



Double the answer



Subtract 4 from the answer



Divide the answer by 2



$$(2n + 10) \div 2 = n + 5$$

Subtract the original number



$$(n + 5) - n = 5$$

PLENARY

Give each group a sheet of cartridge paper and ask them to make up a think-of-a-number activity. It should have at least 4 steps and they should be able to predict the answer at the end. They should use rectangles and squares to model the activity on the cartridge paper and should also use a letter to represent the unknown number. Finally, they should describe each step being modelled by making up and simplifying algebraic expressions. These are to be mounted on the wall.

LESSON 10 ○ CREATING EQUATIONS

GRADE LEVEL: Grade 6

DURATION: 1 hour

SPECIFIC OBJECTIVES

At the end of the lesson, students will be able to:

- write rules for given number patterns
- write equations or expressions from given number patterns
- find solutions for equations



PREREQUISITE KNOWLEDGE

Students should be able to:

- a) express simple sentences and word problems as algebraic expressions
- b) solve simple equations

MATERIAL/MANIPULATIVE

Calendar

CONTENT OUTLINE

Algebraic expressions can be used to describe the relationship between two quantities. If the value of a quantity is not known or varies, a variable is used in its place.

PROCEDURE

Mental/Oral Starters

Class will begin by students doing a quick revision of how to solve simple equations and writing algebraic expressions. Students will use the calendar to produce algebraic expressions to see mathematical relationships between days. The teacher will guide students' thinking by asking questions such as:

– *If today is Friday when will the next Friday be?*

Students will be guided into generating the expression $x + 7$ to represent the next occurrence of today's day or $x + 14$, $x + 21$, etc. for other occurrences.

Main Activity

Students will be placed in groups. The number of students in each group will depend on the discretion of the teacher. Each group will be given a **calendar** and an **activity sheet** with the instructions students will be engaged in.

MAY						
M	T	W	T	F	S	S
	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			

- Each group will be assigned a number which is the sum of four days that form a square on the calendar – for example, 80 (the sum of the four days chosen from the calendar above and shown in the diagram below).

16	17
23	24

- Group members will be required to find the square whose sum gives the number assigned to the group. Group members will be required to devise a method using algebra and arithmetic to find the four days.
- Their responses and the approaches taken will be discussed. The teacher will prompt students to assign a variable to any of the 4 numbers in the square. For example, if the **first** day in their square was m , write algebraic expressions for the four days in the square:

m	$m + 1$
$m + 7$	$m + 8$

- Discuss ways in which this can be used to form an equation to determine the value of m and hence the other numbers in the square.
- For example,

$$m + m + 1 + m + 7 + m + 8 = 80$$
- Groups will be required to compete against each other by alternating which group provides the sum and which supplies the numbers for the dates and vice versa. They will be encouraged to find other methods of determining the numbers in the square.

PLENARY/ASSESSMENT

- Class will listen to each group giving a brief description of the strategies used in finding the expressions and solving the equation. Teacher will ask questions like

- Did you arrive at any strategy to find the dates in the square?
- What simpler ways can you use to find the dates in the square?

For example

- *Method 1*: add any four numbers that are in a square
 - *Method 2*: divide the number assigned by four and then subtract 4 to find the first date in the square.
- Students will be further asked to find out how these steps work and why.

LESSON 11 ○ ALGEBRAIC EXPRESSIONS

GRADE LEVEL: Grade 6

DURATION: 1 hour

SPECIFIC OBJECTIVES



By the end of the lesson, students should be able to:

- write algebraic expressions with two variables to express information in real-life problems
- substitute in algebraic expressions with up to two variables
- find replacements for variables that make number sentences true
- generate calculations involving the four operations based on story problems

PREREQUISITE KNOWLEDGE

Students should be able to:

- express simple sentences and word problems as algebraic expressions
- solve simple equations

MATERIALS/MANIPULATIVES

Two-sided number cards (cards with a different number on either side), 8 small containers, counters and code sheet prepared by teacher

CONTENT OUTLINE

Algebraic expressions can be used to describe the relationship between two quantities. If the value of a quantity is not known or varies, a variable is used in its place.

PROCEDURE

Mental/Oral Starters

Place students in groups. Give each group a 2-sided number card (showing, for example, 5 and 9). Tell students that many possible operations link the two numbers on the number card. Challenge them to write at least 5 equations that relate the numbers on both sides of the card. For example, with a card with 5 on the front and 9 on the back, the following are 4 possible equations:

- $2x - 1 = 9$ $[x = 5]$
- $x + 4 = 9$ $[x = 5]$
- $x - 4 = 5$ $[x = 9]$
- $(x - 1) \div 2 = 4$ $[x = 9]$

Main Activity

Divide the class into groups of 3 or 4. Instruct each group to select a recorder to keep an account of the events beginning in Step 6. Distribute 8 containers and 80 counters to each group.

1. Each group is assigned a different letter of the alphabet and each of the group's 8 containers is labelled with the lowercase form of that letter.
2. Each group chooses a "secret number" between one and ten and informs the teacher of its choice. The teacher keeps a record of all secret numbers on the code sheet.
3. Have each group place the secret number of counters in each of its eight containers.
4. Each group will now have 8 containers, each of which contains the same number of counters and the same letter of the alphabet. Discuss ways to express the total number of counters in all 8 containers. For example:

$$m + m + m + m + m + m + m + m$$

or

$$x + x + x + x + x + x + x + x$$

Build on that idea: $8m$ or $8x$ (algebraic expression)

5. Have each group exchange some containers with one other group. Exchanging groups negotiate how many containers to exchange. For example, 3 m 's are exchanged for 3 x 's. Each group records its holdings in the following manner:

$$m + m + m + m + m + x + x + x \text{ or } 5m + 3x$$

and

$$x + x + x + x + x + m + m + m \text{ or } 5x + 3m$$

(algebraic expressions)

6. Each group informs the teacher of its new way(s) of representing the eight containers. The teacher checks his or her code sheet to tell the group the total number of counters in the eight containers the group now has. For example, the teacher who knows the values for the m and x will supply the group with the total value for this new expression. The first group has $5m + 3x$ counters; the teacher tells them they have 22 counters.
7. Present the new information collected in algebraic form(s). Discuss, if necessary, how to write an equation to express the total number of counters. For example, $5m + 3x = 22$.
8. Each group substitutes for the letter that represents its variable and solves for the other group's variable in the algebraic equation it has developed.

9. Groups continue to trade until they have discovered each group's secret number. Encourage students to keep solutions within their group so each group can make its own discoveries independently.
10. Groups now open their containers to reveal secret numbers for verification of solutions.

PLENARY

A member from each group will share the group's experiences, elaborating on how they were able to determine the variable of one of the other groups.

ASSESSMENT

Students are assessed through informal observation and formal written **Evaluation** Worksheet, to see if they were able to develop equations or expressions from self-created story problems and solve them. For example,

*Mary had 2 packs of **red** pencils and 5 packs of **blue** pencils. In all she has 29 pencils. If there are 3 pencils in the **blue** pack, how many pencils are in the **red** pack?*

