Education Reform Unit

Eastern Caribbean Education Reform Unit Project
(ECERP)

Curriculum Harmonization

MATHEMATICS

***

KINDERGARTEN

Anguilla | Antigua & Barbuda | British Virgin Islands
Dominica | Grenada | Montserrat
St. Kitts & Nevis | St. Lucia | St. Vincent & the Grenadines

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PREFACE

The development of learning outcomes for the core curriculum in OECS primary schools is an essential part of the harmonization of OECS educational systems. The curriculum harmonization process commenced with discussions between the OECS Education Reform Unit (OERU) and educational personnel in all member countries (See *Eastern Caribbean Education Reform Project: Initiative on curriculum and remediation – Design Mission report*, *February 1998*). Subsequent to the preparation of the report curriculum officers, teacher educators and evaluation officers, in a sub-regional workshop in Antigua and Barbuda, developed basic principles for mathematics in the primary school. All mathematics curricula from member countries were examined during the workshop. *The Report of proceedings: sub-regional curriculum and remedial planning workshop held on October 25-30, 1998* presents a full account of the decisions taken at the workshop.

During the years following the Antigua workshop a core team of curriculum officers and teacher educators, together with groups of teachers and principals from most member countries, contributed to the development and refinement of the outcomes. The purpose of using these learning outcomes is to ensure that all children in OECS primary schools attain an acceptable level of knowledge, skills and attitude associated with mathematics. Each member country retains the right and responsibility for integrating these outcomes into the national mathematics curriculum. As usual teachers will continue to use their initiative and resourcefulness in the implementation of the primary mathematics programme.

The OERU is extremely grateful for the contribution made by all persons and institutions that have been involved in this developmental exercise. First, OERU expresses thanks to the Canadian International Development Agency (CIDA) for the interest shown and the funding provided for the reform programme. The Ministries and Departments of Education have contributed resource personnel, accommodation, refreshment, ground transportation, and some materials for workshops. Most importantly, however, has been the high level of cooperation and commitment to the reform effort displayed by both the administrative and professional arms of Ministries of Education.

The following mathematics professionals have made significant contribution over the period of development.

Country	Participant	Designation
Anguilla	Mrs. Rosena Brooks Ms. Alison Hughes Mrs. Josephine Hodge Mrs. Yolande Richardson Mrs. Hyacinth Hughes	Education Officer, Curriculum Curriculum Officer, Mathematics Education Officer Former Chief Education Officer Principal, Valley Primary School
Antigua and Barbuda	Ms. Caron Weston Mr. Conrad Clarke Mr. Michael Francis Mr. Conrad Powell-Clarke	Curriculum Officer, Mathematics Former Lecturer, Antigua State College
British Virgin Islands	Ms. Beverlie Brathwaite	Education Officer, Mathematics
Dominica	Mr. Nicholas Goldberg Mr. Simon Sharplis Ms. Roseanne Lander Mr. Rupert Lance	Senior Education Officer Curriculum Officer, Mathematics Former Lecturer, Dominica State College
Grenada	Mr. Dennis Bell Mrs. Jean Brizan Mr. Cecil Johnson	Curriculum Officer, Mathematics Senior Education Officer, Curriculum Lecturer, Mathematics, T. A. Marryshow, Community College
Montserrat	Mrs. Rosamunde Meade Ms. Yasmin White	Former Education Officer Education Officer, Curriculum and Exams
St. Kitts and Nevis	Dr. Ruth Thomas Mr. Calwyn Morton Ms. Hazel Riley	Director of Curriculum Curriculum Officer, Mathematics Lecturer, Clarence Fitzroy College
St. Lucia	Mrs. Leonise Francois Mr. Joseph Serieux Mrs. Clermina James Dr. Cheryl Campbell	Former Curriculum Head Curriculum Officer, Mathematics Lecturer, Sir Arthur Lewis Community College
St. Vincent and the Grenadines	Mrs. Jacqueline Glasgow-Browne Mrs. Sylvia Jack Dr. Sandra Trotman Miss Yvonne Gaines Miss Zilta James	Curriculum Officer, Mathematics Former Senior Education Officer, Curriculum Former Teacher, Secondary School

The actual planning and subsequent developmental process for the learning outcomes and Teachers' Guide became the responsibility of Mrs. Sonia Severin, Senior Lecturer at Sir Arthur Lewis Community College, St. Lucia to whom the OERU is very grateful.

Mrs. Lorna Callender, former Head of OERU, and Ms. Candia Alleyne, former Head of OERU, have supported the project organizationally and morally; Mr. Johnson Cenac, ECERP Officer, and other members of the administrative and professional staff have made significant contribution in various ways and at various times throughout the development of this work. Special thanks should go to Ms. Cleotha Randolph, Ms. Suzette Merrill, Ms. Zena Hippolyte, Ms. Deborah Alphonse, and Ms. Emma McFarlane, Administrative Professionals, who have been responsible for preparation for the workshops and in refining most of the documents in relation to this initiative.

The OERU hopes that principals and teachers will continue to play their roles in making the outcomes come to life in classrooms throughout the OECS. The commitment and effort will surely contribute to the enhancement of knowledge, and skills and the development of positive attitude towards language in our children.

Henry Hinds, Head
September 2007

INTRODUCTION

This curriculum guide provides information on the focus of mathematics teaching and learning at the Kindergarten level. The document includes a brief rationale for the mathematics curriculum at the primary level, the learning outcomes to be developed at the Kindergarten level, some suggestions for teaching/learning activities and assessment strategies. Also included are the attainment criteria for this grade level and an Appendix.

The learning outcomes, suggested activities and strategies have been specified in the five main content areas of Statistics, Geometry, Measurement, Number Concepts, and Computation. The outcomes for each content area have been organized according to specific topics. Some sets of outcomes also contain general outcomes. These general outcomes are not related to any one specific topic. They have been identified as general outcomes, because they should be developed and reinforced as students engage in activities related to the outcomes for the various topics.

The teaching/learning activities and assessment strategies are suggestions. Teachers are encouraged to augment and further develop these suggestions to meet the needs of the students in their classrooms.

The attainment criteria provide a means of monitoring students' progress in developing the knowledge, skills, and processes outlined in the learning outcomes. They may also be used as basis for organizing teaching/learning experiences.

The Appendix provides an overview of the mathematics curriculum at the primary level. It contains a set of tables that outline the aims of mathematics teaching and learning for the primary level and indicate how these aims have been developed across the grade levels, Kindergarten to Grade 6.

The list of persons who participated in various ways in the development of this curriculum is also included in the Appendix. The contribution of these persons is greatly appreciated. Special thanks are also extended to the many principals and teachers who provided feedback on the drafts of the document and who participated in the pilot implementation process.

Sonia Severin
Consultant

RATIONALE

Participants at the 1998 Sub-Regional Workshop on harmonization of the mathematics curriculum in the Organization of Eastern Caribbean States (OECS) began the process of developing this curriculum guide. The discussions and outcomes of the Workshop indicated that, essentially, the aim of the mathematics curriculum should be the development of mathematically powerful individuals "who understand[s] and can confidently use mathematical concepts and principles across disciplines and in everyday life" (OECS Education Reform Unit (OERU), 1998, p. 33). Additionally, they recommended that the curriculum should enable these individuals to be critical thinkers and problem solvers who enjoy the challenges of mathematics and readily pursue solutions to problems. If the mathematics curriculum is to achieve this aim, it should of necessity focus, from the outset, on the attributes and behaviours that describe this individual.

Analysis of the characteristics of the mathematically powerful individual, as well as descriptions of an appropriate learning environment (also developed at the 1998 workshop), provides an indication of these attributes. The descriptions suggest that students should have developed and be able to apply:

- knowledge of mathematical concepts and procedures
- knowledge of mathematical relationships
- problem solving skills
- reasoning skills
- language and communication skills

The curriculum outlined in this document therefore focuses on these emphases. However, it is guided by particular interpretations of the emphases.

A focus on the development and use of mathematical concepts and procedures begs the question of what is relevant and appropriate mathematics for the primary school student. A response to this question may be obtained by considering the nature of mathematics. Mathematics may be perceived as an art or a way of thinking (Reys, Suydam, & Lindquist, 1984). These descriptions relate to the fact that mathematics is also characterized as a study of patterns and order (Mathematical Sciences Education Board, 1989). Additionally, mathematics is also described as a social activity. It is shaped by our observation and analyses of real world objects and phenomena (Borasi, 1998). Yet another portrayal of mathematics depicts it as a subject that consists of several facts, skills, concepts, and general procedures or processes (Department of Education & Science (DES), 1987; National Council of Teachers of Mathematics [NCTM], 1989, 2000). These descriptions of mathematics imply that students at the primary level should be provided with opportunities to develop mathematical ideas, skills, and processes through investigations that involve interaction with each other and their teacher.

Consistent with the recommendations coming out of the 1998 sub-regional workshop, the mathematical ideas have been organized into five strands or content areas:

- Statistics/Data Management
- Geometry
- Measurement
- Number Concepts, and
- Computation.

With this curriculum, young children's exposure to mathematics therefore begins with an exploration of ways of processing information, basic number work, pre-measurement ideas, and the geometrical shapes that they see around them. As they mature and move through the grades, they move on to more in-depth analysis of the mathematical ideas and procedures. At each grade, there is a focus on ensuring that students develop an understanding of the nature of the subject and what it means to know and do mathematics. Some general elements of the curriculum are as follows:

- An important aspect of the mathematics curriculum is the development of an understanding of, and ability to use, general procedures or strategies that are an integral part of doing mathematics. These procedures include problem solving and logical reasoning, and they are the means through which the students learn about mathematical facts, concepts and skills.

- The facts are related to terms, such as names for numbers or shapes, and qualities such as odd, symmetrical. Additionally, there is attention to notations and their meaning. Some examples are numerals, signs for operations, and number statements. Also included in this category are rules or generalizations, formulae, and conventions (e.g., ways of recording measurements in the metric system).

- The focus on concepts includes the development of an understanding of the meanings associated with a range of concepts as well as the relationships that exist among them.

- There is an emphasis on developing competency in a variety of skills. These skills include calculating or performing basic operations, representing, classifying, estimating, measuring, observing, comparing, inferring, and sequencing (Hatfield, Edwards & Bitter, 1999; James, 1995). Moreover, with the increased influence of technology, sensible use of a calculator, at the very least, is considered an important skill (OERU, 1998).

- Attention is also given to the development of several personal qualities related to work habits and attitudes towards mathematics. The description of the mathematically powerful child identifies persistence as a desirable work habit. Other important work habits are:
    - ✓ The willingness and ability to work independently or co-operatively as part of a group, when necessary;
    - ✓ A tendency to work in a systematic manner, carrying out and reviewing tasks to ensure that the most appropriate steps are used to complete the task;

- ✓ A willingness to try several approaches to a task and to consider an idea from several perspectives (NCTM, 2000).

A focus on desirable work habits is one step towards enhancing students' attitude to mathematics, given that in developing these habits they are likely to experience success in mathematics (Sheffield & Cruishank, 2000). The development of a positive attitude towards mathematics focuses on ensuring that students acquire:

- ✓ A fascination with the subject;
- ✓ An interest in doing the subject;
- ✓ An appreciation for the purposes and relevance of the mathematics that is studied;
- ✓ Confidence in their ability to do the subject (NCTM, 2000; OERU. 1998).

The development of these elements of mathematics can be facilitated by appropriate experiences that emphasize problem solving, logical reasoning, making connections in mathematics, and communication.

Problem solving is one means through which students can generate new knowledge. Interpretations of problem solving have for the most part focused on its role in the application of mathematical concepts and procedures. Schroeder and Lester (1989) refer to this interpretation as 'teaching for problem solving'. In this scenario, students are taught a concept or skill and then are required to use it to solve several problems. According to Schroeder and Lester, this interpretation represents a limited perspective of problem solving. Two other interpretations are also important and should be included in mathematics programmes. These are:

- *Teaching about problem solving*. Students are taught a general procedure, consisting of several steps, for solving problems. One example of such a procedure is Polya's (1973) four steps
  - ✓ Analyze the problem
  - ✓ Identify and select possible strategies
  - ✓ Implement the strategies
  - ✓ Check the solution.

  Students may also be taught a number of problem solving strategies such as draw a diagram or solve a simpler problem.

- *Teaching via problem solving*. In this situation, problems are viewed as a means of developing concepts and skills. Thus, the introduction to a concept may involve analysis of a problem situation. The concept is developed through the search for a solution to that problem.

- Inclusion of the three approaches to problem solving implies that problem solving should not be viewed as an add-on. Thus, it is integrated throughout the mathematics curriculum, with problem solving taking place during and after the development of concepts and skills.

- Students develop mathematical competence and positive personal qualities through activities that allow them to examine and restructure their knowledge (Hatfield, Edwards, & Bitter, 1999; Ishii, 2003; James, 1995; Reys, Suydam, & Lindquist, 1984; van de Walle, 2004). Attention to reasoning skills is therefore important. This emphasis necessitates a classroom atmosphere in which teachers and students explore the 'how' and 'why' of mathematics. Thus, while there is an emphasis in the curriculum on doing and learning mathematics through actions such as calculating and solving, there is also an infusion of experiences that involve justifying, representing, predicting, and testing predictions.

The development and use of reasoning skills should also involve an analysis of how mathematics is organized. Curricula that focus on mathematical relationships reflect the notion that mathematics is a coherent body of knowledge and skills. Connections can be developed, and in this curriculum have been made, between/among

- Mathematical concepts or topics;
- Concepts and procedures - for example, the concept of place value and the regrouping process;
- Modes of representing mathematics - for example, concrete, pictorial, and symbolic representations;
- Mathematics and other subjects - for example, the use of statistical procedures in Mathematics, Science and Social Studies;
- Mathematics and everyday activities.

By focusing on these types of interrelationships, students are more likely to develop a thorough understanding of mathematical facts, concepts, skills and procedures and how they might be applied in a variety of situations. Moreover, this focus will allow them to see the relevance of what they are learning. Significantly, these benefits could positively affect the students' attitude to mathematics.

Development of students' reasoning skills suggests a concurrent emphasis on communication, as it is through language and communication that we formulate our ideas and make our reasoning known. Communication within the mathematics classroom involves reading, writing about, listening to, and discussing mathematics (NCTM, 1989, 2000). It also requires attention to ways in which mathematical ideas can be represented. Therefore, students have been provided with opportunities to:

- read about mathematical ideas, for example, in their textbook, workbook, storybook, or on classroom charts;
- represent mathematical ideas in writing using pictures, diagrams, graphs, words, and symbols;
- participate in discussions, listening to and contributing ideas as necessary.

The discussion of mathematical ideas requires that students be able to explain their understanding of concepts and procedures. Indeed, the significance of an emphasis on communication lies in the fact that it compels students to select aspects of their mathematical knowledge that are important for conveying information in a given

situation and those that are not (Sheffield & Cruishank, 2000). Therefore, students should not only know the various concepts and procedures, they should also be able to identify the contexts in which they are useful.

This communicative emphasis can therefore provide cognitive benefits for students. It can encourage them to reflect on their understandings. It can also help them to regulate their knowledge, in that difficulties in formulating the language to describe a situation may lead them to analyze and modify their understanding and thus, to develop new knowledge (Lappan & Schram, 1989). It also provides opportunities for teachers to assess students' learning and to use the feedback to organize experiences to facilitate further learning.

The question of whether these emphases can effect improvements in students' learning of mathematics is a critical consideration. Apparently, they hold the potential to do so. By incorporating these emphases into the curriculum, students are likely to:

- Learn mathematics meaningfully and therefore, acquire a greater understanding of concepts and procedures;
- Remember and be able to use mathematical concepts, skills, and procedures effectively. If they forget, the focus on interrelationships and problem solving will allow them to derive the relevant information for themselves.
- Recognize the relevance of mathematics to their lives. In so doing, it is likely that they would develop positive attitudes towards the subject.

  (Barb & Quinn, 1997; Grant & Searl, 1997; Ishii, 2003; Reys, Suydam, & Lindquist, 1984)

The range of outcomes and the teaching/learning and assessment strategies included in this guide provide relevant guidelines.

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STATISTICS/DATA MANAGEMENT

Topics	*Learning Outcomes* *By the end of Kindergarten, students should be able to:*
General Readiness	1. Classify objects according to selected attributes, e.g., size, colour, shape, texture, sound, etc.
Data Collection Collecting data through looking Determining frequency	2. Collect simple sets of data in the class and school environment, using observation. 3. Describe the results of classification and data collection activities. 4. Use counting to determine the number of objects in a group.
Data Representation Recording data using words and objects	5. Use simple statements to record and represent data, e.g., 'John has four marbles'. 6. Represent data graphically using objects, e.g., picture cut-outs, blocks.
Data Interpretation Use of comparative terms related to quantity	7. Compare data using phrases such as 'more than', 'less than', 'one more than', 'the same as', the most, etc.

Materials	***Teaching/Learning Activities***	***Assessment Strategies***
Household objects Toys School Supplies Objects and persons in the classroom Manipulatives such as shells, large buttons, blocks Cut-outs that represent the objects observed	*The students can:* Use their sense of sight, touch, and/or hearing to help them sort objects into groups. Talk about the groups; e.g., how the objects in each group are alike, how the groups are different. Play games such as 'I Spy' to develop their observational skills. Search for information by looking at the objects and persons in their classroom in order to answer questions such as the following: How many yellow, blue and red pencils are in the classroom? How many persons have black lunch bags? blue lunch bags? Represent the results of their searches by grouping the objects. Talk about their groups; e.g., which groups have many/a lot of objects; which groups have few objects, which groups have the most objects; which groups have four objects, five objects, etc. Describe their groups using number sentences. E.g., 'There are 4 red pencils in the classroom.' Present the results of their data collection activities by arranging the objects in rows or columns. Use the arranged objects to compare the number of objects in the groups. Respond to problems that focus on how cut-outs can be used to show the information they collected. E.g., the students can provide answers to problems such as the following: 'We collected data on the number of red, yellow pencils in the class. Which cut-outs can we use to show the data on the chalkboard? How many cut-outs should we place on the chalkboard to show the number of red pencils?' Talk about the answers to the problem; decide which suggestions they will use. Use counting and/or one-to-one correspondence to find out how to compare the sets of data.	Practical tasks Observation Questioning Simple projects such as making a scrap book

GEOMETRY

Topics	*Learning Outcomes* *By the end of Kindergarten, students should be able to:*
General Readiness	1. Describe the attributes of objects using phrases such as round', 'straight', 'flat', 'curved', etc.
Three-dimensional shapes	2. Describe the attributes of three-dimensional shapes using phrases such as 'roll', 'slide', 'stack up', 'flat', 'round', 'curved', etc. 3. Classify three-dimensional shapes on the basis of their attributes, e.g., shape, size, type of surface, and function in real life. 4. Identify examples of three-dimensional shapes in real life. 5. Use three-dimensional shapes to make objects, e.g., a rocket, a house.
Plane Shapes Two-dimensional shapes	6. Describe the attributes of two-dimensional shapes. 7. Classify two-dimensional shapes on the basis of their attributes, e.g., shape and size. 8. Use cut-outs of two-dimensional shapes to make patterns and pictures. 9. Trace two-dimensional shapes. 10. Identify rectangles and circles by name.

Materials	***Teaching/Learning Activities***	***Assessment Strategies***
Household objects; e.g., cereal boxes, juice boxes, milk tins Toys Blocks	*The students can:* Listen to descriptions of objects and three-dimensional shapes. Describe what they observe about three-dimensional shapes that have been placed on their desks. Sort the shapes into groups. Talk about why they placed the shapes into the groups that they formed. Participate in show-and-tell activities where they describe a three-dimensional object they have brought from home. Carry out investigations to determine the attributes of the three- dimensional shapes. Examples of questions they can pursue: Which shapes can roll? Which shapes will always roll no matter how you place it down? Which shapes do not roll? Why? Look at a set of three-dimensional shapes, some of which are alike in some way, and select those shapes that do not belong to the set. Give reasons for their selection. Find an object used in real life that looks like a three-dimensional shape that they have been shown. Use blocks and/or household objects to form their favourite toy. Examine a set of two-dimensional shapes, same shape but different sizes, and talk about how they are alike. Examine sets of two-dimensional shapes and select those that are alike. Find a shape from among a set of two-dimensional shapes that looks like one that they have been shown.	Practical tasks Observation Questioning Simple Projects Class Journal: The students indicate the information/ entries to be placed in the journal; the teacher inserts the entries for the students. The journal can be prepared as a big book.

Topics	***Learning Outcomes*** ***By the end of Kindergarten, students should be able to:***
Spatial relationships	11. Describe the relative position of objects using relationships such as ‘above’, ‘below’, ‘in’, ‘on’, ‘outside’. ‘inside’, etc

Materials	***Teaching/ Learning Activities***	***Assessment Strategies***
	The students can: Sort sets of two-dimensional shapes according to given directions, e.g., objects that have the same shape; objects that have the same shape and same size; objects that have the same shape but different sizes. Select their favourite two-dimensional shapes, and trace them several times on paper. (You can then form cut-outs from these tracings) Use the cut-outs of their favourite shapes to form patterns. Talk about why they like their favourite two-dimensional shapes. Select a rectangle (or circle) from among a set of two-dimensional shapes placed on their desks, after having been shown an example of the rectangle (circle). Talk about how rectangles and circles are different. Talk about a set of objects which have been placed in different positions on top, under, and around a desk; e.g., tell where the book is, tell where the pencil is. Follow given directions to find a specific object; e.g., which object is inside the cup? Find the object that is on the book, which is under the desk.	

MEASUREMENT

Topic	*Learning Outcomes* *By the end of Kindergarten, students should be able to:*
<u>Linear Measurement</u> Vocabulary for length, height, distance	*:* 1. Describe the lengths of objects using phrases such as 'short', 'long', 'wide', etc. 2. Compare lengths of objects using phrases such as 'longer than', 'shorter than', 'wider than', etc. 3. Describe heights of objects using phrases such as 'tall', 'short'. 4. Compare the heights of objects using phrases such as 'taller than', 'shorter than', etc. 5. Describe distances using phrases such as 'short', 'long', 'far away', 'nearby', etc. 6. Compare distances using phrases such as 'shorter', 'longer', 'closer', 'further', etc.
<u>Measurement of mass</u>	7. Describe the mass of objects as heavy, light, very light, etc. 8. Compare the mass of objects, using phrases such as 'heavier than', 'lighter than', 'as heavy as', etc.

Materials	***Teaching/Learning Activities***	***Assessment Strategies***
Strips of paper Drinking straws Household objects e.g., combs, bottles, bottle caps, bowls, matchsticks, Popsicle sticks, clocks Objects in the Classroom Balance scales 1cent, 2 cent, and 5 cent coins Containers of different sizes and shapes	*The students can:* Identify objects that they think are long (short, wide, etc.) and state why they think the objects are long (short, wide, etc). Find objects in the classroom according to given directions; e.g., 'Find an object that is the same length as your pencil.' Compare their heights; find out who is the taller of two students. Talk about how they would find out which of two objects is longer or wider, and use their appropriate strategies to compare objects. Collect data on which persons in their group or class think that identified places in their school (e.g., the principal's office, the washroom etc) are far or nearby. Tell whether they live close to or far away from the school and give reasons for their answer. Hold an object that the teacher has identified as light (or heavy) and find another object that is just as light (or heavy). Hold an object and state whether it is heavy or light, and give reasons for their description of the object. Collect objects at home or in their class that are heavy, and objects that are light. Hold two objects, one in each hand, and decide which is heavier. Examine a balance scale to find out how it works. Use a balance scale to compare the mass of two objects.	Practical tasks Observation Questioning

Topics	*Learning Outcomes* *By the end of Kindergarten, students should be able to:*
Measurement of capacity	9. Describe the capacity of containers using phrases such as' holds a lot', 'holds a little', etc. 10. Compare the capacity of containers using phrases such as 'holds more than', 'holds the same as', etc.
Use of non-standard units	11. Estimate the length, mass, and capacity of objects using non-standard units. 12. Measure the length, mass, and capacity of objects using non-standard units. 13. Solve problems involving the estimation and measurement of length, mass, and capacity using non-standard units.

Materials	***Teaching/ Learning Activities***	***Assessment Strategies***
Charts Large and small clocks Sets of 1cent, 2 cents and 5 cents coins Empty or used household objects for a class shop Calendars	*The students can:* Observe containers that are filled with water, and describe their capacity by stating whether the containers hold a large amount or a small amount of water. Compare the capacity of two containers by filling one of the containers with water and pouring it into the other. Use parts of their body, e.g., hand span, foot span, stride, etc., to measure the lengths of objects. Use objects, such as matchsticks, Popsicle sticks, strips of paper of the same length, to measure objects. Carry out practical activities to find answers to questions such as the following: 'How many bottle caps of water will fill the cup?' 'How many bottles of water will the bowl hold?' Use a balance scale and bundles of objects, e.g. Popsicle sticks, coins, as units of measure to find the mass of objects. Guess the linear measure (mass, capacity) of an object before they measure it; then, after they have measured the object, check whether their measurement was larger or smaller than their guess. Talk about activities that they did at various points in time (e.g., today, yesterday) using appropriate vocabulary. Talk about, and keep a class record, of activities they engage in on particular days of the week. Help their teacher keep track of the days of the week by indicating the name of the day that should be written on the chalkboard each morning.	Practical tasks Observation Written exercises Simple projects, e.g., a bulletin board display

Topics	*Learning Outcomes* *By the end of Kindergarten, students should be able to:*
<u>Time</u> Vocabulary Days of the week Months of the year Time on the hour	14. Use time vocabulary appropriately: e.g., today, yesterday, tomorrow, morning, afternoon, etc. 15. Name the days of the week. 16. Identify the current day, 'Today is …'. 17. Identify the day corresponding to tomorrow or yesterday given the current day. 18. Identify the current month. 19. State the month in which they were born. 20. Tell time on the hour. 21. Represent time on the hour on a real or model clock. 22. Represent the time for events that occur on the hour, using a real or model clock.
<u>Money</u> Features of coins Representation of money	23. Describe the 1-cent, 2-cent, and 5-cent coins. 24. Identify the 1-cent, 2-cent, and 5-cent coins. 25. Represent 2 cents and 5 cents in different ways, using coins and drawings. 26. Find the total value of a set of coins up to a total of 5 cents.

Materials	*Teaching/Learning Activities*	*Assessment Strategies*
	The students can: Keep a chart that records the name of the current day, the name of the previous day/yesterday, and the name of the following day/tomorrow, and change the names daily. Observe and talk about the parts of a clock: the clock face, the length of the hands, how the hands move, etc. Observe a demonstration of times on the hour being represented on a clock and talk about the positions of the hands. Identify events in their lives that occur on the hour (e.g., lunch time at school) and represent these times on a clock. Sort a set of 1-cent, 2-cent, and 5-cent coins into groups. Talk about how the coins in one group are alike. Compare the coins in the groups and talk about how the coins in the various are different. Use counting to represent 2 cents and 5 cents as a set of 1-cent coins. Use counting to find the total value of a set of coins. Play shop where they purchase items that cost no more than 5 cents. Identify the coins they can use to purchase the items in the shop.	

NUMBER CONCEPTS

Topic	*Learning Outcomes* *By the end of Kindergarten, students should be able to:*
<u>General Readiness</u>	1. Classify objects into sets, according to shape, size, colour, texture, sound, etc. 2. Describe a set of objects using phrases such as ‘large’, ‘small’, ‘many’, ‘few’, etc.
<u>Counting</u> Counting forwards, Backwards Ordinal numbers	3. Count in sequence up to 50. 4. Count backwards from 10. 5. Count the number of objects in a set of up to 12 objects. 6. Solve problems related to counting operations. 7. Identify the position of an object in an ordinal arrangement of up to 5 objects.

Materials	***Teaching/Learning Activities***	***Assessment Strategies***
	The students can:	
Blocks Paper cut-outs of household objects Numeral cards Numeral cut-outs Numeral cut-outs made out of cardboard painted with glue then covered with sand Calculators	Select, from a set of objects, an object that looks like one they have been shown. Select an object, which has the same attributes as an object that they have been shown. Duplicate a pattern, that is, arrange a set of objects in the same way that they are in a given arrangement. Sort a set of objects into groups according to given directions. Talk about the groups they make in their sorting activities; e.g., whether the groups are large, small, have many or few items. Match the objects in one set with those in another; e.g., match a set of spoons with a set of bowls. Answer questions based on the matching; e.g., 'Was there a spoon for each bowl?' 'Were there more (fewer) spoons than bowls?' Count objects by touching each object in turn. Sing/recite counting and number rhymes. Talk about situations (e.g., playing games) where they use words such as first, second, etc. Act out those situations. Arrange a set of students in a line by giving directions as to who is to be first in line, second, etc. Talk about how they would find out which object in an arrangement is first, second, etc. Trace their fingers over numerals cut out of Bristol board. Trace their finger over numeral cut-outs made with sand. Use their pencil to trace over numerals that have been written with dotted lines. Identify numerals that they have traced by name.	Practical tasks Observation Questioning Written exercises Simple projects

Topic	*Learning Outcomes* *By the end of Kindergarten, students should be able to:*
<u>Whole Numbers</u> Representation of numbers Making and comparing sets	8. Read and identify the numerals 0 to 12. 9. Write the correct numeral to indicate the number of objects in a set. 10. Write numbers from zero to twelve in words. 11. Make sets of up to 12 objects. 12. Identify sets that are equal in number but arranged differently. 13. Draw a variety of arrangements to represent a set of a given size. 14. Make a set that has the same number of objects as a given set. 15. Make a set that has one more object than a given set. 16. Compare the number of objects in two sets, using 1-1 correspondence. 17. Compare the number of objects in sets of up to 12 objects, using phrases such as ‘same number as’, ‘equal to’, ‘more than’, ‘less than’, ‘one more than’, etc. 18. Compare the number of objects in two sets with up to 12 objects, using the symbols ‘=’ and ‘>’.
<u>Introduction to the calculator</u>	19. Describe physical features of a simple calculator, e.g., the keys, the display area. 20. Use calculators to investigate counting operations.

Materials	*Teaching/Learning activities*	*Assessment Strategies*
	The students can: Make sets of up to 12 objects with a variety of objects. Arrange a set of 2 objects (or 3, or 4, or 5, or 6 objects, etc.) in as many ways as they can. Draw these arrangements on paper. Count the number of objects in each arrangement. Form sets by placing the number of objects in an envelope/box to correspond with the numeral written on the envelope/box. Use 1-1 correspondence or counting to make a set that has the same number of objects as another set. Show that these sets are equal by using the equal sign. Make two equal sets. Add one object to one of the sets. Compare the two sets to determine which set has more objects and how many more objects this set has than the other. Represent a set that has one more object than a given set in pictorial form. Show the relationship between the number of objects in these sets by using the '>' sign. Use counting to help them state/write a statement to compare a set that has one more object than a given set; e.g., 1 more than 7 is 8. Carry out similar activities involving sets that have one less object than a given set. Explore their calculator. Talk about what they observe; e.g., how to turn the calculator on and off, what happens when they press a key, what happens when they press several number keys in succession. Play with their calculators to determine how the calculator counts. Use the calculator to count.	

COMPUTATION

Topic	*Learning Outcomes* *By the end of Kindergarten, students should be able to:*
<u>Addition</u>	1. Combine two sets of objects, and count the number of objects in the resulting set, totals up to nine.
Vocabulary	2. Describe the set obtained from combining two sets of objects using phrases such as 'larger', 'has more than', etc.
Representation of addition	3. Use objects to add two numbers, totals up to nine.
	4. Use pictorial representations to add two numbers, totals up to nine.
	5. Write number sentences to represent addition.
	6. Create and solve problems involving addition.
	7. Separate a set of objects by taking away a given quantity of objects.
	8. Describe the resulting set obtained after the separation of a set, using phrases such as 'has less than'
<u>Subtraction</u> Vocabulary	9. Use objects to subtract one number from another, with both numbers being less than or equal to nine.
Representation of Subtraction	10. Use pictorial representations to subtract one number from another, with both numbers being less than or equal to nine.
	11. Write number sentences to represent subtraction.
	12. Identify situations in their everyday activities (e.g., sharing sweets) where they use subtraction.
	13. Create and solve simple problems involving subtraction.
<u>Use of the Calculator</u>	14. Identify the keys for addition and subtraction on their calculators.
	15. Explain how to use the calculator to add or subtract two numbers.

Materials	***Teaching/Learning Activities***	***Assessment Strategies***
	The students can:	
Manipulatives such as shells, stones, buttons, etc. Numeral cards: cards with a numeral (1 to 9) Cards with pictures depicting addition situations Cards with pictures depicting subtraction situations Large number line that can be placed on the floor Calculators	Talk about situations in their everyday activities (e.g., games) where they use addition. Act out problems that involve addition. Follow directions to carry out addition. E.g., 'Show me 3 buttons. Now show me another 2 buttons. How many buttons are there in all?' Talk about whether the combined set has more or fewer objects than the initial sets. Draw pictures to represent incomplete number statements, e.g., 3 and 5 = ?, and write the answer to complete the statement. Talk about situations in their everyday activities (e.g., sharing sweets) where they use subtraction. Act out problems that involve subtraction. E.g., 'I have six pencils. If I give Maria three pencils, how many pencils will I be left with?' Talk about how they can use pictures/diagrams to show the solutions to the problems. Follow directions to carry out subtraction situations. E.g., '7 balloons take away 4 balloons = ____ balloons?' Talk about whether the combined set has more or fewer objects than the initial sets. Use objects to develop a family of number statements for a given number; e.g., the family for 7 would include 3 and 4, 5 and 2, 6 and 1, 9 take away 2, 8 take away 1 etc. Draw diagrams to solve problems that involve addition or subtraction. Write number sentences to show their answers.	Practical tasks Observation Questioning Written exercises

Materials	*Teaching/Learning Activities*	*Assessment Strategies*
	The students can: Play matching card games. E.g., matching a card with a pictorial representation of an addition statement (or a subtraction statement) with a card that has the numeral corresponding to the answer. Make jumps on a large number line to correspond to incomplete addition (or subtraction) statements, and state the answer that completes the statement. Find the key on their calculator that corresponds to +. Explore how to use the key to find answers to addition statements. Explore how to use their calculator to carry out subtraction. Work in pairs; one student uses a calculator to solve an addition (or subtraction) problem; the other uses objects or pictorial representations. They then compare their answers. Make up and tell stories that involve addition or subtraction.	

ATTAINMENT CRITERIA

The attainment criteria outline the mathematical competencies expected of students at this grade level. The criteria move progressively from Level 1(basic competency) to Level 4. It is expected that at each attainment level, the students would also be able to apply the competencies to situations involving real-life experiences, other subjects, and other mathematical topics as appropriate and to carry out tasks involving problem solving, communication, and reasoning.

The criteria are as follows.

Statistics/Data Management

Level 1: Classify objects according to selected attributes and collect simple sets of data by observation.

Level 2: Classify objects according to selected attributes; collect simple sets of data by observation; determine, by counting, the number of objects in each set of data or classification; and describe the data collected.

Level 3: Classify objects according to selected attributes; collect simple sets of data by observation; determine, by counting, the number of objects in each set of data or classification; describe the data collected; and record the data using simple statements.

Level 4: Classify objects according to selected attributes; collect simple sets of data by observation; determine, by counting, the number of objects in each set of data or classification; describe the data collected; record the data using simple statements, picture cut-outs, and blocks; and compare data using comparative terms related to quantity.

Geometry

Level 1: Describe and classify objects and three-dimensional shapes according to their attributes.

Level 2: Describe and classify objects and three-dimensional shapes according to their attributes; identify examples of three-dimensional shapes in real life; and combine three-dimensional shapes to make objects.

Level 3: Describe and classify objects and three-dimensional shapes according to their attributes; identify examples of three-dimensional shapes in real life; combine three-dimensional shapes to make objects; describe and classify two-dimensional shapes according to their attributes; make patterns and pictures with cut-outs of two-dimensional shapes; and trace two-dimensional shapes.

Level 4: Describe and classify objects and three-dimensional shapes according to their attributes; identify examples of three-dimensional shapes in real life; combine three-dimensional shapes to make objects; describe and classify two-dimensional shapes according to their attributes; make patterns and pictures with cut-outs of two-dimensional shapes; trace two-dimensional shapes; identify rectangles and circles by name; and describe the relative position of objects using vocabulary related to spatial relations.

Measurement

Measurement – Length, mass, and capacity

Level 1: Use appropriate vocabulary to describe and compare measurements of length, mass, and capacity

Level 2: Use appropriate vocabulary to describe and compare measurements of length, mass, and capacity; and estimate and measure the length of objects using non-standard units.

Level 3: Use appropriate vocabulary to describe and compare measurements of length, mass, and capacity; and estimate and measure the length and mass of objects using non-standard units.

Level 4: Use appropriate vocabulary to describe and compare measurements of length, mass, and capacity; estimate and measure the length and mass of objects using non-standard units, and estimate and measure the capacity of containers using non-standard units.

Measurement – Time

Level 1: Use the vocabulary related to time appropriately.

Level 2: Use the vocabulary related to time; identify the current day; name the days of the week; and identify the day corresponding to 'tomorrow' or 'yesterday' given the current day.

Level 3: Use the vocabulary related to time; identify the current day; name the days of the week; identify the day corresponding to 'tomorrow' or 'yesterday' given the current day; identify the current month; and identify the month in which they were born.

Level 4: Use the vocabulary related to time; identify the current day; name the days of the week; identify the day corresponding to 'tomorrow' or 'yesterday' given the current day; identify the current month; identify the month in which they were born; tell time on the hour; and represent time on the hour using a real or model clock; and represent the time for events that occur on the hour on a real or model clock.

Measurement – Money

Level 1: Describe the 1-cent, 2-cent, and 5-cent coins.

Level 2: Describe the 1-cent, 2-cent, and 5-cent coins and identify the 1-cent, 2-cent, and 5-cent coins.

Level 3: Describe the 1-cent, 2-cent, and 5-cent coins; identify the 1-cent, 2-cent, and 5cent coins; and represent 2 cents and 5 cents in a variety of ways using coins and drawings.

Level 4: Describe the 1-cent, 2-cent, and 5-cent coins; identify the 1-cent, 2-cent, and 5-cent coins; represent 2 cents and 5 cents in a variety of ways using coins and drawings; and find the total value of a set of coins up to a total of five cents.

Number Concepts

Number Concepts – Counting

Level 1: Classify objects according to their attributes; describe a set of objects using vocabulary related to quantity; and count the number of objects in a set of up to 12 objects.

Level 2: Classify objects according to their attributes; describe a set of objects using vocabulary related to quantity; count the number of objects in a set of up to 12 objects; and count in sequence up to 50.

Level 3: Classify objects according to their attributes; describe a set of objects using vocabulary related to quantity; count the number of objects in a set of up to 12 objects; count in sequence up to 50; count backwards from 10; and describe the physical features of a calculator.

Level 4: Classify objects according to their attributes; describe a set of objects using vocabulary related to quantity; count the number of objects in a set of up to 12 objects; count in sequence up to 50; count backwards from 10; describe the physical features of a calculator; use a calculator to investigate counting operations; and identify the ordinal position of an object in an arrangement.

Number Concepts – Whole Numbers

Level 1: Make sets of up to 12 objects; read and identify the numerals 0 to 12; and write the numeral to indicate the number of objects in a set.

Level 2: Make sets of up to 12 objects; read and identify the numerals 0 to 12; write the numeral to indicate the number of objects in a set; identify sets that are equal in number but arranged differently; and draw a variety of arrangements to represent a set of a given size.

Level 3: Make sets of up to 12 objects; read and identify the numerals 0 to 12; write the numeral to indicate the number of objects in a set; identify sets that are equal in number but arranged differently; draw a variety of arrangements to represent a set of a given size; write the numbers from 0 to 12 in words; compare the number of objects in a set using 1 – 1 correspondence; and compare the number of objects in two sets using vocabulary related to comparisons.

Level 4: Make sets of up to 12 objects; read and identify the numerals 0 to 12; write the numeral to indicate the number of objects in a set; identify sets that are equal in number but arranged differently; draw a variety of arrangements to represent a set of a given size; write the numbers from 0 to 12 in words; compare the number of objects in a set using 1 – 1 correspondence; compare the number of objects in a set using vocabulary related to comparisons; make a set that has the same number as a given set; make a set that has one more object than a given set; and compare the number of objects in two sets with up to 12 objects using symbols.

Computation

Computation - Addition

Level 1: Combine two sets of objects; describe the set obtained from combining two sets using vocabulary related to quantity; and determine the number of objects in the combined set using counting.

Level 2: Combine two sets of objects; describe the set obtained from combining two sets using vocabulary related to quantity; determine the number of objects in the combined set using counting; use objects to add two numbers (totals up to nine); use pictorial representations to add two numbers (totals up to nine).

Level 3: Combine two sets of objects; describe the set obtained from combining two sets using vocabulary related to quantity; determine the number of objects in the combined set using counting; use objects to add two numbers (totals up to nine); use pictorial representations to add two numbers (totals up to nine); write number sentences to represent addition; and identify the keys for addition on their calculators.

Level 4: Combine two sets of objects; describe the set obtained from combining two sets using vocabulary related to quantity; determine the number of objects in the combined set using counting; use objects to add two numbers (totals up to nine); use pictorial representations to add two numbers (totals up to nine); write number sentences to represent addition; identify the keys for addition on their calculators; and explain how to use a calculator to add numbers.

Computation – Subtraction

Level 1: Separate a set of objects by taking away a given quantity; describe the resulting set obtained after separation of a set using vocabulary related to quantity; and determine the number of objects in the resulting set using counting.

Level 2: Separate a set of objects by taking away a given quantity; describe the resulting set obtained after separation of a set using vocabulary related to quantity; determine the number of objects in the resulting set using counting; use objects to subtract one number from another (both numbers less than nine); use pictorial representations to subtract one number from another (both numbers less than nine).

Level 3: Separate a set of objects by taking away a given quantity; describe the resulting set obtained after separation of a set using vocabulary related to quantity; determine the number of objects in the resulting set using counting; use objects to subtract one number from another (both numbers less than nine; use pictorial representations to subtract one number from another (both numbers less than nine); write number sentences to represent subtraction; and identify the keys for subtraction on their calculators.

Level 4: Separate a set of objects by taking away a given quantity; describe the resulting set obtained after separation of a set using vocabulary related to quantity; determine the number of objects in the resulting set using counting; use objects to subtract one number from another (both numbers less than nine); use pictorial representations to subtract one number from another (both numbers less than nine); write number sentences to represent subtraction; identify the keys for subtraction on their calculators; and explain how to use a calculator to subtract one number from another.

RECORD KEEPING

The following is an example of a checklist, which may be used as a means of monitoring a student's progress in attaining the competencies outlined in the criteria. The competencies are related to the area of Statistics/Data Management. Similar checklists may be prepared for each of the content strands by using the competencies listed in Level 4 to generate the items for the checklist.

For each of the competencies, place a tick (v) in the column headed 'Yes', if at the time of evaluation the student has acquired the knowledge and/or skills related to the competency. Otherwise, check 'No'.

Student's Name:		
Competencies	***Yes***	***No***
The student can: 1. Classify objects according to selected attributes. 2. Collect simple sets of data by observation. 3. Determine, by counting, the number of objects in each set of data or classification. 4. Describe the data collected. 5. Record the data using simple statements. 6. Compare data using comparative terms related to quantity.		

APPENDIX

Scope and Sequence Information

This section illustrates the scope and sequence of the specific learning outcomes in relation to the general exit outcomes for each strand. The tables identify the grade level at which concepts, skills, and processes related to each of the general exit outcomes are introduced and the grade levels at which they are further developed.

General Outcomes	***Grade Levels***						
	K	**1**	**2**	**3**	**4**	**5**	**6**
Statistics							
Discuss data collection methods	v	v	v	v	v	v	v
Collect data	v	v	v	v	v	v	v
Present data using pictographs, bar graphs and tables	v	v	v	v	v	v	v
Interpret graphs and tables	v	v	v	v	v	v	v
Discuss relationships among data collection methods		v	v	v	v	v	v
Choose appropriate methods to represent data			v	v	v	v	v
Apply statistics to other aspects of mathematics and other disciplines				v	v	v	v
Geometry							
Investigate attributes of three-dimensional shapes	v	v	v	v	v	v	v
Represent three-dimensional shapes	v	v	v	v	v	v	v
Investigate the attributes of two-dimensional shapes	v	v	v	v	v	v	v
Represent two-dimensional shapes	v	v	v	v	v	v	v
Demonstrate a sense of spatial awareness	v	v	v	v	v	v	v
Appreciate the aesthetic value of geometry	v	v	v	v	v	v	v
Measurement							
Appreciate the importance of measurement in every day life	v	v	v	v	v	v	v
Use correct measurement vocabulary/terminology	v	v	v	v	v	v	v
Identify standard units of measurement and their abbreviations	v	v	v	v	v	v	v
Identify and use measuring instruments	v	v	v	v	v	v	vv
Select appropriate units and instrument to measure an object	v	v	v	v	v	v	v
Estimate and measure attributes of an object	v	v	v	v	v	v	v
Describe relationships within each type of measurement		v	v	v	v	v	v
Convert from one unit to another						v	v
Perform basic operations using units of measurement	v	v	v	v	v	v	v

General Outcomes	*Grade Levels*						
	K	**1**	**2**	**3**	**4**	**5**	**6**
Number Concepts							
Relate number to the world of objects	v	v	v	v	v	v	v
Represent and interpret number in a variety of ways	v	v	v	v	v	v	v
Translate number names to numerals	v	v	v	v	v	v	v
Explain the properties of numbers	v	v	v	v	v	v	v
Explain the relationships that exist among the various types of numbers			v	v	v	v	v
Perform and explain algorithms accurately			v	v	v	v	v
Investigate and explain the various routes to an answer to a problem	v	v	v	v	v	v	v
Determine when it is appropriate to use a calculator, a pencil and paper strategy or a mental strategy to investigate number concepts	v	v	v	v	v	v	v
Computation							
Use the vocabulary associated with the four basic operations	v	v	v	v	v	v	v
Carry out addition, subtraction, multiplication, and division of whole numbers	v	v	v	v	v	v	v
Carry out addition, subtraction, multiplication, and division of fractions		v	v	v	v	v	v
Carry out addition, subtraction, multiplication, and division of decimals					v	v	v
Explain and use the relationships that exist among the four basic operations		v	v	v	v	v	v
Apply computations to real-life situations	v	v	v	v	v	v	v
Estimate the results of an operation	v	v	v	v	v	v	v
Determine the reasonableness of the answer obtained on carrying out an operation	v	v	v	v	v	v	v
Determine when it is appropriate to use a calculator, a pencil and paper strategy or a mental strategy to investigate number concepts	v	v	v	v	v	v	v

MATHEMATICS

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KINDERGARTEN

O.E.C.S. Education Reform Unit

Designed by Emma Mc Farlane & Beverly Pierre