Teacher's Guide
Mathematics

Primary Education Smart+
Prathomsuksa

4

Contents

Preface

Why we have to learn mathematics?

In the 21st century learning, mathematics plays an important role because mathematics help people to have creative reasoning and systematic thinking and enable people to analyze problems or situations considerably. As a result, they can predict, plan, decide and solve real-life problems appropriately, practically and efficiently. Mathematics is also a tool in the study of science, technology and other subjects which is a fundamental of human resource development. To develop the economy of the country to be equal to other countries, the study of mathematics is needed to continually update and develop according to the social and economic conditions while the knowledge of advanced science and technology has been progressing so fast in the globalized world.

Indicators and content of mathematics revised edition B.E. 2561 (A.D. 2018) according to the Basic Education Core Curriculum B.E. 2551 (A.D. 2008) encourages students to have the skills they need for learning in the 21st century: analytical thinking, critical thinking, creative thinking, problem solving, the use of technology and communication and collaboration. Consequently, learners will be aware of the changes of economy, society, culture and environment, they will be competitive and live with global community.

A successful mathematics education needs to prepare the learner to be ready for learning things and working after graduation or furthering their study at higher level, therefore schools should provide the appropriate learning according to learners' ability.

What is learned in mathematics?

Mathematics is divided into 3 strands, namely number and algebra, measurement and geometry, and statistics and probability.

✧ Number and Algebra

Learning about real number system, the properties of numbers, ratio, percentage, estimation, problem-solving involving numbers, applying real numbers in real life, patterns, the relation of function and set, logic, expressions, monomial, polynomial, equation, equation system, and inequality, graph, the interest and value of money, sequences and series and applying the knowledge of numbers and algebra in various situations.

✧ Measurement and Geometry

Learning about length, distance, weight, area, volume and capacity, money and time, measuring unit, estimation for measurement, trigonometric ratio, geometric figures and properties, visualization of geometric models, geometric theories, geometric transformation through translation, reflection and rotation, and applying the knowledge of measurement and geometry in various situations.

✧ Statistics and Probability

Learning about statistical enquiry, data collection, statistic calculation, presentation and interpretation of qualitative and quantitative data, the fundamental counting principle, probability, applying the knowledge of statistics and probability in explaining various situations as well as for facilitating decision-making in real life.

Strands and Learning Standards

Strand 1: Numbers and Algebra

Standard M.1.1: Understand various ways of numbers presentation, number system, number operations, the result of number operations and the properties of operations.

Standard M.1.2: Understand and analyze patterns, relations, function, sequences and series and application.

Standard M.1.3: Use expressions, equations and inequalities, explanation of relations or facilitating problem-solving as given.

Strand 2: Measurement and Geometry

Standard M.2.1: Understand the fundamental of measurement, measure and estimate the sizes of wanted objects and application.

Standard M.2.2: Understand and analyze geometric figures, the properties of geometric figures, the relationship between geometric figures and geometric theories, and application.

Strand 3: Statistics and Probability

Standard M.3.1: Understand the statistical process and use statistics knowledge to solve problems.

Standard M.3.2: Understand the fundamental counting principle, probability and application.

Mathematical Skills and Processes

Mathematical skills and processes are the ability of applying the knowledge in learning other subjects in order to gain the knowledge and apply it into daily life efficiently. Skills and processes in mathematics as mentioned above focus particularly on the essential ones that need to be developed in learners' abilities as followings:

1. **Problem-solving** is the ability to understand, analyze, plan and solve the problems, as well as choose the appropriate method by considering the reasoning and validity of the answers.

2. **Mathematical communication and representation** are the abilities to use mathematical language and symbols in communication, representation, summary and presentation accurately and clearly.

3. **Connection** is the ability to use the knowledge of mathematics as a tool in learning mathematics, other contents, other sciences and apply the knowledge in real life.

4. **Reasoning** is the ability to give reasons, provide and listen to the reasons to support or argue leading to the inferences underlined with the mathematical facts.

5. **Creative thinking** is the ability to enhance the previous concept that they have already known or create the new concepts to improve and develop the body of knowledge.

Learners' Quality of Grade 6 Students

✦ Read and write numbers and numbers in words of counting numbers, fractions, decimals not more than 3 decimal places, ratio, percentage, number sense, have number operation skills; addition, subtraction, multiplication and division, estimate results and apply the knowledge in various situations.

✦ Describe characteristics and properties of geometric figures, find the perimeters and areas of geometric figures, draw triangles, quadrilaterals and circles, find volume and capacity of rectangular prism and apply the knowledge in various situations.

✦ Represent data in a bar chart, use data from bar charts, pie charts, two-way tables and line graphs to explain various situations and make a decision.

Yearly Teaching Plan

Mathematics Prathomsuksa 4 (Grade 4)

12 chapters   180 hours

Learning areas	Time (hours)

1. Numbers Greater than 100,000
   • Reading and writing numbers greater than 100,000
   • Place value, digit value and using zero as a placeholder
   • Writing numbers in expanded form
   • Comparing and ordering numbers
   • Estimation
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2. Addition and Subtraction
   • Addition
   • Subtraction
   • Combined operations
   • Solving word problems
   • Creating word problems
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3. Multiplication
   • Properties of multiplication
   • Multiplying by 1-digit numbers
   • Multiplying by 2-digit numbers
   • Multiplying by 3-digit numbers
   • Solving multiplication word problems
   • Creating multiplication word problems
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4. Division
   • Division by 2-digit divisors
   • Solving division word problems
   • Creating division word problems
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5. Combined Operations • Combined operations • Using combined operations to solve word problems • Creating word problems involving combined operations	10
6. Fractions • Proper fractions, improper fractions and mixed numbers • Equivalent fractions • Comparing and ordering fractions • Operations involving fractions • Solving word problems involving fractions	20
7. Decimals • Writing and naming decimals • Place values and digit values of digits in decimals • Writing decimals in expanded form • Equivalent decimals • Comparing and ordering decimals • Operations involving decimals • Solving word problems involving addition and subtraction of decimals	18
8. Time • Relationship between units of time • Duration of time • Schedule (timetables) • Schedule (program) • Solving word problems involving time	15
9. Points, Lines, Line Segments, Rays and Planes • Points • Lines • Line segments • Rays • Planes	12

10. Angles • Types of angles • Measuring angles • Drawing angles	18
11. Rectangles • Types of rectangles • Drawing rectangles • Perimeter of a rectangle • Area of a rectangle • Solving word problems involving perimeter and area of rectangles	18
12. Bar Charts and Two-way Tables • Reading and drawing bar charts • Two-way tables	12

Note: The hours needed for each subtopic can be changed when necessary. The above allocated hours are just a suggestion. Total hours for this subject is as prescribed in the basic learning time structure, while the learners must attain the standard as prescribed in the learning standards and indicators.

Chapter 1 Numbers Greater than 100,000

Time: 14 hours

Strand 1: Numbers and Algebra

Standard M.1.1 (Numbers): Understand various ways of numbers presentation, number system, number operations, the result of number operations and the properties of operations.

Indicators:

M 1.1 Gr4/1   Read and write Hindu-Arabic, Thai numerals and numbers in words showing cardinal numbers exceeding 100,000.

M 1.1 Gr4/2   Compare and arrange sequence of cardinal numbers exceeding 100,000 from various situations.

Learning objectives:

Students will be taught to:

- Understand numbers greater than 100,000.
- Compare and order numbers greater than 100,000.

Competency:

- Communication skills
- Thinking skills

Start up:

- Assess the students' prior knowledge about numbers greater than 100,000 by asking what the students knew and what they want to know more about numbers greater than 100,000.

- Let student write all their prior knowledge in Part K column on page 1 and have students share what they know about numbers greater than 100,000. Then, let students write some questions which they want to know in Part W column on page 1.

Teaching/Learning activities:

1st – 3rd hours (Reading and writing numbers greater than 100,000)

1. Introduce numbers greater than 100,000 by asking the students:
    - Are there any numbers more than 100,000?
    - What number is ten times 100,000? How do we read and write it?

2. Demonstrate how to use a place value table.

3. Guide them to read and write hundreds, thousands, ten thousands, hundred thousands, millions, ten millions and hundred millions by using the examples on pages 2, 3 and 4 for further explanation.

4. Have some students to write a few numbers containing more than 6 digits with the numbers in words on the board. Then, ask the rest of the students to read those numbers altogether.

5. Have students try Practice on page 4 and discuss the answers with them.

6. Have students do Exercises A and B on page 3 of the Workbook as their homework.

4th – 5th hours (Place value, digit value and using zero as a placeholder)

1. Ask students to write a 7-digit number on their papers, then show and read it to their classmate.

2. Write a 7-digit number on the board and explain the place value of each digit and its digit value. Emphasize that a zero in a number has a place value. Zero is used as a placeholder in a number.

3. Explain further by using the examples on pages 5 and 6.

4. Get a few students to write numbers containing more than 6 digits and get the other students to state the place value of each digit in each number and its digit value.

5. Have students try Practice on page 6 and discuss the answers with them.

6. Have students do Exercises C and D on page 4 of the Workbook as their homework.

6th – 7th hours (Writing numbers in expanded form)

1. Use the example on page 7 to show how to write numbers greater than 100,000 in expanded form.

2. Have students try Practice on page 7 and discuss the answers with them.

3. Have students do Exercises E to G on pages 5 and 6 of the Workbook as their homework.

8th – 10th hours (Comparing and ordering numbers)

Comparing numbers

1. Write two numbers greater than 100,000 on the board and ask them the following questions:

   - Which one is the greater number? Which one is the smaller number?

   - How do you compare these numbers?

   - What are the symbols for comparison such as "greater than", "smaller than", "equal to" and "not equal to"?

2. Remind students of the signs of comparison and the terms used in comparison.

3. Use the examples on pages 8 and 9 to explain how to compare two numbers step by step.

Ordering numbers

1. Remind students of the meanings of ascending and descending.

2. Write three numbers greater than 100,000 on the board and ask students to arrange the three numbers in ascending and descending orders.

3. Use the examples on page 10 for further explanation.

4. Have students try Practice on page 11 and discuss the answers with them.

5. Have students do Exercises H to O on pages 6 to 9 of the Workbook as their homework.

11th – 13th hours (Estimation)

1. Introduce the concept of rounding numbers to students by giving them an example in real life situation. For example, ask them a question:

   - How many boys and girl are there in our classroom?

     They may answer the exact numbers, such as 22 boys and 28 girls, if they have already known the answers. Clearly say to students that there are about 20 boys and 30 girls in our classroom. So, there are about 50 students in our classroom. Now, show them how to round the numbers to the nearest ten.

2. Revise numbers with students. Write numbers containing more than 5 digits on the board. Ask students to read them out and write the numbers in words. Then, ask them to write the numbers in the expanded form.

3. Explain how to round off whole numbers to the nearest ten and hundred. When rounding off a number to the nearest ten, always refer to the digit in the ones place. When rounding off a number to the nearest hundred, always refer to the digit in the tens place.

4. Write a few numbers on the board and ask students to round the numbers to the nearest ten and hundred.

5. Guide them to round off whole numbers to the nearest thousand using the example on page 12. When rounding off a number to the nearest thousand, always refer to the digit in the hundreds place.

6. Write a few numbers on the board and ask students to round the numbers to the nearest thousand.

7. Guide them to round off whole numbers to the nearest hundred thousand using the example on page 13.

8. Have students try Practice on page 14 and discuss the answers with them.

9. Discuss with students some experiences of rounding a number:
   - What are the benefits of rounding off a number?
   - Have students ever rounded a number? Give some examples.

10. Have students do Exercises P and Q on pages 9 to 11 of the Workbook as their homework.

14th hours (Conclusion)

1. Get the students to tick what they have learned and understood on page 14 (Part L column).

2. Review the vocabulary used by referring to keywords in each subtopic in this chapter.

3. Guide the whole class to conclude the concept of numbers up to 100,000 with the following sample activities:

   (a) Super Winner
   - Students pair up with their own number cards. Teacher tells them the rules of play.
   - Teacher calls aloud, "Who has a greater number will be the winner and earn 1 point." Students will compare their numbers with each other. Then, let them change their partner. Teacher gives a new command and calls aloud, "Who has a smaller number will be the winner and earn 1 point." Teacher can change his/her commands alternately. The student who can collect the most points is the super winner.

(b) Super Winning Team

- Students group themselves into teams of 5 students. Each team writes their own number cards for playing game. Each team should have at least 5 numbers and each number should have more than 6 digits.

- Teacher calls aloud, "Arrange your number cards in ascending/descending order." Any teams who do correctly can earn 1 point. Then, ask them to form a new team of 5 students. Teacher gives a new command and looks for a super winning team which is the team with the most points.

4. Have students complete Mastery Practice on pages 12, 13 and 14 of the Workbook.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 4
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 4
- Paper and marker pens for making number cards

Assessment:

1. To assess cognitive behavior, test on page 14 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

Chapter 2 Addition and Subtraction

Time: 18 hours

Strand 1: Numbers and Algebra

Standard M.1.1 (Numbers): Understand various ways of numbers presentation, number system, number operations, the result of number operations and the properties of operations.

Indicator:

M 1.1 Gr4/7   Reasonably estimate the results of addition, subtraction, multiplication and division from various situations.

M 1.1 Gr4/8   Find the unknown numbers in addition and subtraction equations of cardinal numbers exceeding 100,000 and 0.

M 1.1 Gr4/9   Find the answers of mixed addition, subtraction, multiplication and division of cardinal numbers and 0.

M 1.1 Gr4/10 Show mathematical methods to solve 2-step word problems of cardinal numbers exceeding 100,000 and 0.

M 1.1 Gr4/12 Create 2-step word problems of cardinal numbers and 0 and find the answers.

Learning objectives:

Students will be taught to:

- Perform addition of numbers.
- Perform subtraction of numbers.
- Perform computations involving addition and subtraction to solve word problems.
- Using estimation for addition and subtraction.

Competency:

- Communication skills
- Thinking skills
- Problem-solving skills

Start up:

- Assess the students' prior knowledge about addition and subtraction by asking what the students knew and what they want to know more about addition and subtraction.

- Let students write all their prior knowledge in Part K column on page 15 and have the students share what they know about addition and subtraction. Then, let students write some questions which they want to know in Part W column on page 15.

Teaching/Learning activities:

1st – 3rd hours (Addition)

1. Give each student an addition problem and ask them to solve it. Then, the teacher gives the answers on the board and get them to match the questions.

2. Remind them of the meaning of addition.

3. Guide students to add two numbers and three numbers using a standard written method. Emphasize the need to align the digits of the same place values vertically and add them up. Start with a digit in the ones place and regroup when necessary.

4. Using the examples of adding three numbers on pages 16 and 17, show them that they can either add all the three numbers at once or add two numbers first before adding the third number.

5. Remind them of the properties of addition which are the commutative property and the associative property by using the examples on pages 17 and 18.

6. Guide students to use estimation for calculation using the example on page 19.

7. Write three numbers on the board and have students add them up. Compare the result from using calculation method and estimation method. Repeat this activity with other numbers.

8. Have students try Practice on pages 20 and 21 and discuss the answers with them.

9. Have students do Exercises A, B and C on pages 18 and 19 of the Workbook as their homework.

4th – 6th hours (Subtraction)

1. Remind students the meaning of subtraction.

2. Guide students to subtract two numbers and three numbers using a standard written method. Emphasize the need to align the digits of the same place values vertically and subtract them. Start with a digit in the ones place and regroup when it is necessary.

3. Use the examples on subtracting three numbers on pages 22 and 23, show them that they should subtract the second number from the first number first. Then, subtract the third number from the initial answer to get the final answer.

4. Write a few subtraction problems with three numbers on the board and ask students to solve them. Emphasize that order is very important in subtraction problems. If the numbers are reordered, the answers will be different.

5. Use the example on page 23 to guide students to use estimation for subtraction.

6. Have students try Practice on pages 24 and 25 and discuss the answers with them.

7. Have students do Exercise E on page 21 of the Workbook as their homework.

7th – 8th hours (Combined operations)

1. Remind students that they always have to do the operation in the brackets first. Use the examples on page 26 to explain the working in combined operations.

2. Have students try Practice on pages 26 and 27 and discuss the answers with them.

3. Have students do Exercise G on pages 23 and 24 of the Workbook as their homework.

9th – 13th hours (Solving word problems)

Word problems involving addition

1. Explain how to solve a word problem involving addition step by step on page 28. Always emphasize that they have to understand and analyze the problem first before writing the number sentence and solving it.

2. Have students try Practice on page 29 and discuss the answers with them.

3. Have students do Exercise D on pages 19 and 20 of the Workbook as their homework.

Word problems involving subtraction

1. Explain how to solve a word problem involving subtraction step by step on page 30. Always emphasize that they have to understand and analyze the problem first before writing the number sentence and solving it.

2. Have students try Practice on page 31 and discuss the answers with them.

3. Have students do Exercise F on pages 22 and 23 of the Workbook as their homework.

Word problems involving combined operations

1. Tell students that sometimes a word problem may consist of more than one operations. Therefore, we need to use combined operations to solve it.

2. Use the example on page 32 to explain and guide students on how to solve word problems involving combined operations.

3. Have students try Practice on page 33 and discuss the answers with them.

4. Have students do Exercise H on pages 24, 25 and 26 of the Workbook as their homework.

14th – 17th hours (Creating word problems)

1. Explain how to create an addition word problem step by step using the example on page 34.

2. Have students try Practice on page 34 and discuss the answers with them.

3. Explain how to create a subtraction word problem step by step using the example on page 35.

4. Have students try Practice on page 35 and discuss the answers with them.

5. Explain how to create a word problem involving combined operations step by step using the example on page 36.

6. Form a few groups of students and have each of the groups to create a word problem and then share to other groups to solve.

7. Have students try Practice on page 36 and discuss the answers with them.

8. Have students do Exercise I on page 27 of the Workbook as their homework.

18th hours (Conclusion)

1. Get the students to tick what they have learned and understood on page 36 (Part L column).

2. Review the vocabulary used by referring to keywords in each subtopic in this chapter.

3. Guide the whole class to conclude the concept of addition and subtraction with the following sample activities:

   - Students pair up and solve the problems as teacher commands (addition or subtraction problems).

   - Any pairs of students who solve the problem correctly will get 1 point.

   - Each student changes their partner for each question as teacher commands (approximately 10 questions). The winner will be the one who can earn the most points.

4. Have students complete Mastery Practice on pages 28, 29 and 30 of the Workbook.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 4
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 4

Assessment:

1. To assess cognitive behavior, test on page 36 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

Chapter 3 Multiplication

Time: 16 hours

Strand 1: Numbers and Algebra

Standard M.1.1 (Numbers): Understand various ways of numbers presentation, number system, number operations, the result of number operations and the properties of operations.

Indicator:

M 1.1 Gr4/7   Reasonably estimate the results of addition, subtraction, multiplication and division from various situations.

M 1.1 Gr4/9   Find the unknown numbers in multiplication equations of many digits numbers of 2 numbers, and the product is not more than 6-digit numbers. And find the unknown numbers in division equations that dividend is not more than 6 digits and divisor is not more than 2 digits.

M 1.1 Gr4/11 Show mathematical methods to solve 2-step word problems of cardinal numbers exceeding 100,000 and 0.

M 1.1 Gr4/12 Create 2-step word problems of cardinal numbers and 0 and find the answers.

Learning objectives:

Students will be taught to:

- Understand properties of multiplication.
- Multiply any two numbers.
- Solve word problems involving multiplication.

Competency:

- Thinking skills
- Problem-solving skills
- Analytical skills

Start up:

- Assess the students' prior knowledge about multiplication by asking what the students knew and what they want to know more about multiplication.
- Let student write all their prior knowledge in Part K column on page 37 and have the students share what they know about multiplication. Then let students write some questions which they want to know in Part W column on page 37.

Teaching/Learning activities:

1ˢᵗ – 2ⁿᵈ hours (Properties of multiplication)

1. Help students to recall multiplication tables by playing the following game:
   - Students sit in a circle, and a starting person is selected.
   - The starting person stands behind the student next to him or her.
   - The teacher shows a multiplication problem flashcard.
   - The student who says the answer first moves on to challenge the next student.
   - If a sitting student says the answer first, the students switch places.
2. Use the examples on pages 38 and 39 to explain the properties of multiplication: commutative property, associative property, distributive property and multiplicative identity property.
3. Have students try Practice on page 39 and discuss the answers with them.
4. Have students do Exercise A on page 33 of the Workbook as their homework.

3rd – 5th hours (Multiplying by 1-digit numbers)

1. When multiplying numbers, write them in the standard written method. Start to multiply from the digit in the ones place and regroup when it is necessary.

2. Use the examples on pages 40 and 41 to explain step by step and how to verify the answers.

3. Have students try Practice on page 41 and discuss the answers with them.

4. Have students do Exercise C (questions 1, 2 and 3) on page 34 of the Workbook as their homework.

6th – 8th hours (Multiplying by 2-digit numbers)

1. Guide students on how to multiply 2-digit numbers by 10, 100, 1,000 and 10,000 by using the examples on page 42.

2. Use the examples on pages 43 and 44 to explain how to multiply multi-digit numbers by 2-digit numbers step by step and how to verify the answers.

3. Have students try Practice on page 44 and discuss the answers with them.

4. Have students do Exercises B (questions 1 to 6), C (questions 4, 5, 6 and 12) and D (questions 1, 2, 3, 4, 7 and 8) on pages 34, 35 and 36 of the Workbook as their homework.

9th – 11th hours (Multiplying by 3-digit numbers)

1. Guide students on how to multiply 3-digit numbers by 10, 100 and 1,000 by using the examples on page 45.

2. Use the examples on pages 45, 46 and 47 to explain how to multiply multi-digit numbers by 3-digit numbers step by step and how to verify the answers.

3. Have students try Practice on page 47 and discuss the answers with them.

4. Have students do remaining questions of Exercises B, C, D and E on pages 33 to 36 of the Workbook as their homework.

12th – 13th hours (Solving multiplication word problems)

1. Use the example on page 48 to explain how to solve multiplication word problem step by step. Always emphasize that they have to understand and analyze the problem first before writing the number sentence and solving it.

2. Have students try Practice on page 49 and discuss the answers with them.

3. Have students do Exercise F on pages 37 and 38 of the Workbook as their homework.

14th – 15th hours (Creating multiplication word problems)

1. Explain how to create multiplication word problem step by step using the example on page 50.

2. Form a few groups of students and have each of the groups to create a word problem and then share to other groups to solve.

3. Have students try Practice on page 50 and discuss the answers with them.

4. Have students do Exercise G on page 39 of the Workbook as their homework.

16th hours (Conclusion)

1. Get the students to tick what they have learned and understood on page 50 (Part L column).

2. Review the vocabulary used by referring to keywords in each subtopic in the chapter.

3. Guide the whole class to conclude the concept of multiplication with the following sample activity:

   (a) Tic-tac-toe multiplication game

   - Teacher prepares multiplication problem flashcards and put either an X or an O on the other side of the flashcards.

   - Give each pair of students one flashcard and ask them to solve the problem.

- Explain students that the rules are exactly like those of a standard tic-tac-toe.
- Randomly choose one team to start the game by placing on the board and the other teams to play.
- The winning team is the last team that can complete three marks in a row.

4. Have students complete Mastery Practice on pages 40 and 41 of the Workbook.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 4
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 4
- Multiplication tables
- Multiplication problem flashcards

Assessment:

1. To assess cognitive behavior, test on page 50 (Part L column).

2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.

3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

Chapter 4 Division

Time: 9 hours

Strand 1: Numbers and Algebra

Standard M.1.1 (Numbers): Understand various ways of numbers presentation, number system, number operations, the result of number operations and the properties of operations.

Indicator:

M 1.1 Gr4/7   Reasonably estimate the results of addition, subtraction, multiplication and division from various situations.

M 1.1 Gr4/9   Find the unknown numbers in multiplication equations of many digits numbers of 2 numbers, and the product is not more than 6-digit numbers. And find the unknown numbers in division equations that dividend is not more than 6 digits and divisor is not more than 2 digits.

M 1.1 Gr4/11 Show mathematical methods to solve 2-step word problems of cardinal numbers exceeding 100,000 and 0.

M 1.1 Gr4/12 Create 2-step word problems of cardinal numbers and 0 and find the answers.

Learning objectives:

Students will be taught to:

- Divide by 2-digit numbers.
- Solve problems involving division.

Competency:

- Thinking skills
- Problem-solving skills
- Analytical skills

Start up:

- Assess the students' prior knowledge about division by asking what the students knew and what they want to know more about division.
- Let students write all their prior knowledge in Part K column on page 51 and have the students share what they know about division. Then, let students write some questions which they want to know in Part W column on page 51.

Teaching/Learning activities:

1st – 4th hours (Division by 2-digit divisors)

1. Long division is used with divisors of 2 or more digits. Use the examples on pages 52, 53 and 54 to explain further.
2. Help students to understand Math Tips on page 53.
3. Write a few division problems on the board and ask students to try to solve them.
4. Guide students to verify the answer by multiplying the answer with the divisor. Remember to add the remainder if there is any.
5. Have students try Practice on page 55 and discuss the answers with them.
6. Have students do Exercises A to E on pages 43 to 46 of the Workbook as their homework.

5th – 6th hours (Solving division word problems)

1. Use the example on page 56 to explain how to solve a division word problem step by step. Always emphasize that they have to understand and analyze the problem first before writing the number sentence and solving it.

2. Have students try Practice on page 57 and discuss the answers with them.

3. Have students do Exercise F on pages 47 and 48 of the Workbook as their homework.

7th – 8th hours (Creating division word problems)

1. Explain how to create a division word problem step by step using the example on page 58.

2. Form a few groups of students and have each of the groups to create a word problem and then share to other groups to solve.

3. Have students try Practice on page 58 and discuss the answers with them.

4. Have students do Exercise G on page 48 of the Workbook as their homework.

9th hours (Conclusion)

1. Get the students to tick what they have learned and understood on page 58 (Part L column).

2. Review the vocabulary used by referring to keywords in each subtopic in the chapter.

3. Have students complete Mastery Practice on pages 49 and 50 of the Workbook.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 4
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 4
- Division problem flashcards

Assessment:

1. To assess cognitive behavior, test on page 58 (Part L column).

2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.

3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

Chapter 5 Combined Operations

Time: 10 hours

Strand 1: Numbers and Algebra

Standard M.1.1 (Numbers): Understand various ways of numbers presentation, number system, number operations, the result of number operations and the properties of operations.

Indicator:

M 1.1 Gr4/7   Reasonably estimate the results of addition, subtraction, multiplication and division from various situations.

M 1.1 Gr4/8   Find the unknown numbers in addition and subtraction equations of cardinal numbers exceeding 100,000 and 0.

M 1.1 Gr4/9   Find the unknown numbers in multiplication equations of many digits numbers of 2 numbers, and the product is not more than 6-digit numbers. And find the unknown numbers in division equations that dividend is not more than 6 digits and divisor is not more than 2 digits.

M 1.1 Gr4/10 Find the answers of mixed addition, subtraction, multiplication and division of cardinal numbers and 0.

M 1.1 Gr4/11 Show mathematical methods to solve 2-step word problems of cardinal numbers exceeding 100,000 and 0.

M 1.1 Gr4/12 Create 2-step word problems of cardinal numbers and 0 and find the answers.

Learning objectives:

Students will be taught to:

- Perform combined operations involving addition, subtraction, multiplication and division.

Competency:

- Thinking skills
- Problem-solving skills
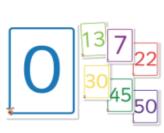- Analytical skills

Start up:

- Assess the students' prior knowledge about combined operations by asking what the students knew and what they want to know more about combined operations.
- Let students write all their prior knowledge in Part K column on page 59 and have the students share what they know about combined operations. Then, let students write some questions which they want to know in Part W column on page 59.

Teaching/Learning activities:

1st – 3rd hours (Combined operations)

1. Let students play a game by dividing students into groups of 3 to 4 students. Then, give them 3×3 combined operations problems and 9 answer cards. Ask them to match the problems with answers. The winner is the first group that can

99 x 52 = ___	68 x 52 = ___	52 x 13 = ___
69 x 63 = ___	54 x 12 = ___	75 x 62 = ___
99 x 91 = ___	95 x 68 = ___	Free Space

match them all correctly.

2. In combined operations problems, always do the operations in the brackets first.

3. Guide students to solve combined operations and verify the answers by using the examples on pages 60 and 61.

4. Have students try Practice on page 62 and discuss the answers with them.

5. Have students do Exercises A and B on pages 52 and 53 of the Workbook as their homework.

4th – 6th hours (Using combined operations to solve word problems)

1. Guide students to solve a combined operations word problem using the example on page 63.

2. Ask students to try Practice on page 64 and discuss the answers with them.

3. Have students do Exercise C on pages 54, 55 and 56 of the Workbook as their homework.

7th – 9th hours (Creating word problems involving combined operations)

1. Use the example on page 65 to explain how to create word problem step by step on page 65.

2. Form a few groups of students and have each of the groups to create a word problem and then share to other groups to solve.

3. Have students try Practice on page 65 and discuss the answers with them.

4. Have students to do Exercise D on page 57 of the Workbook as their homework.

10th hours (Conclusion)

1. Get the students to tick what they have learned and understood on page 65 (Part L column).

2. Review the vocabulary used by referring to keywords in each subtopic in the chapter.

3. Guide the whole class to conclude the concept of combined operations with the following sample activities:

   (a) Play the same 3×3 combined operations problems game but change the problems.

   (b) Bingo math game.

4. Have students complete Mastery Practice on pages 58, 59 and 60 of the Workbook.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 4
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 4
- 3×3 combined operations problems and 9 answer cards

Assessment:
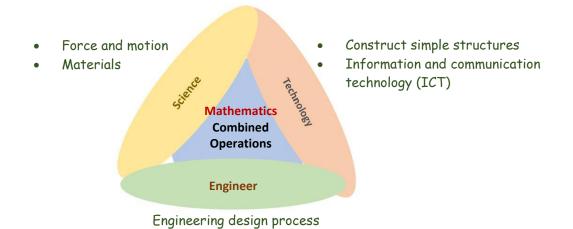
1. To assess cognitive behavior, test on page 65 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: A card tower

Overview

In this activity, students are required to build a tower with index cards. It is not only a challenging activity, but also a great team building activity to have students work together. Furthermore, they are conditioned by the materials, time and budget from the activity which makes the activity more challenging and fun for them.

Subject integration

- Force and motion
- Materials

- Construct simple structures
- Information and communication technology (ICT)

Science

Technology

Mathematics
Combined
Operations

Engineer

Engineering design process

Activity guide

Time: 3 hours

Start up:

1. Divide the students into groups of 3 to 4 students.
2. Let them know that this is the first activity that they will apply science, technology, engineering, and mathematics concepts to design and create something. We call it the "STEM education".

3. Remind them of the STEM activities when they were in third grade:

- Which is the most favorite activity? Why?

- What did you get from those STEM activities?

- Ask students to explain the engineering design process.

Lesson development:

1. Let students read the situation on page 66. Ask students to underline the sentences that they are required to do with red color and underline the limited conditions with blue color. Then, ask students to identify a problem. Teacher may ask the following questions:

   (a) What will you have to do?

   (b) What are your missions?

   (c) What is the problem of this situation?

   (d) What do you need to know to get started?

2. Remind them of their knowledge of how to build a strong construction. Then engage students to explore and make connections between science, technology, engineering and mathematics by using some of the following questions:

   (a) If you want to make a tall and stable tower, what do you have to consider?

   (b) Think about the shape of your tower, how will its top and bottom be?

   (c) What shape will enable the tower to stand firmly – triangle, square or other shapes? Why?

   (d) What are the causes of success or failure in your previous work?

   (e) What did you learn from your failures?

   (f) What points should you improve?

   (g) What shape should you design for a stronger structure?

   (h) What types of foundations can support a tall building?

   (i) What is your limited material in this activity?

   (j) Can you use other materials?

   (k) What are your new challenges in this activity?

(l) Can you search for more information about card towers?

(m) How do you measure the height of a tower? What is an appropriate measuring tool and standard unit?

(n) How do you calculate the budget of each tower and find the difference?

3. Ask students to think about how to assess their project. Discuss in class and set their criteria using the following questions:

(a) What are the achievement criteria? (The strength of the tower, its height, standing freely for at least 15 minutes, etc.)

(b) How do we evaluate our success? (The accuracy of measuring height, time and calculating a budget, teamwork, creativity, etc.)

4. Get the students to brainstorm. Let them decide and choose their best solution. They should draw their design including the labels of materials and draft method. Then, let them follow their plans and create.

5. After they have finished their work, ask them to assess their card tower by using the criteria stated in no.3. Teacher may ask these following questions:

(a) Did your work meet the criteria?

(b) Can it stand freely and firmly?

(c) What is the maximum height that you can build?

(d) Can you figure out the weak points of the tower?

(e) Do you and your team feel satisfied with your work? Why? Why not?

(f) What works or what does not work?

(g) How will you modify your solution to make it better?

(h) Does your tower stand freely for at least 15 minutes? Why? Why not?

6. Let them improve their design. Teacher may point out their weak points, then motivate them to think about how to improve it. (Teacher may skip this step due to time constraint and may ask them to explain the need to do so and how to do it instead.)

7. Each group presents of their work and explain their journey of creating it. (Teacher may suggest them a suitable type of presentation and/or assign them the topics for presentation such as team members, product, journey of creating their work, problems, how to test and ways to improve.)

Conclusion:

1. End the lesson by asking students the following questions:
    (a) Did you apply the engineering design process into your work?
    (b) Did each team come up with the same design? Why? Why not?
    (c) What are the key success factors that affect your group work? (Teamwork, creative thinking, etc.)
    (d) What subject knowledge did you apply into this activity?
    (e) What will happen if you build the card tower without a proper plan and design?
    (f) What did you learn from this activity?

Suggested materials:

Index cards, ruler or meter stick, scissors

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 6 Fractions

Time: 20 hours

Strand 1: Numbers and Algebra

Standard M.1.1 (Numbers): Understand various ways of numbers presentation, number system, number operations, the result of number operations and the properties of operations.

Indicator:

M 1.1 Gr4/3 Tell, read and write fractions and mixed numbers that show the quantities of objects, and show objects as given fractions and mixed numbers.

M 1.1 Gr4/4 Compare and arrange sequence of fractions and mixed numbers which one denominator is a multiple of the other.

M 1.1 Gr4/13 Find positive and negative results of fractions and mixed numbers which one denominator is a multiple of the other.

M 1.1 Gr4/14 Show mathematical methods of finding the answers of word problems involving addition and subtraction of fractions and mixed numbers which one denominator is a multiple of the other.

Learning objectives:

Students will be taught to:

- Read and write fractions and mixed numbers.
- Compare and order fractions.
- Understand equivalent fractions.
- Add and subtract fractions.
- Solve word problems involving fractions.

Competency:

- Thinking skills
- Problem-solving skills
- Analytical skills

Start up:

- Assess the students' prior knowledge about fractions by asking what the students knew and what they want to know more about fractions.
- Let students write all their prior knowledge in Part K column on page 68 and have the students share what they know about fractions. Then ask the students to write some questions which they want to know in Part W column on page 68.

Teaching/Learning activities:

1st – 5th hours (Proper fractions, improper fractions and mixed numbers)

1. Encourage students to do the following activity:
   - Divide students into groups of 3 students.
   - Give each group a rectangle, a square, and a circle shape of paper.
   - Ask them to fold each paper equally.
   - Get them to compare these 3 shapes of paper and find out which one is folded unequally and what are the differences between these figures?

2. Help students understand equal parts and non-equal parts by using the examples on page 69.

3. Guide students on how to read and write fractions on page 69.

4. Write a few fractions on the board and a few circles and ask students to shade the circles correctly to represent each fraction. Have them read the fractions aloud too.

5. Explain students meaning of a proper fraction, an improper fraction and a mixed number on pages 70 and 71.

6. Ask students to give an example of fraction for each type of fraction.

7. Explain to students how to convert mixed numbers into improper factions and how to convert improper factions into mixed numbers.

8. Have students try Practice on page 74 and discuss the answers with them.

9. Have students do Exercises A to E on pages 65 and 66 of the Workbook as their homework.

6ᵗʰ hours (Equivalent fractions)

1. Explain the concept of equivalent by using the diagrams on page 75.

2. Write two fractions on the board and ask students to determine whether they are equivalent fractions or not.

3. Ask students to demonstrate their understanding of equivalent fractions by using play dough, folding the paper or drawing the pictures to the class.

4. Have students try Practice on page 75 and discuss the answers with them.

5. Have students do Exercise F on page 67 of the Workbook as their homework.

7ᵗʰ – 11ᵗʰ hours (Comparing and ordering fractions)

Comparing fractions with the same denominator

1. Demonstrate how to compare fractions with the same denominator step by step to the students by using play dough or the diagrams of cakes or pizzas.

2. Remind students of the signs used in comparison and use the examples on page 76 to explain further.

3. Write a few fractions with the same denominator on the board and ask students to identify which fraction is smaller or greater fraction. Emphasize to students that the fraction with the greater numerator is the greater fraction.

Comparing fractions with the same numerator

1. Demonstrate how to compare fractions with the same numerator step by step to the students by using play dough or diagrams of cakes or pizzas.

2. Write a few fractions with the same numerator on the board and ask students to identify which fraction is smaller or greater fraction. Emphasize to students that the fraction with the smaller denominator is the greater fraction.

3. Referring to the examples on page 77, explain to students on how to compare the fractions by using the comparison signs.

Comparing fractions of different numerators and denominators

1. Use the example on page 78 to demonstrate how to compare fractions of different numerators and denominators step by step to students.

2. Remind them to equalize the denominators before comparing the fractions.

3. Write two fractions which a denominator of a fraction is a multiple of another on the board. Ask student to compare the fractions.

Comparing a proper fraction with a mixed number

1. Use the example on page 79 to demonstrate how to compare a proper fraction with a mixed number step by step to students.

2. Emphasize to students that a mixed number is greater than a proper fraction because a mixed number has a whole number.

3. Write a proper fraction and a mixed number on the board. Ask student to compare the fractions.

Comparing a proper fraction with an improper fraction

1. Use the example on page 79 to demonstrate how to compare a proper fraction with an improper fraction step by step to the students.

2. Emphasize to students that an improper fraction is greater than 1 or equal to 1 and therefore it is greater than a proper fraction.

3. Write a proper fraction and an improper fraction on the board. Ask students to compare the fractions.

Comparing an improper fraction with a mixed number

1. Use the example on page 80 to demonstrate how to compare an improper fraction with a mixed number step by step to the students.

2. Remind them to convert the mixed number to an improper fraction when the denominators are different. Remind them to equalize the denominators before comparing the fractions.

3. Write an improper fraction and a mixed number on the board. Ask students to compare the fractions.

4. Have students do Exercise G on page 67 of the Workbook as their homework.

Ordering fractions

1. Use the examples on pages 80 and 81 to demonstrate how to order fractions step by step to students.

2. Write some fractions consisting of different types of fractions on the board. Ask students to order the fractions in ascending and descending order.

3. Have students try Practice on page 82 and discuss the answers with them.

4. Have students do Exercises H, I and J on pages 67 and 68 of the Workbook as their homework.

12th – 17th hours (Operations involving fractions)

Adding fractions with the same denominator

1. Write fractions with the same denominator on the board and demonstrate the steps to add fractions with the same denominator.

2. Use the examples on page 83 for further explanation.

Adding two fractions with different denominators

1. Write two fractions with different denominators on the board and demonstrate the steps to add two fractions with different denominators.

2. Remind students to equalize the denominators before adding up and to write the final answer in simplified proper fraction or mixed number.

3. Use the example on page 84 for further explanation.

Adding a whole number and a fraction

1. Write a whole number and a fraction on the board and demonstrate the steps to add a whole number and a fraction.

2. Use the example on page 84 for further explanation.

Adding a fraction and a mixed number

1. Write a fraction and a mixed number on the board and demonstrate the steps to add a fraction and a mixed number.

2. Remind students to convert the mixed number into an improper fraction and equalize the denominators before adding up.

3. Use the example on page 85 for further explanation.

Adding two mixed numbers

1. Write two mixed numbers on the board and demonstrate the steps to add the mixed numbers.

2. Remind students to convert the mixed numbers into improper fractions and equalize the denominators before adding up. Remind them to simplify the fraction for the final answer.

3. Use the example on page 85 for further explanation.

Subtracting fractions with the same denominator

1. Write two fractions with the same denominator on the board and demonstrate the steps to subtract the fractions.

2. Remind students to simplify the fraction for final answer.

3. Use the examples on page 86 for further explanation.

Subtracting two fractions with different denominators

1. Write two fractions with different denominators on the board and demonstrate the steps to subtract the fractions.

2. Remind students to equalize the denominators before subtracting the fractions.

3. Use the example on page 87 for further explanation.

Subtracting a fraction from a whole number

1. Write a fraction and a whole number on the board and demonstrate the steps to subtract a fraction from a whole number.
2. Remind students to convert the whole number into an improper fraction and equalize the denominators before subtracting the fractions.
3. Use the example on page 87 for further explanation.

Subtracting a fraction from a mixed number

1. Write a fraction and a mixed number on the board and demonstrate the steps to subtract a fraction from a mixed number.
2. Remind students to convert the mixed number into an improper fraction and equalize the denominators before subtracting the fractions.
3. Use the example on page 88 for further explanation.

Subtracting two mixed numbers

1. Write two mixed numbers on the board and demonstrate the steps to subtract two mixed numbers.
2. Remind students to convert the mixed numbers into improper fractions and equalize the denominators before subtracting the fractions.
3. Use the example on page 88 for further explanation.
4. Have students try Practice on page 89 and discuss the answers with them.
5. Have students do Exercises K, L and M on pages 69 to 72 of the Workbook as their homework.

18ᵗʰ – 19ᵗʰ hours (Solving word problems involving fractions)

1. Guide students to solve word problems involving fractions by using the example on page 90.
2. Have students try Practice on page 91 and discuss the answers with them.
3. Have students do Exercise N on pages 73 and 74 of the Workbook as their homework.

20th hours (Conclusion)

1. Get the students to tick what they have learned and understood on page 91 (Part L column).

2. Review the vocabulary used by referring to keywords in each subtopic in the chapter.

3. Guide the whole class to conclude the concept of fractions with the following sample activity:

   - Ask students to work in pairs and follow the teacher's commands about fractions that they have learned by using play dough, folding paper or drawing the diagrams.

   - Any pairs of students who do correctly will get one point.

   - Each student will change their partner for each command (approximately 10 commands). The winner will be one who can earn the most points.

4. Have students complete Mastery Practice on pages 75, 76 and 77 of the Workbook.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 4
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 4
- Play dough, paper for folding and color markers for drawing

Assessment:

1. To assess cognitive behavior, test on page 91 (Part L column).

2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.

3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

Chapter 7 Decimals

Time: 18 hours

Strand 1: Numbers and Algebra

Standard M.1.1 (Numbers): Understand various ways of numbers presentation, number system, number operations, the result of number operations and the properties of operations.

Indicator:

M 1.1 Gr4/5   Read and write decimals with not more than 3 places that show the quantities of objects and show objects as given decimals.

M 1.1 Gr4/6   Compare and arrange sequence of decimals with not more than 3 places from various situations.

M 1.1 Gr4/15 Find positive and negative results of decimals with not more than 3 places.

M 1.1 Gr4/16 Show mathematical methods to solve 2-step word problems of adding and subtracting decimals with not more than 3 places.

Learning objectives:

Students will be taught to:

- Understand decimals.
- Comparing and ordering decimals.
- Find positive and negative results of decimals with not more than 3 places.
- Solve decimal word problems.

Competency:

- Thinking skills
- Problem-solving skills
- Analytical skills

Start up:

- Assess the students' prior knowledge about decimals by asking what the students knew and what they want to know more about decimals.
- Let students write all their prior knowledge in Part K column on page 92 and have the students share what they know about decimals. Then ask the students to write some questions which they want to know in Part W column on page 92.

Teaching/Learning activities:

1st – 4th hours (Writing and naming decimals)

Decimal fractions

1. Explain the relationship between fractions and decimals.
2. Use the examples on page 93 to explain how fractions with denominators of 10 are written as decimals.
3. Guide students to read decimal fractions.
4. Write a few fractions with 10 as the denominator on the board. Then, ask students to draw diagrams and convert the fractions into decimals. Get them present their diagrams and read the decimals aloud to the class.

Mixed decimals

1. Explain the concept of mixed decimals by using the examples on page 94.
2. Draw some diagrams or show some diagrams to represent mixed decimals on the board and get some students to write and read the decimals.

Decimals with more than 1 decimal place

1. Use the example on pages 95 and 96 to explain the concept of decimals with more than 1 decimal place.

2. Draw some diagrams of decimals with more than 1 decimal place on the board and get some students to write and read those decimals.

3. Have students try Practice on pages 96 and 97 and discuss the answers with them.

4. Have students do Exercises A to E on pages 87, 88 and 89 of the Workbook as their homework.

5th hours (Place values and digit values of digits in decimals)

1. Use the example on page 98 to explain the concept of place values and digit values of digits in decimals.

2. Have students try Practice on page 98 and discuss the answers with them.

3. Have students do Exercise F on page 89 of the Workbook as their homework.

6th hours (Writing decimals in expanded form)

1. Use the example on page 99 to explain the concept of writing decimals in expanded form.

2. Ask each group of students to create some decimals and give to the other groups to write the decimals in expanded form.

3. Have students try Practice on page 99 and discuss the answers with them.

4. Have students do Exercise G on page 90 of the Workbook as their homework.

7th hours (Equivalent decimals)

1. Use the example on page 100 to explain the concept of equivalent decimals.

2. Have students try Practice on page 100 and discuss the answers with them.

3. Have students do Exercises H and I on page 90 of the Workbook as their homework.

8th – 10th hours (Comparing and ordering decimals)

1. Use the examples on page 101 to explain how to compare decimal fractions and mixed decimals.

2. Write two decimal fractions and two mixed decimals of different values on the board.

3. Ask students to compare by putting the "smaller than" or "greater than" signs between two decimals. Ask them, "Which one is smaller?" or "Which one is greater?"

4. Remind them of the concept of ascending and descending orders on page 102.

5. Organize students into two groups of 5, draw or show some diagrams on the board to represent decimal fractions for one group and draw or show other diagrams to represent mixed decimals for another group.

6. Ask them to write decimals in numerals and answer the questions, "Which one is the smallest?" and "Which one is the greatest?"

7. Get them to arrange these decimals in ascending and descending orders.

8. Have students try Practice on page 103 and discuss the answers with them.

9. Have students do Exercises J to N on pages 91 and 92 of the Workbook as their homework.

11ᵗʰ – 15ᵗʰ hours (Operations involving decimals)

Addition of decimals

1. Ask students when they need to add decimals. Encourage them to give several examples. If students cannot give any examples, remind them of money.

2. Review their prior knowledge of decimals with the following activity:

   • Ask each student to write clearly a decimal number between 0 and 10 on an A4 size paper.

   • Randomly choose 10 students to stand in front of the class and hold their decimal number.

   • Ask them to show their decimal number and read it out.

   • Tell them to arrange themselves in ascending or descending orders without speaking.

- Let them see how long it takes for 10 students to complete the task.

- Teacher checks the answers and repeat the same way for other students.

3. Demonstrate how to add decimals step by step by using the standard written method. The decimals must be aligned by their place values.

4. Use the examples on pages 104 and 105 to explain further.

5. Have students do Exercises O and Q (questions 1, 2 and 3) on pages 92 and 93 of the Workbook as their homework.

Subtraction of decimals

1. Demonstrate how to subtract decimals step by step by using the standard written method. Always align the digits by their place values before subtracting.

2. Use the examples on pages 106 and 107 for further explanation.

3. Have students do Exercises P and Q (questions 4, 5 and 6) on page 93 of the Workbook as their homework.

Combined (addition and subtraction) operations

1. Remind students that when perform any combined operations, do the operations in the brackets first. Use the examples on page 108 to demonstrate the steps to do combined operations for decimals.

2. Have students try Practice on page 108 and discuss the answers with them.

3. Have students do Exercise R on page 93 of the Workbook as their homework.

16th – 17th hours (Solving word problems involving addition and subtraction of decimals)

1. Guide students to solve word problems involving addition and subtraction of decimals. Use the example on page 109 and explain step by step.

2. Always ask them to analyze the problems and write the number sentences before attempting to do the operations.

3. Have students try Practice on page 110 and discuss the answers with them.

4. Have students do Exercise S on pages 94 and 95 of the Workbook as their homework.

18th hours (Conclusion)

1. Get the students to tick what they have learned and understood on page 110 (Part L column).

2. Review the vocabulary used by referring to keywords in each subtopic in the chapter.

3. Guide the whole class to conclude the concept of decimals with the following sample activities:

(a) Game A

- Give a decimal card to each student.

- Ask students to pair up and compare their cards.

- Teacher will command, the winner will be the one who has a smaller value or a greater value alternately and the winner will get 1 point. Then, they have to change their partner for the next command.

- The winner of the game is the one who can collect the most points.

(b) Game B

- Give a decimal card to each student and ask them to form their team of 5.

- Tell them to arrange their decimals cards in ascending order. Any teams that do correctly, each team member will get 1 point.

- Get them to change their team members. Then, ask them to arrange their decimal cards in descending order. Any teams that do correctly, each team members will get 1 point.

- Teacher will ask them change team members for every question and arrange the decimal cards in ascending and descending orders alternately.

- The winner of the game is the one who can collect the most points.

4. Guide the whole class to conclude the concept of operations involving decimals with the following sample activities:

   (a) Activity A: The missing number

   - Ask them to find the missing decimal number, for example, $6.45 + \square = 8.95$.

   (b) Activity B: Creating word problem

   - Challenge students to create their own word problems.

   - Give them some number sentences and ask them to create word problems which are new and interesting.

5. Have students complete Mastery Practice on pages 96 and 97 of the Workbook.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 4
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 4
- Decimal cards
- Diagrams to show decimal fractions and mixed decimals

Assessment:

1. To assess cognitive behavior, test on page 110 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

Chapter 8 Time

Time: 15 hours

Strand 2: Measurement and Geometry

Standard M.2.1: Understand the fundamental of measurement, measure and estimate the sizes of wanted objects and application.

Indicator:

M 2.1 Gr4/1   Demonstrate how to solve word problems involving time.

Learning objectives:

Students will be taught to:

- Read time from clocks.
- Tell duration of time.
- Read and extract data from timetables, programs and calendars.
- Prepare schedules.
- Understand the relationships between units of time.
- Solve word problems involving time.
- Understand the relationship between the units of time.
- Solve word problems involving time.

Competency:

- Thinking skills
- Problem-solving skills
- Analytical skills

Start up:

- Assess the students' prior knowledge about time by asking what the students knew and what they want to know more about time.
- Let students write all their prior knowledge in Part K column on page 111 and have the students share what they know about time. Then ask the students to write some questions which they want to know in Part W column on page 111.

Teaching/Learning activities:

1st – 4th hours (Relationship between units of time)

Units of time

1. Review students' prior knowledge of time by asking them some questions:
   - How many periods of Math per week?
   - How many minutes of Math per period?
2. Guide students to tell the units of time; second, minute, hour, day, week and year.
3. Referring to pages 112, 113 and 114, explain the relationships of the units of time such as seconds, minutes, hours, days, weeks, months and years to the students.

Converting units of time

1. Using the examples on page 114 to explain to students the concept of converting units of time.
2. Have students try Practice on page 115 and discuss the answers with them.
3. Have students do Exercises A, B and G on pages 100, 101, 102 and 107 of the Workbook as their homework.

5th – 7th hours (Duration of time)

1. Use the examples on page 116 to explain how to calculate the duration of time.
2. Remind students the relationships of the units of time, such as there are 60 minutes in an hour and there are 7 days in a week.
3. Have students try Practice on page 117 and discuss the answers with them.

4. Have students do Exercises C and D on pages 103 and 104 of the Workbook as their homework.

8ᵗʰ – 9ᵗʰ hours [Schedule (timetables)]

1. Introduce schedules or timetables (bus, train or class timetables) to the students and ask them the following questions:

- What are these?
- Have you ever seen these schedules before?
- Where can you see these schedules?
- What are the purpose of these schedules?

2. Guide them to read and extract information from the timetable on page 118.
3. Show them a movie schedule and ask them to read and extract information from it.
4. Have students try Practice on page 119 and discuss the answers with them.
5. Have students do Exercise E on page 105 of the Workbook as their homework.

10ᵗʰ – 11ᵗʰ hours [Schedule (program)]

1. Get them to read and extract information from a schedule (program) on page 120 and ask them, "What are the differences between this schedule and those previous one?"
2. Have students try Practice on page 121 and discuss the answers with them.
3. Have students do Exercise F on page 106 of the Workbook as their homework.

12ᵗʰ – 14ᵗʰ hours (Solving word problems involving time)

1. Use the examples on page 122 to explain how to solve word problems involving time and remind them of the relationships of the units of time.
2. Have students try Practice on page 123 and discuss the answers with them.
3. Have students do Exercise H on pages 108 and 109 of the Workbook as their homework.

15th hours (Conclusion)

1. Get the students to tick what they have learned and understood on page 124 (Part L column).

2. Review the vocabulary used by referring to keywords in each subtopic in the chapter.

3. Guide the whole class to conclude the concept of time with the following activities:

   (a) Ask each group of 5 students to prepare a train or a flight timetable.

   (b) Form a few groups of students and have each of the groups to create at least 5 word problems and then share to another group to solve.

4. Have students complete Mastery Practice on pages 110, 111 and 112 of the Workbook.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 4
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 4
- An analog clock and a digital clock
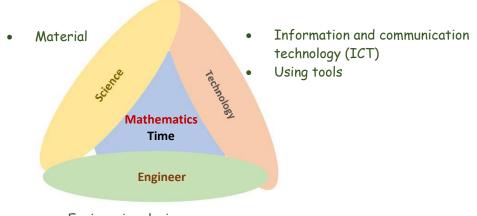- Bus, train, class and movie schedules

Assessment:

1. To assess cognitive behavior, test on page 124 (Part L column).

2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.

3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: Reusable monthly wall calendar

Overview

A calendar is a system of organizing days for any activities. Calendar has got a plenty of uses such as to pre-plan task to precede a good routine of a day, to ensure completion of task on time, and it is the best reminder. There are many selections of calendar such as wall calendar and desktop calendar. In this activity, students are required to design and create a reusable monthly wall calendar. The dates in the reusable monthly wall calendar should be able to change accordingly.

Subject integration

- Material
- Information and communication technology (ICT)
- Using tools

Engineering design process

Activity guide

Time: 3 hours

Start up:

1. Divide the students into groups of 3 to 4 students.
2. Let students talk about their activity plan on each day. What remind them to do or what thing that help them to remember their plan.

Lesson development

1. Let students read the situation on page 124. Ask students to underline the sentences that they are required to do with red color and underline the limited conditions with blue color. Then, ask students to identify a problem. Teacher may use the following questions:

   (a) What is the situation about?

   (b) What will you have to do?

   (c) What are your missions?

   (d) What do you need to know to get started?

2. Encourage students to explore and make connections between science, technology, engineering and mathematics by using some of the following questions:

   (a) What are the purposes of the calendar?

   (b) What calendar styles have you ever seen?

   (c) What characteristics of materials are suitable for a calendar?

   (d) What is reuse material?

   (e) What is a reusable monthly wall calendar?

   (f) Should it be lightweight?

   (g) Can you use other materials instead of paper?

   (h) What tools do you need?

3. Ask students to think about how to assess their project. Discuss in class and set their criteria using the following questions:

   (a) What are the achievement criteria? (light weight material, reusable, etc.)

   (b) How do we evaluate our success? (can be pasted or hung the wall and stay in place, dates or notes can be deleted to allow new dates or notes to be added, etc.)

4. Get students to brainstorm. Let them decide and choose their best solution. They should draw their design including labels of materials and draft method. Then, let them follow their plans and create.

5. After they have finished their work, ask them to assess their reusable monthly wall calendar by using the criteria stated in no.3. Teacher may ask these following questions:

   (a) Did your work meet the criteria?

   (b) What works or what does not work?

   (c) How will you modify your solution to make it better?

6. Let them improve their design. Teacher may point out their weak points, then motivate them to think about how to improve it. (Teacher may skip this step due to time constraint and may ask them to explain the need to do so and how to do it instead.)

7. Each group presents their work and explain their journey of creating it. (Teacher may suggest them a suitable type of presentation and/or assign them the topics for presentation such as team members, product, journey of creating their work, problems, how to test and ways to improve.)

Conclusion:

1. End the lesson by asking students the following questions:

   (a) Do you think that you act as an engineer? Why? Why not?

   (b) What is the engineering design process?

   (c) Did you apply the engineering design process into your work?

   (d) Did each team come up with the same design? Why? Why not?

   (e) What subject knowledge did you apply into this activity?

   (f) What did you learn from this activity?

   (g) What are the key success factors that affect your group work? (Teamwork, creative thinking, etc.)

   (h) What will happen if you build the calendar without a proper plan and design?

Suggested materials:

Glue, marker, color paper, scissors, pencil, ruler, sticky tape, construction paper

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 9 Points, Lines, Line Segments, Rays and Planes

Time: 12 hours

Strand 2: Measurement and Geometry

Standard M.2.2: Understand and analyze geometric figures, the properties of geometric figures, the relationship between geometric figures and geometric theories, and application.

Indicator:

M 2.2 Gr4/1   Distinguish types of angles, names and components of angles and write symbols for angles.

Learning objectives:

Students will be taught to:

- Understand points, lines, line segments, rays and angles.

Competency:

- Thinking skills
- Applying life skills

Start up:

- Assess the students' prior knowledge about points, lines, line segments, rays and planes by asking what the students knew and what they want to know more about points, lines, line segments, rays and planes.

- Let students write all their prior knowledge in Part K column on page 126 and have the students share what they know about points, lines, line segments, rays and planes. Then ask the students to write some questions which they want to know in Part W column on page 126.

Teaching/Learning activities:

1st – 3rd hours (Points)

1. Introduce the concept of points by playing an A-B-C spot game. Get the students to stand in a circle. Identify three spots in the circle as A, B and C spots. (The A, B and C spots have to be limited within the circle). Do not indicate the spots.

2. Ask them to remember the A, B and C spots in their mind.

3. Say "Go to A spot!" and they all have to walk to their A spot. (Everybody must walk to their A spot without any noises.) Then say "Go to B spot!" or "Go to C spot!" many times. Challenge them by changing the spot faster. (So, they have to concentrate and try to remember where their spots are.)

4. Explain the concept of points by using the example on page 127. Guide them on how to read, write and draw a symbol for a point.

5. Have students try Practice on page 127 and discuss the answers with them.

6. Have students do Exercise F on page 116 of the Workbook as their homework.

4th – 5th hours (Lines)

1. Explain the concept of lines by using the example on page 128.

2. Guide them on how to read, write and draw a symbol for a line.

3. Have students try Practice on page 128 and discuss the answers with them.

4. Have students do Exercise A on page 114 of the Workbook as their homework.

6th – 7th hours (Line segments)

1. Explain the concept of line segments by using the example on page 129.

2. Guide them on how to read, write and draw a symbol for a line segment.

3. Introduce the concept of line segments by asking each student to draw a line segment in order to create a diagram. For example, the first student draws a line segment on the board and then the next student continues with another line segment and so on. At the end, ask them to count the line segments and points in the diagram.

4. Have students try Practice on page 130 and discuss the answers with them.

5. Have students do Exercises B and G on pages 114 and 116 of the Workbook as their homework.

8th – 9th hours (Rays)

1. Explain the concept of rays by using the examples on page 131.

2. Guide them on how to read, write and draw a symbol for a ray.

3. Have the students try Practice on page 131 and discuss the answers with them.

4. Have students do Exercises C and H on pages 114 and 117 of the Workbook as their homework.

10th – 11th hours (Planes)

1. Explain the concept of planes by using the examples on page 132.

2. Introduce to students that a plane is two-dimensional (2D). Guide them on how to name a plane.

3. Ask students to show some examples of planes in classroom.

4. Have the students try Practice on page 132 and discuss the answers with them.

5. Have students do Exercises D and E on page 115 of the Workbook as their homework.

12th hours (Conclusion)

1. Get the students to tick what they have learned and understood on page 133 (Part L column).

2. Guide the whole class to conclude the concept of points, lines, line segments, rays and planes by using the same A-B-C spot game or draw line segments to create a diagram and then ask them count and correct the answers.

3. Have students complete Mastery Practice on pages 118 to 121 of the Workbook.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 4
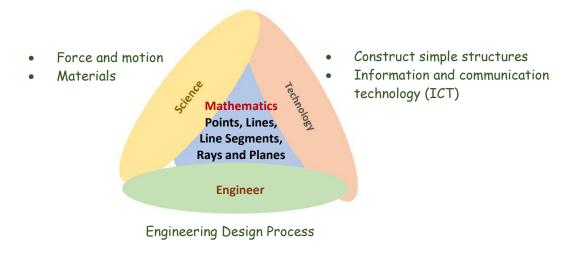- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 4

Assessment:

1. To assess cognitive behavior, test on page 133 (Part L column).

2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.

3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: I love kites!

Overview

Kite flying is a fun and popular outdoor activity in Thailand. In this activity, the students will create their kites with the listed materials. It is easy for the students to apply their knowledge of mathematics in order to create this handmade kite. They should test their kite with a tail and without a tail. Let them discuss their experience of flying a kite so that they can use their creativity to create a better one.

Subject integration

- Force and motion
- Materials

Science

Mathematics
Points, Lines, Line Segments, Rays and Planes

Technology

- Construct simple structures
- Information and communication technology (ICT)

Engineer

Engineering Design Process

Activity guide

Time: 3 hours

Start up:

1. Divide the students into groups of 3 to 4 students.
2. Discuss about our popular outdoor activity during Kite Festival in February and March.

Lesson development:

1. Have the students to read the situation on page 133. Then, lead the students to discuss and identify a problem by answering these questions:

    (a) What are you required to do?

    (b) What are your missions?

    (c) What is the problem of this situation?

    (d) What do you need to know to get started?

2. Engage the students to explore and make connections between science, technology, engineering and mathematics by asking some of these following questions:

    (a) What does the shape of a kite look like?

    (b) Are the sides of the kite symmetry? Why?

    (c) How do you start to make a kite? Can you start by using two drinking straws?

    (d) What materials should be used for making kites? Give a list of materials and explain why you choose them.

    (e) How do you connect each side?

    (f) Does a big kite fly better than a small kite? Why?

    (g) What factors affect the ability of a kite to fly – the size, the shape or the materials?

    (h) Does it need a tail? What is the function of a tail?

    (i) How do you measure the duration of your kite flying in the air? (The best kite in your class should fly the longest time in the air.)

    (j) How can you accurately measure how high the kite is flying actually?

3. Ask the students to think about how to assess their project. Lead them to discuss in class and set their criteria using the following questions:

    (a) What are the achievement criteria? (Duration of the kite flying in the sky, finish the project on time, limited materials, etc.)

(b) How do we evaluate our success? (Measure the duration of the kite flying in the sky, the height of the kite, creative design, etc.)

4. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them follow their plans and create.

5. After they have finished their work, ask them to assess their kite by using the criteria stated in no.3. Teacher may ask the following questions:

    (a) Did your kite meet the criteria?

    (b) Do you and your team feel satisfied with your work? Why? Why not?

    (c) What works? What does not work?

    (d) Can it fly for a long time?

    (e) How high can it fly?

    (f) Can you figure out the weak points of your kite?

    (g) How will you modify your solution to make it better?

6. Let them improve their design. Teacher may point out their weak points, then motivate them to think about how to improve it. (Teacher may skip this step due to time constraint and may ask them to explain the need to do so and how to do it instead.)

7. Each group presents their work and explain their journey of creating it. (Teacher may suggest them a suitable type of presentation and/or assign them the topics for presentation such as team members, product, journey of creating their work, problems, how to test and ways to improve.)

Conclusion:

1. End the lesson by asking the students the following questions:

    (a) Do you think that you have acted as an engineer? Why?

    (b) What is the engineering design process?

    (c) Did you apply the engineering design process into your work?

    (d) Can you apply it in your daily life?

(e) Did each team come up with the same design? Why? Why not?

(f) What are the key success factors that affect your group work? (Teamwork, creative thinking, etc.)

(g) Do you think that teamwork is important? Why?

(h) What subject knowledge did you apply into this activity?

(i) What are the benefits of this activity?

(j) What will happen if you build the kite without a proper plan and design?

(k) What did you learn from this activity?

Suggested materials:

Aluminum foil, kite string, sticky tape, drinking straw, scissors, glue, ruler

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 10 Angles

Time: 18 hours

Strand 2: Measurement and Geometry

Standard M.2.1: Understand the fundamental of measurement, measure and estimate the sizes of wanted objects and application.

Indicator:

M 2.1 Gr4/2   Measure and create angles using a protractor.

Standard M.2.2:

Understand and analyze geometric figures, the properties of geometric figures, the relationship between geometric figures and geometric theories, and application.

Indicator:

1. Distinguish types of angles, names and components of angles and write symbols for angles.

Learning objectives:

Students will be taught to:

- Draw and measure angles.
- Understand types of angles.

Competency:

- Communication skills
- Applying life skills

Start up:

- Assess the students' prior knowledge about angles asking what the students knew and what they want to know more about angles.

- Let students write all their prior knowledge in Part K column on page 135 and have the students share what they know about angles. Then ask the students to write some questions which they want to know in Part W column on page 135.

Teaching/Learning activities:

1st – 6th hours (Types of angles)

1. Show students diagrams that have geometric shapes. Ask them to find out whether they find angles in the diagrams. Ask them, "How many angles are there?"

2. Use the example on page 136 to explain how to name an angle.

3. Show students different types of angles and ask them to observe what are the differences and similarities among those angles.

4. Explain each type of angles – right angle, acute angle, obtuse angle, straight angle and reflex angle using examples on pages 137 and 138.

5. Draw each type of angles on the board and ask students to identify them.

6. Tell the students to use their arms to make angles when teacher say the types of angles. Observe the angles demonstrated by students and check their understanding of angles. Repeat several times until students consistently demonstrate the angles correctly.

7. Watch a video of types of angles by scanning the QR code below.

8. Discuss with students what they have learned from the video.

9. Have students try Practice on pages 138 and 139 and discuss the answers with them.

10. Have students do Exercises A, B and C on pages 124 and 125 of the Workbook as their homework.

7ᵗʰ – 12ᵗʰ hours (Measuring angles)

1. Every student should have a protractor. Guide students to read the scales on a protractor – the inner scale and the outer scale.

2. Guide students to measure angles by using the examples on pages 141 and 142. Explain where they should place the protractor on the angles. Explain the Math Tips on page 141.

3. Draw a few angles on a few pieces of paper and get students to measure them. Explain the Math Tips on page 142.

4. Have students try the question in Let's Think on page 142 and discuss the answers with students.

5. Guide students on how to measure reflex angles on page 143.

6. Use Math Tips on page 143 to remind students that the lengths of the sides do not affect the size of an angle.

7. Have students try Practice on page 144 and discuss the answers with them.

8. Have students do Exercises D, E and F on pages 126 and 127 of the Workbook as their homework.

13ᵗʰ – 17ᵗʰ hours (Drawing angles)

1. Review their prior knowledge of angles by asking them each type of angle. Ask students to answer what shapes you are drawing on the board. They must raise their hand when they want to answer. When students answer correctly, discuss the characteristics of angles in a class.

2. Guide students on how to draw angles by using protractor using the steps on pages 145 and 146.

3. Have students work in pairs. Ask a student to draw an angle of 110°. Then ask their partner to check if the angle is drawn correctly. Ask them to switch the role and draw a few angles of different sizes.

4. Have students try Practice on page 147 and discuss the answers with them.

5. Have students to complete Exercise G on page 128 of the Workbook as their homework.

18th hours (Conclusion)

1. Get the students to tick what they have learned and understood on page 148 (Part L column).

2. Review the vocabulary used by referring to keywords in each subtopic in the chapter.

3. Guide the whole class to conclude the concept of angles with the following sample activities:

(a) Angle game
   - Demonstrate how two students can play angle game together. One student should be the "caller" of each angle; another student will create the angles with their arms and call out the angle types.

(b) Toothpick angles
   - Students will create their own angle poster using toothpicks to represent types of angles including the labels of those angles. Encourage students to decorate and color their posters creatively. When they are finished, arrange an art exhibition in the classroom.
   - Materials: toothpicks, glue, construction paper and markers.

(c) Clap and say

- Have students sit in a circle. Explain to them that they will play clap and say game.
- Choose a student to start the game and ask the student to clap his/her hands. Then the student uses his/her hands to make an angle and say the name of the angle. Then turn to the next student.

4. Have students complete Mastery Practice on pages 129, 130 and 131 of the Workbook.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 4
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 4
- Diagrams of geometric shapes and types of angles
- Protractors
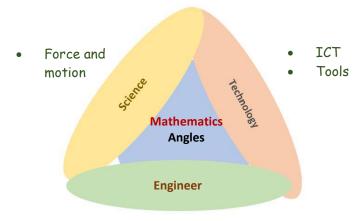- Toothpicks, glue, construction paper and markers

Assessment:

1. To assess cognitive behavior, test on page 148 (Part L column).

2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.

3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: Marble run

Overview

In this activity, students will design and create a marble run that includes different sizes of angles. The marble run can be built as a sculpture (at least 20 cm tall) or made as a handheld marble run (as least 30 cm wide). A marble run consists of one or more marbles rolling down pieces of tracks or ramps. The tracks and ramps have different sizes of angles that affect the motion of the marbles.

Subject integration

- Force and motion

- ICT
- Tools

Science

Technology

Mathematics
Angles

Engineer

Engineering Design Process

Activity guide

Time: 3 hours

Start up:

1. Divide the students into groups of 3 to 4 students.

2. Talk about their previous STEM activities by asking the following questions:

    (a) Do you like those activities? Why? Why not?

    (b) Which one is your favorite activity? Why?

    (c) Did you learn from those activities? Can you tell about it?

    (d) Did you work alone or work as a team? How was your team?

    (e) Did your team work collaboratively?

(f) What did you help your team? Are you a good team member?

(g) What is the process that you used to design and create your works?

(h) Can you apply it in your daily life?

3. Discuss about geometry that they have learned and how they draw and measure angles.

Lesson development:

1. Have students to read the situation on page 148. Then, lead students to discuss and identify a problem by answering the following questions:

(a) What are you required to do?

(b) What are your missions?

(c) What is the problem of this situation?

(d) What do you need to know to get started?

2. Engage students to explore and make connections between science, technology, engineering and mathematics by asking the following questions:

(a) What are some systems that are designed to move things along a specific course? (Aqueduct, sewer, roller coaster, subway, escalator, conveyor belt, power line, etc.)

(b) Where does water go when it goes down the drain? (To the sewer, then to a sewage plant, then back to the environment.)

(c) How does water get to your home? (Pipes bring water into your house.)

(d) What could go wrong with the way water comes to your home? (Pipes could break.)

- Today you will make a marble run, which is a lot like a pipe that carries water. The catch? We want the marble to go through this marble run as slowly as possible.

(e) Have you ever played marbles? How is it? Is it heavy?

(f) Can we control the marble tracks after we throw it? How?

(g) If we want the marbles go in long distance, what should we do? Should we put more force?

(h) Use car as example to explain students about how marbles run in track. If a car goes from very slow to very fast in a short amount of time is that fast or slow?

(i) Ask students to think about factors which can make marbles run in track faster or slower such as:

- Slope – angle of a piece of track (the steeper the angle the faster the acceleration).

- Impediments – an obstruction that causes the marble to slow down.

3. Ask students to think about how to assess their project. Guide them to discuss in class and set their criteria using the following questions:

(a) What are the achievement criteria? (A complete marble run tracks, etc.)

(b) How do we evaluate our success? (The marble run tracks which is in line with condition such as at least 20 cm tall or at least 30 cm wide)

4. Get students to brainstorm. Let them decide and choose their best solution. They should draw their design including the labels of materials and draft method. Then, let them follow their plans and create. Teacher can give some suggestions if some students may not understand well about angles.

5. After they have finished their work, ask them to assess their marble run tracks by using the criteria stated in no.3. Teacher may ask the following questions:

(a) Did your work meet the criteria?

(b) Do you and your team feel satisfied with your work? Why? Why not?

(c) What works or what does not work?

(d) Can it stand freely? Can it be hold by hand?

(e) Can you figure out the weak points of your marble run tracks?

(f) How will you modify your solution to make it better?

6. Let them improve their design. Teacher may point out their weak points, then motivate them to think about how to improve it. (Teacher may skip this step due

to time constraint and may ask them to explain the need to do so and how to do it instead.)

7. Each group presents their work and explain their journey of creating it. (Teacher may suggest them a suitable type of presentation and/or assign them the topics for presentation such as team members, product, journey of creating their work, problems, how to test and ways to improve.)

Conclusion:

1. End the lesson by asking students the following questions:
   (a) Do you think that you act as an engineer? Why or why not?
   (b) What is the engineering design process?
   (c) Did you apply the engineering design process into your work?
   (d) Did each team come up with the same design? Why or why not?
   (e) What are the key success factors that affect your group work? (Teamwork, creative thinking, etc.)
   (f) Do you think that teamwork is important? Why or why not?
   (g) What subject knowledge did you apply into this activity?
   (h) What are the benefits of this activity?
   (i) What will happen if you build the marble run tracks without a proper plan and design?
   (j) What did you learn from this activity?

Suggested materials:

Marbles, straws, glue, cardboard, sticky tape, molding clay, shoe box, ice cream sticks

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 11 Rectangles

Time: 18 hours

Strand 2: Measurement and Geometry

Standard M.2.1: Understand the fundamental of measurement, measure and estimate the sizes of wanted objects and application.

Indicator:

M 2.1 Gr4/3 Demonstrate the methods of finding answers to word problems involving perimeter and the area of rectangles.

Standard M.2.2

Understand and analyze geometric figures, the properties of geometric figures, the relationship between geometric figures and geometric theories, and application.

Indicator:

M 2.2 Gr4/2   Create rectangles according to the indicated length of the sides.

Learning objectives:

Students will be taught to:

- Understand type and draw rectangles.
- Understand perimeter rectangles.
- Calculate area of rectangles.
- Solve word problem of rectangles.

Competency:

- Thinking skills
- Problem-solving skills
- Analytical skills

Start up:

1. Assess the students' prior knowledge about rectangles by asking what the students knew and what they want to know more about rectangles.

2. Let students write all their prior knowledge in Part K column on page 150 and have the students share what they know about rectangles. Then ask the students to write some questions which they want to know in Part W column on page 150.

Teaching/Learning activities:

1st – 3rd hours (Types of rectangles)

1. Introduce two types of rectangles – rectangles and squares by drawing some rectangles on the board and ask students to name them.

2. Ask students to observe and differentiate each types of rectangles. Explain Math Tips on page 151.

3. Have students try Practice on page 152 and discuss the answers with them.

4. Have students do Exercises A and B on page 134 of the Workbook as their homework.

4th – 8th hours (Drawing rectangles)

1. Guide students on how to draw rectangles by using a set square or a protractor and a ruler by using the example on page 153.

2. Following Math Tips on page 154, ask them to draw rectangles in different sizes.

3. Have students try Practice on page 154 and discuss the answers with them.

4. Have students do Exercise C on page 135 of the Workbook as their homework.

9th – 11th hours (Perimeter of a rectangle)

1. Explain the concept of perimeter by using the example on page 155.

2. Demonstrate how to find the perimeter of the rectangle on page 155.

3. Explain the formulae to calculate perimeters of rectangles in Math Tips on page 155.

4. Have students try Practice on page 156 and discuss the answers with them.

5. Have students do Exercise D on page 136 of the Workbook as their homework.

12th – 14th hours (Area of a rectangle)

1. Guide students on how to find the areas of rectangles and squares by using formulae on page 157 and Math Tips on page 158.

2. Have students try Practice on pages 158 and 159 and discuss the answers with them.

3. Have students do Exercise F on page 138 of the Workbook as their homework.

15th – 17th hours (Solving word problems involving perimeter and area of rectangles)

1. Explain to students on how to solve word problems in order to find the areas of rectangles.

2. Demonstrate how to solve word problems by using examples on page 160.

3. Have students try Practice on page 161 and discuss the answers with them.

4. Have students do Exercises E and G on pages 137 and 139 of the Workbook as their homework.

18th hours (Conclusion)

1. Get the students to tick what they have learned and understood on page 162 (Part L column).

2. Review the vocabulary used by referring to keywords in each subtopic in the chapter.

3. Guide the whole class to conclude the concept of rectangles with the following sample activities:

   (a) Think and say game

   - Choose a volunteer to draw a rectangle on the board. If a student wants to answer what the shape on the board is, he/she must raise his/her hand. When a student answers correctly, discuss its characteristics of the shape to the class.

   - Walk around the classroom with a rectangle card and randomly ask students what a particular shape is. Then ask students to tell you 1 or 2 characteristics of the shape and give examples where they can find this shape in their daily life.

   (b) Paired Practice

   - In pairs, ask students to look around the classroom and find various rectangles and angles in the classroom, such as the board and the corners of the board, or the legs of a chair, and sort the types of rectangles and angles.

4. Have students complete Mastery Practice on pages 140, 141 and 142 of the Workbook.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 4
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 4
- Set square or protractor, ruler
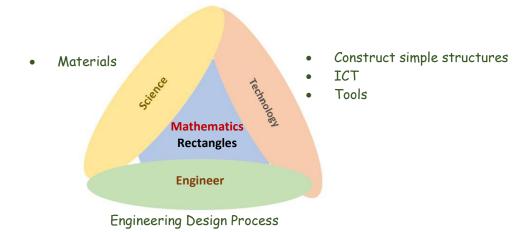- Rectangles and geometric shape cards

Assessment:

1. To assess cognitive behavior, test on page 162 (Part L column).

2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.

3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: Tangles of headphone cables

Overview

Poor storage of headphone cables is the main cause of cable breaking. Some people keep them in their pockets or bags however their cables always get tangled later, no matter how neatly they try to wrap them. In this chapter, students and their team are working in a phone company. They are required to design and create a headphone cable wrap for customers in order to prevent the cables from getting tangled. They will apply their knowledge of rectangles and/or triangles for designing their devices.

Subject integration

- Materials

- Construct simple structures
- ICT
- Tools

Science

Technology

Mathematics
Rectangles

Engineer

Engineering Design Process

Activity guide

Time: 3 hours

Start up:

1. Divide the students into groups of 3 to 4 students.

2. Review their prior knowledge or prior experiences of the engineering design process:

   (a) What is the engineering design process?

   (b) What are the steps of the engineering design process?

(c) What are the purposes of the engineering design process?

(d) Have you ever applied the engineering design process to a project? Give some examples.

Lesson development:

1. Have students read the situation on page 162. Then, lead students to discuss and identify a problem by answering the following questions:

   (a) What are you required to do?

   (b) What are your missions?

   (c) What is the problem of this situation?

   (d) What do you need to know to get started?

2. Engage students to explore and make connections between science, technology, engineering and mathematics by asking the following questions:

   (a) What materials of cables are usually made of?

   (b) What are the properties of those materials?

   (c) Do the different types of cables have their own breaking points?

   (d) Have you ever seen any devices that can protect the tangle of headphone cables? How do they look like?

   (e) Can you apply your knowledge of rectangles to this project?

   (f) What is a suitable size of the device?

   (g) What is a proper shape of the device? Rectangle or square? What are the differences?

   (h) What materials can be used? Soft or hard?

   (i) What are the good and bad points of soft and hard materials?

   (j) How do you use the device? Keep in a bag or attach with a mobile?

3. Ask students to think about how to assess their project. Guide them to discuss in class and set their criteria using the following questions:

(a) What are the achievement criteria? (Functional and practical item, etc.)

(b) How do we evaluate our success? (Easy to use, endurance, safety and creative design, etc.)

4. Get students to brainstorm. Let them decide and choose their best solution. They should draw their design including the labels of materials and draft method. Then, let them follow their plans and create.

5. After they have finished their work, ask them to assess their tangle-free wrap by using the criteria stated in no.3. Teacher may ask the following questions:

(a) Did your work meet the criteria?

(b) Do you and your team feel satisfied with your work? Why? Why not?

(c) What works or what does not work?

(d) Can you figure out the weak points of your work?

(e) How will you modify your solution to make it better?

6. Let them improve their design. Teacher may point out their weak points, then motivate them to think about how to improve it. (Teacher may skip this step due to time constraint and may ask them to explain the need to do so and how to do it instead.)

7. Each group presents their work and explain their journey of creating it. (Teacher may suggest them a suitable type of presentation and/or assign them the topics for presentation such as team members, product, journey of creating their works, problems, how to test and ways to improve.)

Conclusion:

1. End the lesson by asking students the following questions:

(a) Do you like this activity? Why? Why not?

(b) Do you think that you act as an engineer? Why? Why not?

(c) Did you apply the engineering design process into your work?

(d) Did each team come up with the same design? Why? Why not?

(e) What are the key success factors that affect your group work? (Teamwork, creative thinking, etc.)

(f) Do you think that teamwork is important? Why? Why not?

(g) What subject knowledge did you apply into this activity?

(h) What are the benefits of this activity?

(i) What will happen if you build the tangle-free wrap without a proper plan and design?

(j) What are the benefits of designing before creating?

(k) What are the steps that you used to design and create your works?

(l) What did you learn from this activity?

Suggested materials

A variety of cardboards or construction papers, newspaper, old magazines, glue, straws, scissors or cutter (use under adult's supervision)

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 12 Bar Charts and Two-way Tables

Time: 12 hours

Strand 3: Statistics and Probability

Standard M.3.1: Understand the statistical process and use statistics knowledge to solve problems.

Indicator:

M 3.1 Gr4/1   Use data from bar charts, two-way table to find the answers of word problems.

Learning objectives:

Students will be taught to:

- Construct bar charts.

Competency:

- Communication skills
- Technological application skills

Start up:

- Assess the students' prior knowledge about bar charts and two-way tables asking what the students knew and what they want to know more about bar charts and two-way tables.

- Let students write all their prior knowledge in Part K column on page 164 and have the students share what they know about bar charts and two-way tables. Then ask the students to write some questions which they want to know in Part W column on page 164.

Teaching/Learning activities:

1st – 7th hours (Reading and drawing bar charts)

Reading bar charts

1. Explain what bar charts are and the components of a bar chart by using the example on page 165 and analyze it with them. Explain the use of the jagged line in a bar chart.

2. Show students a bar chart and have them try to extract information from it.

3. Have students try the question in Let's Think on page 165 and discuss the answers with students.

4. Have students do Exercises A, B and C on pages 144, 145 and 146 of the Workbook as their homework.

Drawing bar charts

1. Use the example on page 166 to guide students on how to construct a bar chart step by step and remind them to use an interval scale consistently.

2. Have students try Practice on pages 167 and 168 and discuss the answers with them.

3. Have students do Exercises D and E on pages 147 and 148 of the Workbook as their homework.

8th – 11th hours (Two-way tables)

1. Explain what a two-way table is and the components of a two-way table. Use the example on page 169 to analyze the two-way table with the students.

2. Give students more examples and explain how to interpret the tables.

3. Have the students try Practice on pages 170 and 171, then discuss the answers with them.

4. Have students do Exercises F and G on pages 149 and 150 of the Workbook as their homework.

12th hours (Conclusion)

1. Get the students to tick what they have learned and understood on page 171 (Part L column).

2. Review the vocabulary used by referring to keywords in each subtopic in the chapter.

3. Guide the whole class to conclude the concept of bar charts and two-way tables with the following sample activities:

    (a) Make a survey

    - Assign students to make a survey based on their interests and present at least 5 issues in a bar chart.

    - Each group exchanges their survey and practice.

    (b) Satisfaction survey

    - The whole class create a survey project such as a satisfaction survey of lunch or favorite subjects among gender and class. Ask them to present their two-way table and explain about their findings to other classes.

4. Have students complete Mastery Practice on pages 151, 152 and 153 of the Workbook.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 4
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 4
- Examples of bar charts and two-way tables

Assessment:

1. To assess cognitive behavior, test on page 171 (Part L column).

2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.

3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

Scoring Rubric for Affective Domain

Skill	Needs improvement (1)	Partially proficient (2)	Proficient (3)	Advanced (4)
Self-motivation	Consistently fail to meet established deadlines	Take initiative to complete assignments and improve or correct behaviors	Occasionally complete and turn in assignments before the scheduled deadline	Never miss a deadline and often complete assignments well ahead of deadlines
Communication	Unable to speak or write clearly and is unable to correct their behaviors despite intervention by instructors, does not actively listen	Needs work to speak or write clearly, sometimes able to identify alternative communication strategies	Speak clearly, write legibly, listen actively, and adjust communication strategies to various situations	Comfortable utilize a variety of communication styles, write legibly, speak clearly, and listen actively
Teamwork	Manipulate the team or act with disregard to the team, disrespectful to team members, resistant to change or refuse to cooperate in attempts to work out solutions	Sometimes act for personal interest at the expense of the team, act independent of the team or appear non-supportive, and occasionally unwilling to work out a solution	Place the success of the team above self-interest, do not undermine the team, help and support other team members, and show respect for all team members	Place success of the team above self-interest, take a leadership role and use good management skills while leading, and involve all team members in the decision-making process
Neatness	The work appears sloppy and unorganized. It is hard to know what information goes together	The work is organized but may be hard to read at times	The work is neat and organized. It is easy to read	The work is neat, clear, and organized. It is easy to read
Completion	Most of the work is not complete even additional time or suggestions were given	Some work is not complete and need additional suggestions	Some work is not complete and need additional time	All works are complete
Responsibility	Always relies on others to complete assignments	Rarely does the work and needs constant reminders to stay on task	Usually does the work and seldom needs reminders to stay on task	Always does assigned work without being reminded

Analytic Scoring Scale

Understanding the problem	**2 points** Complete understanding of the problem
	1 point Part of the problem misunderstood or misinterpreted
	0 point Complete misunderstanding of the problem
Planning a solution	**2 points** Plan could have led to a correct solution if implemented
	1 point Partially correct plan based on part of the problem being interpreted correctly
	0 point No attempt or totally inappropriate plan
Getting an answer	**2 points** Correct answer
	1 point Copying error, computational error, partial answer for a problem with multiple answers
	0 point No answer or wrong answer based on an inappropriate plan

*The analytic scoring scale from Charles, R., Lester, F., & O'Daffer, P. (1987). How to evaluate progress in problem-solving, Reston, VA: National Council of Teachers of Mathematics retrieve from *Assessing Students' Mathematical Problem-Solving and Problem-Posing Skills*. Available from:
https://www.researchgate.net/publication/269519904_Assessing_Students'_Mathematical_Problem-Solving_and_Problem-Posing_Skills [accessed May 19 2019].

Process-based Scoring Rubric

Understanding the concept	**4 points** Complete understanding
	2 points Some understanding
	1 point Poor understanding
Solution of the problem	**4 points** All correct
	2 points Partially correct
	1 point Attempted to solve
Creativity of the problem	**4 points** Completely different from the text
	2 points Somewhat different from the text
	1 point Comparable to types in text
Solution of partner's problem	**4 points** All correct
	2 points Partially correct
	1 point Attempted to solve

* The process-based scoring rubric from Kulm, G. (1994). Mathematics assessment: What works in the classroom. San Francisco, CA: Jossey Bass Inc. Permission pending Available from: https://www.researchgate.net/publication/269519904_Assessing_Students'_Mathematical_Problem-Solving_and_Problem-Posing_Skills [accessed May 19 2019].

Scoring Rubric for STEM Activities

Skill	Needs improvement (1)	Partially proficient (2)	Proficient (3)	Advanced (4)
Creativity	The project has little creative and unique aspects	The project has some creative and unique aspects	The project adequate has creative and unique aspects	The project has plenty of creative and unique aspects
Communication and collaboration	The information is not organized. Data is presented inaccurately. There is no drawing plan	Some information is clear and organized. There is a drawing plan without any label	Most information is clear and organized. There is a clearly labelled drawing plan	All information and data are clear and organized. They are presented accurately. There is a clearly labelled drawing plan
Technology operations	No technological resource was used in the project or was used incorrectly	Little technological resource was used in the project or was not used correctly	Technological resource was used in the project correctly	Multiple technological resources were used appropriately
Teamwork	Pupils demonstrate no cooperation, courtesy, enthusiasm, confidence, and accuracy	Pupils demonstrate little cooperation, courtesy, enthusiasm, confidence, and accuracy	Most pupils demonstrate some cooperation, courtesy, enthusiasm, confidence, and accuracy	All pupils demonstrate high level of cooperation, courtesy, enthusiasm, confidence, and accuracy
Presentation	Presentation lacks detail needed to understand the team's solution	Presentation provides adequate explanation of how the solution was developed and how it works	Presentation or visual aids provide clear, effective, and creative explanation of how solution was developed and how it works	Presentation and visual aids provide very clear, effective, and creative explanation of how solution was developed and how it works