Teacher's Guide
Mathematics

Primary
Education
Smart+
Prathomsuksa

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Contents

Preface

Why do we have to learn mathematics?

In the 21st century learning, mathematics plays an important role because mathematics helps people to have creative reasoning and systematic thinking and enables 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 learners to be ready for learning things and working after graduation or furthering their study at higher levels, 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, graphs, 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, mass, area, volume and capacity, money and time, measuring units, 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 5 (Grade 5)

11 chapters   160 hours

Learning areas	Time (hours)
1. Whole Numbers • Combined operations • Solving word problems involving combined operations	20
2. Fractions • Comparing fractions • Addition and subtraction of fractions • Multiplication of fractions • Division of fractions • Combined operations of fractions • Solving word problems involving combined operations of fractions	20
3. Decimals • Relationship between fractions and decimals • Estimating decimals • Estimating the results of decimal addition and subtraction • Multiplication of decimals • Division of decimals • Solving word problems involving multiplication and division of decimals • Performing combined operations on decimals • Solving word problems involving combined operations on decimals	25

4. Percentage • Reading and writing percentages • Finding the percentages of whole numbers • Writing a discount as a percentage • Solving word problems involving percentages	20
5. Length • Relationships between units of length • Measuring length • Solving word problems involving length	10
6. Mass • Relationships between units of mass • Measuring mass • Solving word problems involving mass	10
7. Volume and capacity • Volume and capacity of a cuboid • Relationship between units of volume and capacity • Solving word problems involving volumes and capacities of cuboids	10
8. Lines and Angles • Corresponding, alternate, interior and external angles • Perpendicular lines • Parallel lines • Drawing parallel lines	15
9. Quadrilaterals • Types and properties of quadrilaterals • Diagonals of quadrilaterals • Constructing quadrilaterals • Perimeter of a quadrilateral • Area of a quadrilateral • Solving word problems involving quadrilaterals	12

	8
10. Prisms • Characteristics of prisms	

11. Data presentation
   • Reading and drawing bar charts with a jagged line
   • Reading and drawing multiple bar charts
   • Reading line graphs
	10

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 Whole numbers

Time: 7 hours

Strand 1: Numbers and Algebra

Standard M 1.1

Indicators:

M 1.1 Gr5/1   Write fractions that the denominators are the factor of 10 or 100 or 1,000 in decimals.

M 1.1 Gr5/2   Show mathematical methods of finding answers of word problems using the rule of three in arithmetic.

Learning objectives:

- Understand and perform combined operations.

- Perform solving word problems involving combined operations.

- Creating and solving word problems based on number sentences.

Competency:

- Thinking skills

- Problem-solving skills

Start up:

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

- Write all their prior knowledge (Part K) on page 1 and have students share what they know about whole numbers. Then ask students to write some questions which they want to know (Part W) on page 1.

Teaching/ learning activities:

1st – 3rd hours (Combined operations)

1. Guide students on how to solve combined operations on page 2. Remind them to always do the operations in the brackets first.

2. Explain more examples on how to solve combined operations on page 3 (Teacher may ask each student for each step to ensure that they understand.)

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

4. Assign them to do Exercises A to C in the workbook on pages 2 to 5 as their homework.

4th – 6th hours (Solving word problems involving combined operations)

1. Guide students to solve word problems involving combined operations by using the example on page 5.

2. Emphasize that they have to understand the problems first and write what they need to find out and then what operation they want to use (Rule of three). Refer to page 6.

3. Write some number sentences on the board. Guide students on how to create word problems based them.

4. Assign each group to write a number sentence and then give to another group to create a word problem and solve it on the board.

5. Have students try Practice on pages 7 and 8 and discuss the answers with them.

6. Assign them to do Exercise D in the workbook on pages 6 and 7 as their homework.

7th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 8 (Part L column).

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

3. Guide the whole class to conclude the concept of whole numbers with these sample activities:

- Work in pairs. Assign one of the students to create word problems by using supermarket brochures. The other will solve the word problems.

- Divide the class into six groups. Give different sets of four numbers to any three groups and ask them to create number sentences and word problems with combined operations using those numbers. The other three groups will have to solve them.

4. Have them complete Mastery Practice in the workbook on pages 8 and 9.

Learning materials:

• Primary Education Smart Plus Mathematics Textbook Prathomsuksa 5
• Primary Education Smart Plus Mathematics Workbook Prathomsuksa 5

Assessment:

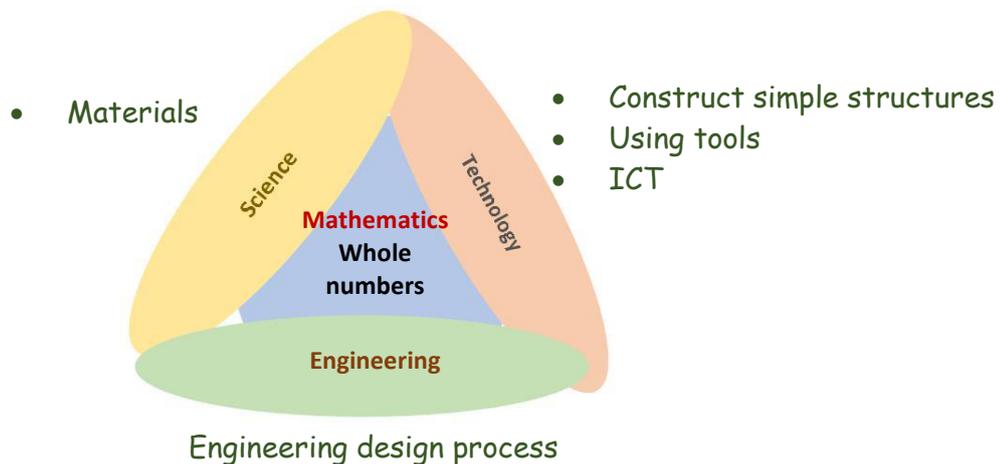1. To assess cognitive behavior, test on page 8 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

STEM Activity: Transportation game

Overview

Bangkok is served by three rail rapid transit systems, namely MRT, BTS and ARL. These public transportation lines are interconnected. Students are required to design and create a game for 2 players. It is about travelling on the rail rapid transit systems in Bangkok. They will set up a complete set of instructions for the game and they can also put extra details on the board or map if they wish.

Subject integration

- Materials

- Construct simple structures
- Using tools
- ICT

Science

Technology

Mathematics
Whole numbers

Engineering

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:

   - What is the engineering design process?

   - What are the steps of the engineering design process?

   - What are the purposes of the engineering design process?

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

Lesson Development:

1. Assign students to read the situation on page 9. Then, lead students to discuss and identify a problem by answering to these questions:

    (a) What are we required to do?

    (b) What are our missions?

    (c) What is the problem of this situation?

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

2. Then, motivate students to explore and make connections between science, technology, engineering and mathematics by posing some of these following questions:

    (a) What materials should you select? What are the characteristics of those materials?

    (b) How do you get the transportation maps?

    (c) What does your game look like?

    (d) Who can play this game (age, gender)?

    (e) What are the objectives of the game?

    (f) What is the game all about?

    (g) How do you play this game? Can you explain in detail: how to start, how to make a move, how to calculate the price of the ticket, how to be a winner of the game?

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

    (a) What are the achievement criteria? (a transportation game with the rules of a game, a game design, etc.)

    (b) How do we evaluate our success? (A satisfaction survey)

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

5. After they have finished their work, ask them to assess their transportation game by using the criteria stated in no.3. Teacher may pose these 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) Is it easy or difficult to play?

   (e) Can you figure out the weak points of your game?

   (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. Get each group to prepare a presentation 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 their works, problems, how to test and improvement.)

Conclusion:

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

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

   (b) Do you think that you have acted as an engineer? Why or why not?

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

   (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?

(g) What will happen if you create the transportation game without a proper plan and design?

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

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

(j) What did you learn from this activity?

Suggested materials:

Cardboard, map, dice, token

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 2 Fractions

Time: 25 hours

Strand 1: Numbers and Algebra

Standard M 1.1 (Numbers)

Indicators:

M 1.1 Gr5/3 Find the results of adding and subtracting fractions and mixed numbers.

M 1.1 Gr5/4 Find the results of multiplying and dividing fractions and mixed numbers.

M 1.1 Gr5/5 Show mathematical methods of finding answers of 2- step word problems of addition, subtraction, multiplication and division.

Learning objectives:

- Compare and order fractions and mixed numbers.

- Find the results of adding fractions and mixed numbers.

- Find the results of subtracting fractions and mixed numbers.

- Find the results of multiplying fractions and mixed numbers.

- Find the results of dividing fractions and mixed numbers.

- Show how to solve word problems involving addition, subtraction, multiplication and division of fractions in 1 step.

- Solve problems of mixed addition, subtraction, multiplication and division of fractions in 2 steps.

- Show how to solve word problems involving mixed addition, subtraction, multiplication, and division of fractions in 2 steps.

Competency:

- Communication skills

- Thinking skills

- Problem-solving skills

Start up:

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

- Write all their prior knowledge (Part K) on page 11 and have students share what they know about fractions. Then ask students to write some questions which they want to know (Part W) on page 11.

Teaching/ learning activities:

1st – 4th hours (Comparing fractions)

1. Explain how to compare and arrange fractions in orders.

2. Review meaning of a proper fraction, a mixed number and an improper fraction. Refer to page 12.

3. Explain how to compare and arrange a proper fraction with a mixed number. Refer to page 12.

4. Explain how to compare and arrange an improper fraction with a mixed number. Refer to page 12.

5. Review concept of comparing two fractions with the same denominator. The fraction with greater numerator has the greater value.

6. Write two fractions with the same denominator on the board and ask students to identify the smaller fraction.

7. Explain how to compare mixed numbers. When comparing mixed numbers, the greater the whole number, the greater the mixed number. Refer to page 13.

8. When comparing mixed numbers, we should compare the fractional parts if the whole numbers are the same. If both fractional parts of the mixed numbers have the same denominator, compare the numerators.

9. When comparing mixed numbers, convert them into improper fractions. Equalize the denominators and compare the numerators. Refer to page 13.

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

11. Assign them to do Exercises A to C in the workbook on pages 13 to 15 as their homework.

5th – 8th hours (Addition and subtraction of fractions)

1. Show students a picture of a pizza and ask:

Let's say Koi ate $\frac{1}{8}$ of a pizza and Tong ate $\frac{1}{4}$ of a pizza.

- How much of the pizza did Koi and Tong eat altogether?
- How much of the pizza did Tong eat more than Koi?

Have students discuss how they would solve this word problem. Ask some students to share how they would solve the problem. Tell them that today they will learn about adding fractions with different denominators.

2. Guide students on how to add and subtract fractions with different denominators. Reminds them that they need to find the equivalent fractions with the same denominator before adding them up.

3. Use the example on page 15 for further explanation.

4. Write two fractions with different denominators on the board and ask students to add them up.

5. Show them how to add two mixed numbers. Always remember to convert fractions into equivalent fractions with the same denominator before adding.

6. Use the examples on pages 16 for further explanation on subtraction.

7. Assign them to do Activity Corner on page 16.

8. Explain how to perform combined operations of addition and subtraction. Remind them to always perform the operations within the brackets first. When mixed numbers are involved, convert them into improper fractions before performing the operations. Remind them to simplify the fraction or convert the improper fraction back into a mixed number for as the answer. Refer to page 17.

9. Have students try Practice on page 18 and discuss the answers with them.

10. Assign them to do Exercises D to F in the workbook on pages 16 to 18 as their homework.

9ᵗʰ – 13ᵗʰ hours (Multiplication of fractions)

1. Pose the following word problem to students:

   Susan ate $\frac{1}{8}$ of a pizza. Tom ate 2 times more than Sally. How much of the pizza did Tom eat? Let students discuss how to solve this word problem.

   Ask some students to share how they solve the problem. They can use either multiplication or addition. Remind them that repeated addition is another form of multiplying, so multiplication is the most efficient way to solve this problem.

2. Guide them on how to multiply a whole number by a fraction. Refer to page 19.

3. Write a whole number and a fraction on the board and ask them to multiply.

4. Introduce the concept of fraction of a whole number. Refer to page 19. Using pictures in explanation will help students to understand the concept of fraction of a whole number more clearly.

5. To find a fraction of a whole number, multiply the whole number by the numerator of the fraction and retain the denominator. Refer to page 20.

6. Explain how to multiplying a fraction by a whole number. Remind them to find the product of a fraction and a whole number, multiply the numerator by the whole number and retain the denominator. Refer to page 21.

7. Guide them to understand the concept of a fraction of a fraction. Using pictures will be efficient. Refer to page 21.

8. Explain how to multiplying two fractions. Remind them when multiplying two fractions, multiply one numerator by the other numerator and one denominator by the other denominator. Refer to page 22.

9. Explain how to multiply a fraction by a mixed number. Remind them when multiplying mixed numbers, convert the mixed numbers into improper fractions before multiplying them. Refer to pages 22 and 23.

10. Have students try Practice on pages 23 and 24. Discuss the answers with them.

11. Assign them to do Exercises G to K in the workbook on pages 19 to 22 as their homework.

14th – 18th hours (Division of fractions)

1. Ask students, "How does multiplication relate to division?" and pose the following problem:

   - How many boxes of pizza with 8 pieces in each box, can 32 pieces of pizza make?

   Guide students by asking these questions:

   - How many times does 8 go into 32?
   - What is 32 divided by 8?

2. Explain the concept of reciprocal of a fraction to students by using the examples on pages 25 and 26.

3. Remind students of the steps needed for division of fractions. Use the examples on pages 26 to 28 to explain further.

4. Explain the concept of division involving mixed numbers. Remind them when performing a division involving mixed numbers, convert the mixed numbers into improper fractions before performing the division.

5. Have students try Practice on page 30 and discuss the answers with them.

6. Assign them to do Exercise L to O in the workbook on pages 23 to 25 as their homework.

19th – 21st hours (Combined operations of fractions)

1. Remind students to always perform the operations in the brackets first, follow by multiplication and divisions from left to right and finally perform the addition and subtraction from left to right respectively.

2. Use the example on pages 31 and 32 for further explanation.

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

4. Assign them to do Exercise P in the workbook on page 26 as their homework.

22nd – 24th hours (Solving word problems involving combined operations of fractions)

1. Let students know that they will apply their knowledge of multiplication and division of fractions into their daily applications.

2. Guide students to solve words problems involving combined operations of fractions. Use examples of pages 34 and 35. Remind them that they must understand the problems before writing the number sentences.

3. Have students try Practice on pages 35 and 36, then discuss the answers with them.

4. Assign them to do Exercise Q in the workbook on pages 27 to 29 as their homework.

25th hour (Conclusion)

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

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

3. Guide the whole class to conclude the concept of operations on fractions with these sample activities:

   - Give each student a fraction card, then assign them into groups and make some word problems from a card number and solve them.

   - Assign students to create a poster with word problems involving combined operation on fractions.

4. Have them complete Mastery Practice in the workbook on pages 30 and 31.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 5
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 5
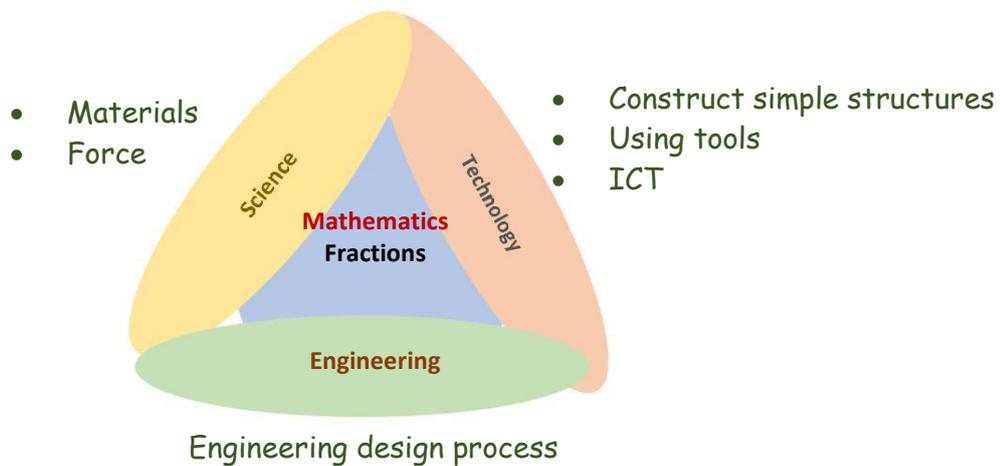- Pictures of pizzas

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 Rubrics.

STEM Activity: Math Jenga

Overview

Jenga is a block-stacking, stack-crashing game. The players take turns to remove one block at a time from a tower of blocks. Each block is removed and placed on the top of the tower, creating a progressively taller structure. In this activity, student will design and create a new Jenga game. This new Jenga game is not only fun to play, but also helps the 5th grade students to practice their skills on operations of fractions.

Subject integration

- Materials
- Force

- Construct simple structures
- Using tools
- ICT

Science

Technology

Mathematics
Fractions

Engineering

Engineering design process

Activity Guide

Time: 3 hours

Start up:

1. Divide students into groups of 3 to 4 students.
2. Review their prior knowledge or prior experiences of the engineering design process:
   - What is the engineering design process?
   - What are the steps of the engineering design process?
   - What are the purposes of the engineering design process?
   - Have you ever applied the engineering design process to a project? Give some examples.

Lesson development:

1. Assign students to read the situation on page 37. Then, lead students to discuss and identify a problem by answering to these questions:
    (a) What are we required to do?
    (b) What are our missions?
    (c) What is the problem of this situation?
    (d) What do we need to know to get started?

2. Motivate students to explore and make connections between science, technology, engineering and mathematics by posing some of these following questions:
    (a) What is a Jenga game? How do we play it?
    (b) Who will play your Jenga game?
    (c) What are the operations of fractions for the 5th grade students?
    (d) Think about the rules – number of players, how to play, how to decide a winner.
    (e) What other materials can we use instead of wooden blocks?

3. Ask students to think about how to assess their project. Guide them to discuss in class and set their criteria by these following questions:
    (a) What are the achievement criteria? (A Jenga game and the fraction problems, rules, satisfaction, etc.)
    (b) How do we evaluate our success? (A satisfactions survey)

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

5. After they have finished their work, ask them to assess their Jenga game by using the criteria stated in no.3. Teacher may pose these 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 game?

(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. Get each group to prepare a presentation 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 their works, problems, how to test and improvement.)

Conclusion:

1. End the lesson by asking students the following questions:
    (a)   Do you like this activity? Why or why not?
    (b)   Do you think that you have acted as an engineer? Why or why not?
    (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 Jenga game 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 set of Jenga blocks, stickers, colored paper, scissors, glue

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 3 Decimals

Time: 31 hours

Strand: Numbers and Algebra

Standard M 1.1

Indicators:

M 1.1 Gr5/5   Show mathematical methods of finding answers of 2- step word problems of addition, subtraction, multiplication and division.

M 1.1 Gr5/6   Find the products of multiplying decimals with not more than three decimal places.

M 1.1 Gr5/7   Find the products of dividing decimals not more than 3 decimal places

with denominations are cardinal numbers or decimals not more than 3 decimal places and divisors are cardinal numbers.

M 1.1 Gr5/8   Show mathematical methods of finding answers of 2- step decimal word problems of addition, subtraction, multiplication and division.

Learning objectives:

- Write fractions that have the denominator of a factor of 10 100 or 1,000 in decimal format.

- Round off decimals to the nearest whole numbers, tenth and hundredth.

- Find the product of multiplication of decimals by whole numbers and decimals.

- Find the product of division of decimals by whole numbers and decimals.

- Analyze and show how to solve word problem involving multiplication, and division of decimals in 1 step.

- Analyze and show how to solve word problem involving adding, subtracting, multiplication, and division of decimals in 2 steps.

Competency:

- Communication skills
- Thinking skills
- Problem-solving skills
- Applying life skills

Start up

- Assess students' prior knowledge about decimals by asking what students knew and what they want to know more about decimals.
- Write all their prior knowledge (Part K) on page 39 and have students share what they know about decimals. Then ask students to write some questions which they want to know (Part W) on page 39.

Teaching/ learning activities:

1st – 4th hours (Relationship between fractions and decimals)

1. Explain how to convert a fraction with a denominator that is a factor of 10, 100 or 1,000 into a decimal. Refer to pages 40 and 41.

2. Explain how to convert other decimals into fractions. Ask them to covert the fractions to their equivalent fractions with the denominators of 10, 100 or 1,000. Remind them do not forget to convert the final product into the simplest form. Refer to pages 41 and 42.

3. Guide students to convert decimals into fractions. Refer to page 43.

4. Explain more to make them understand better by using Math Tips on page 44.

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

6. Assign them to do Exercises A to D in the workbook on pages 34 to 36 as their homework.

5th – 8th hours (Estimating decimals)

1. Guide students to round off decimals to the nearest whole number. When rounding off decimals to the nearest whole number, always look at the digit in the tenths place. Refer to page 45.

2. Guide students to round off decimals to the nearest tenth. When rounding off decimals to the nearest tenth, always look at the digit in the hundredths place. Refer to page 46.

3. Guide the students to round off decimals to the nearest hundredth. When rounding off decimals to the nearest hundredth, always look at the digit in the thousandths place. Refer to page 47.

4. To ensure students understand clearly, write a few decimals on the board and ask students to round off the decimals to the nearest any places.

5. Teacher may ask students why we round off decimals.

6. Ask the students to try Practice on page 48. Discuss the answers with them.

7. Assign the students to work on Exercise E on page 36 of the workbook as their homework.

9th – 11th hours (Estimating the results of decimal addition and subtraction)

1. Inform students that we usually receive a receipt when we go shopping. How do we inspect the receipt if the sum is correct? Tell them that we can estimate the sum by rounding off each item first.

2. Guide students to estimate a sum by rounding off each decimal that will be added first. Refer to pages 49 and 50.

3. Guide the students to estimate a difference by rounding off each decimal first. Refer to pages 50 and 51.

4. Teacher may ask students to compare these two methods.

5. Ask the students to try Practice on page 52. Discuss the answers with them.

6. Assign the students to work on Exercises F to K on pages 37 and 38 of the workbook as their homework.

12th – 16th hours (Multiplication of decimals)

1. Introduce the concept of multiplication of decimals by whole numbers. It is the adding of the decimals repeatedly.

2. Refer to pages 53 and 54 on multiple decimals by whole number by converting the decimals into fractions first.

3. Explain more that it is not necessary to convert them into fractions. We can multiply them as though they were whole numbers. Then add the number of decimal places in the numbers being multiplied, and place the decimal point in the product so that the number of decimal places in the product is the sum of the numbers of decimal places in the factors. Refer to pages 54 to 56.

4. Remind students that we can multiply decimals by whole numbers using different methods such as by repeating addition, by converting the decimals into fractions first before multiplying and by multiplying as if they are whole numbers.

5. Guide students how to multiply a decimal by 10, 100 or 1,000. We can move the decimal point 1, 2 or 3 places respectively to the right. Refer to Math Tips on page 56.

6. Remind students that when we multiply decimals by decimals, we need to extra caution with the positioning of the decimal point in the product.

7. Use the examples on page 57 to explain.

8. Use the examples on page 58 to explain further.

9. Have students try Practice on page 59 and discuss the answers with them.

10. Assign them to complete Exercises L to O in the workbook on pages 39 to 41 as their homework.

17th – 21st hours (Division of decimals)

1. Remind students that when we divide decimals by whole numbers, we can find quotients by using the relationship between decimals and fractions. We can change the decimals into fractions first and then mutiply the numerators together and denominators together.

2. Use the examples on pages 60 and 61 to explain.

3. Engage students to divide a decimal by 10, 100 or 1,000. We can move the decimal point 1, 2 or 3 places respectively to the left. Refer to Math Tips on page 62.

4. Use the examples on pages 63 to 65 to guide students to find quotients by long division.

5. Inform students that we can convert a fraction into a decimal by dividing its numerator by its denominator. Use the examples on page 65 to explain.

6. Ask the students to try Practice on pages 66. Discuss the answers with them.

7. Have students work on Exercises P to S on pages 42 to 46 of the workbook as their homework.

22nd – 24th hours (Solving word problems involving multiplication and division of decimals)

1. Guide students to analyze and understand words problems by reading the problems in order to understand the given information. Then, determine what you are required to find out and solve the problem. Refer to page 67.

2. Have students try Practice on page 68 and discuss the answers with them.

3. Assign them to do Exercise T in the workbook on page 47 as their homework.

25th - 27th hours (Performing combined operations on decimals)

1. Remind students that when we perform any combined operations, we need to do the operations in the brackets first.

2. Use the examples on page 69.

3. Ask the students to try Practice on page 70. Discuss the answers with them.

4. Have the students work on Exercise U on page 48 of the workbook as their homework.

28th – 30th hours (Solving word problems involving combined operations on decimals)

1. Guide students to analyze and understand words problems involving combined operations on decimals, and always write them in number sentences before performing the operations. Refer to page 71.

2. Have students try Practice on pages 72 and 73, and discuss the answers with them.

3. Assign them to do Exercise V in the workbook on page 49 as their homework.

31st hour (Conclusion)

1. Get students to tick what they have learned and understood on page 73 (Part L).

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

3. Guide the whole class to conclude the concept of operations on decimals with these sample activities:

- The missing number: Ask them to find the missing decimal number.
  Example $6.45 + \ldots\ldots\ldots = 8.95$

- Creating word problems: 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.

- To review the content of the lesson, watch the Multiplying Decimals Song on YouTube. Encourage the students to sing along to the chorus.

- Pair activity: A student in each group writes five problems involving decimals on a piece of paper and randomly exchange the paper with other group. The first student in each group will work on the first problem. Then, the paper will be passed to the second student who will check the first problem and work on the

second problem. The paper will be passed to the third student and this continues until the problems are completed.

- Group activity: Divide students into a few groups. Each group is to prepare five word problems and the answers in separate pieces of paper. Then, they need to exchange the paper with the questions with other groups and work on them. When all groups have finished, they have to ask for the answer key from the owner of the problems and check the answers. They can get 1 point for one problem solved correctly. If the owner group does any mistake in the answer, the owner group will lose 1 point. The winner is the team that gets the most points.

4. Have them complete Mastery Practice in the workbook on pages 50 and 51.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 5
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 5

Assessment:

1. To assess cognitive behavior, test on page 73 (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 Rubrics.

STEM Activity: Paper fortune teller

Overview

Paper fortune teller is a form of origami used in children's games. In this activity, students are supposed to be as a mathematics teacher. They will design and create learning materials to help students to practice mathematical skills such as fractions and decimals. First, they will play the paper fortune teller and then they will design and create a better new paper fortune teller by using the engineering design process.

Subject integration
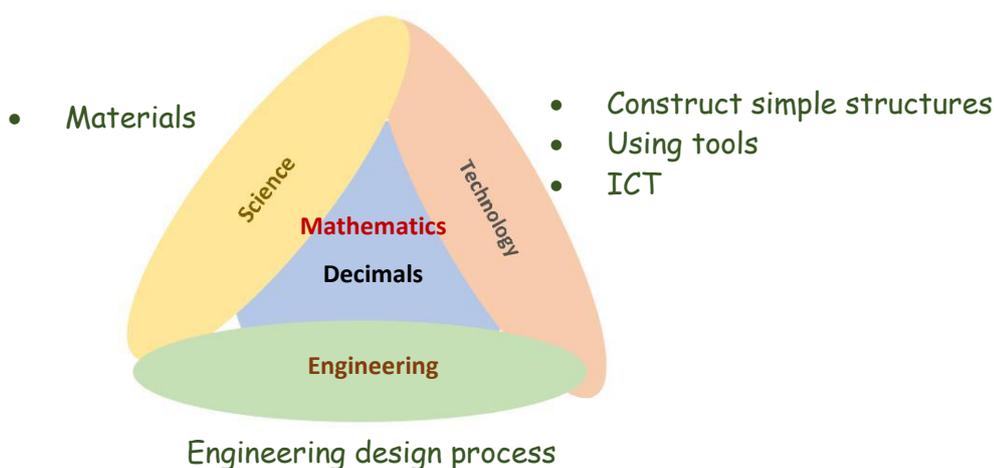
Activity Guide

Time: 3 hours

Start up:

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

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

   - What is the engineering design process?

   - What are the steps of the engineering design process?

   - What are the purposes of engineering design process?

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

Lesson development:

1. Assign students to read the situation on page 74. Then, lead students to discuss and identify a problem by answering to these questions:
   (a) What are we required to do?
   (b) What are our missions?
   (c) What is the problem of this situation?
   (d) What do we need to know to get started?
   (e) Show and discuss the paper fortune teller.
   (f) Have you ever played the paper fortune teller before? How do you play? Is it fun?
   (g) Can you design and create a better one?

2. Then motivate students to explore and make connections between science, technology, engineering and mathematics by posing some of these following questions:
   (a) What are the mathematical skills that teacher wants the students to practice?
   (b) What are the concepts of mathematics that most of students in the class do not understand?
   (c) What is the most difficult concept of fractions and decimals?
   (d) Do students prefer to practice mathematical skills by playing a game?
   (e) What type of paper will you use - thick or thin, colored or white?
   (f) What are the hidden messages related to fractions and decimals?
   (g) How do you know whether it is an interesting game?
   (h) How do you know whether it really helps to improve mathematical skills of the players or not?

3. Ask students to think about how to assess their project. Guide them to discuss in class and set their criteria by these following questions:
   (a) What are the achievement criteria? (A variety of problems involving operations on decimals, creative design, etc.)
   (b) How do we evaluate our success? (A student satisfaction survey)

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

5. After they have finished their work, ask them to assess their paper fortune teller by using the criteria stated in no.3. Teacher may pose these 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) Is it fun to play?
   (e) Can you figure out the weak points of your work?
   (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. Get each group to prepare a presentation 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 their works, problems, how to test and improvement.)

Conclusion:

1. End the lesson by asking students the following questions:
   (a) Do you like this activity? Why or why not?
   (b) Do you think that you act as an engineer? Why or why not?
   (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 create the paper fortune teller 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:

Types of paper (thick, thin, colored, white), crayons

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 4 Percentage

Time: 17 hours

Strand 1: Numbers and Algebra

Standard M 1.1 (Numbers)

Indicator:

M 1.1 Gr5/9   Show mathematical methods of finding answers of not more than 2-step percentage word problems.

Learning objectives:

- Read and write percentages.
- Explain and use the concept of percentages and the relationships between percentages and decimals or fractions.
- Finding the percentages of whole numbers.
- Write a discount as a percentage.
- Solve word problems involving percentages.

Competency:

- Communication skills
- Thinking skills
- Problem-solving skills

Start up:

- Assess students' prior knowledge about percentage by asking what they knew and what they want to know more about percentage.
- Write all their prior knowledge)Part K(on page 76 and have students share what they know about percentage. Then ask students to write some questions which they want to know)Part W(on page 76.

Teaching/ learning activities:

1ˢᵗ – 5ᵗʰ hours (Reading and writing percentages(

1. Explain the concept of percentage and its symbol. Refer to page 77.

2. Explain the relationships between percentages and fractions. Demonstrate how to convert fractions into percentages and vice versa step by step. Refer to pages 77 and 78.

3. Explain the relationships between percentages and decimals. Demonstrate how to convert decimals into percentages and vice versa step by step. Refer to pages 78 and 79.

4. Explain the relationship between decimals, percentages and fractions. Show them how to convert a percentage into a decimal and vice versa. Decimals, percentages and fractions are interchangeable.

5. Guide students how to compare fractions, decimals and percentages on page 79.

6. Have them try Practice on page 80 and discuss the answers with them.

7. Assign them to do Exercises A to G in the workbook on pages 54 to 56 as their homework.

6ᵗʰ – 8ᵗʰ hours (Finding the percentages of whole numbers)

1. Demonstrate how to find a percentage of a whole number by using the examples on page 81.

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

3. Assign them to complete Exercises H to J in the workbook on pages 56 to 59 as their homework.

9ᵗʰ – 13ᵗʰ hours (Writing a discount as a percentage)

1. Explain the concept of discount by using the example on page 83.

2. Explain the steps to calculate the sale price of an item when a percentage discount is given. We can find the discount by multiplying the percentage discount by the

original price. With this discount, we find the sale price by subtracting the discount from the original price. Refer to page 83.

3. Explain steps to calculate the percentage discount of an item when the discount is given. We can write the discount as a fraction of the original price. Then, multiply that amount by 100. Refer to page 84.

4. Help students to gain more understanding of discount by mimicking the events of annual sales. Ask some students to take a role of sale assistance offering discounts to customers whereas other students need to calculate the discounted prices.

5. Have students try Practice on pages 84 and 85. Discuss the answers with them.

6. Assign them to do Exercises K and L in the workbook on pages 59 to 61 as their homework.

14th - 16th hours (Solving word problems involving percentages)

1. Explain the concept of solving word problems involving percentages by applying meaning of percentage and using the relation between percentage and fraction. Refer to page 86.

2. Teacher may use examples in their daily life in order for them to understand more, such as words problems about their friends and their school.

3. Have students try Practice on page 87 and discuss the answers with them.

4. Assign them to do Exercise M in the workbook on pages 61 and 62 as their homework.

17th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 87 (Part L).

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

3. Guide the whole class to conclude the concept of percentage with these sample activities:

- M&M activity: Divide the class into a few groups. Give each group some M&M candies. Ask each group to find out the percentage of the number of each colored candy such as the percentage of blue M&M and the percentage of green M&M. Challenge students to create other word problems based on their M&M candies and share those problems with the class.

4. Have them complete Mastery Practice in the workbook on pages 63 and 64.

Learning materials:

• Primary Education Smart Plus Mathematics Textbook Prathomsuksa 5

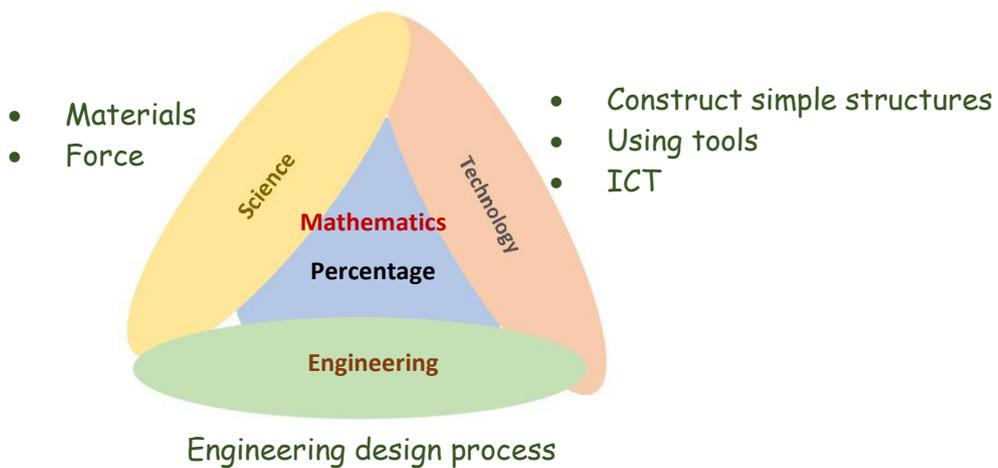• Primary Education Smart Plus Mathematics Workbook Prathomsuksa 5

Assessment

1. To assess cognitive behavior, test on page 87 (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 Rubrics.

STEM Activity: Napkin parachute

Overview

A parachute is an umbrella-shaped device of light fabric generally used to slow down a falling object through the air. Students are required to design and create a parachute that lands a toy on its target. They are allowed to use the provided materials only and find out the percentage of their parachutes that successfully landed on the target.

Subject integration

- Materials
- Force

Science

Mathematics

Percentage

Technology

- Construct simple structures
- Using tools
- ICT

Engineering

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:
   - What is the engineering design process?
   - What are the steps of the engineering design process?
   - What are the purposes of the engineering design process?
   - Have you ever applied the engineering design process to a project? Give some examples.

Lesson Development:

1. Let students read the situation on page 88. Then, guide the whole class to discuss and identify the problem by answering these 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. Let students watch the VDO clip of parachutes at

   After finished watching, ask them to make a simple parachute and observe how it falls. Encourage the whole class to discuss and find out whether their parachutes fall effectively. Let them brainstorm and find solution for their new parachutes.

   (a) What are your possible solutions?

   (b) How will your parachutes look like?

   (c) What materials will you use?

3. Then motivate students to explore and make connections between science, technology, engineering and math by using some of these following questions:

   (a) What is the material of the napkin?

   (b) What are the characteristics of the fabric?

   (c) Is fabric heavier than plastics?

   (d) What is the force that makes things fall down?

   (e) Do heavy things fall down faster than light things?

   (f) What are the requirements of your parachutes?

   (g) How do you make sure the parachute lands on the target?

   (h) How do you find out the percentage of your parachute successfully landed on the target?

(i) What tools do we need for making a parachute?

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

   (a) What are the achievement criteria?)High percentage of parachute successfully landed on the target.(

   (b) How do you evaluate your success?)Percentage of parachute successfully landed on the target.(

5. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.

6. After they have finished their work, ask them to assess their parachute by using the criteria stated in no.4. Teacher may pose these following questions.

   (a) What works? What does not work?

   (b) Did your parachute successfully land on the target?

   (c) What is your percentage of your parachute successfully landed on the target?

   (d) Do you and your team feel satisfied with your work? Why?

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

7. Let them improve their design. Point out their weak points and 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.(

8. Get each group to prepare a presentation 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 their works, problems, how to test and improvement.(

Conclusion:

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

- What did you learn from this activity?

- What steps you used to design and create your works?

- Can you use those steps in your daily living?

- What are benefits of designing before creating?

Suggested materials:

Napkins, string, sticky tape, toy car

Assessment

Refer to Scoring Rubric for STEM Activities

Chapter 5 Length

Time: 10 hours

Strand 1: **Measurement & Geometry**

Standard M. 2.1

Indicator:

M 2.1 Gr5/1   Show mathematical methods of finding the answers of word problems involving length that conversed unit of length and written in decimal form.

Learning objectives:

- Convert between units of length.
- Measure lengths in centimeters, meters and kilometers.
- Solve word problems involving length that conversed unit of length and written in decimal form.

Competency:

- Problem-solving skills
- Applying life skills

Start up:

1. Assess students' prior knowledge about length by asking what they knew and what they want to know more about length.
2. Write all their prior knowledge)Part K(on page 90 and have students share what they know about length. Then ask students to write some questions which they want to know)Part W(on page 90.

Teaching/ learning activities:

1ˢᵗ – 3ʳᵈ hours (Relationships between units of length)

1. Review their concept of decimal in Chapter 3 and units of length.

2. Explain how to convert between units of length (expressed in decimal form). Refer to page 91.

3. Use examples from page 92 to explain how convert between the units.

4. Have them try Practice on page 93 and discuss the answers with them.

5. Assign them to do Exercises A to D in the workbook on page 66 as their homework.

4ᵗʰ – 6ᵗʰ hours (Measuring length)

1. Demonstrate how to measure length in millimeters, centimeters, meters and kilometers. Refer to page 94 to 97.

2. Assign students to measure objects inside and outside of the classroom.

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

4. Assign them to do Exercises E to H in the workbook on pages 67 and 68 as their homework.

7ᵗʰ – 9ᵗʰ hours (Solving word problems involving length)

1. Recall how to find the results of addition, subtraction, multiplication and division in decimals form.

2. Explain the concept of solving word problems involving conversion of units of length written in decimal form. Refer to pages 99 and 100.

3. Have them try Practice on page 101 and discuss the answers with them.

4. Assign them to do Exercise I in the workbook on pages 69 and 70 as their homework.

10th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 101 (Part L).
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.
3. Have them complete Mastery Practice in the workbook on pages 71 and 72.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 5
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 5
- Measuring tools such as a ruler, a meter ruler, etc.

Assessment

1. To assess cognitive behavior, test on page 101 (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 Rubrics.

Chapter 6 Mass

Time: 10 hours

Strand 2 Measurement & Geometry

Standard M. 2.1

Indicator:

M 2.1 Gr5/2   Show mathematical methods of finding the answers of word problems involving weight that conversed units of weight and written in decimal form.

Learning objectives:

- Convert between units of mass.

- Measure mass in grams and kilograms.

- Solve word problems involving mass that conversed unit of mass and written in decimal form.

Competency:

- Problem-solving skills

- Applying life skills

Start up:

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

2. 2 Write all their prior knowledge)Part K(on page 102 and have them share what they know about mass. Then ask them to write some questions which they want to know)Part W(on page 102.

Teaching/ learning activities:

1ˢᵗ – 3ʳᵈ hours (Relationships between units of mass)

1. Review their concept of decimal in Chapter 3 and units of mass.

2. Explain how to convert between units of mass (expressed in decimal form). Refer to pages 103 and 104.

3. Have them try Practice on page 104 and discuss the answers with them.

4. Assign them to do Exercise A in the workbook on page 74 as their homework.

4ᵗʰ – 6ᵗʰ hours (Measuring mass)

1. Demonstrate how to measure mass in grams and kilograms. Refer to page 105.

2. Assign students to measure the mass of some objects in the classroom.

3. Assign students to measure the mass of a group of objects by using decimal concepts. Refer to page 106.

4. Have them try Practice on page 107 and discuss the answers with them.

5. Assign them to do Exercises B to E in the workbook on pages 75 to 78 as their homework.

7ᵗʰ – 9ᵗʰ hours (Solving word problems involving mass)

1. Review how to find the results of addition, subtraction, multiplication and division in decimals form.

2. Explain the concept of solving word problems involving the conversion units of mass written in decimal form. Refer to pages 108 and 109.

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

4. Assign them to do Exercise F in the workbook on pages 79 and 80 as their homework.

10th hour (Conclusion)

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

2. Teacher may assign students to measure their weights and then create some word problems for their friends to solve.

3. Review the vocabulary used by referring to key words in each subtopic in the chapter.

4. Have them complete Mastery Practice in the workbook on pages 81 and 82.

Learning materials:

• Primary Education Smart Plus Mathematics Textbook Prathomsuksa 5

• Primary Education Smart Plus Mathematics Workbook Prathomsuksa 5

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 Rubrics.

Chapter 7 Volume and capacity

Time: 11 hours

Strand 2: Measurement & Geometry

Standard M 2.1

Indicator:

M 2.1 Gr5/3   Show mathematical methods of finding the answers of word problems involving volume and capacity of cuboids.

Learning objectives:

- Convert between units of length.

- Measure volume and capacity of cuboids.

- Solve word problems involving volume and capacity of cuboids.

Competency:

- Problem-solving skills

- Applying life skills

Start up:

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

2. Write all their prior knowledge)Part K(on page 111 and have students share what they know about volume and capacity. Then ask students to write some questions which they want to know)Part W(on page 111.

Teaching/ learning activities:

1st – 4th hours (Volume and capacity of a cuboid)

1. Explain and show what a cuboid is.

2. Show students how to find the volume of a cuboid by multiplying the length, width and height of the cuboid. Refer to page 112.

3. Explain to students the units of volume of a cuboid and how to calculate the volume of a cuboid. Refer to page 113.

4. Show students the abbreviations used for units of volume. Refer to Math Tips on page 113.

5. Explain to students about capacity and let them compare between capacity and volume. Refer to page 113.

6. Show them how to find capacity and volume from examples on page 114.

7. Show students the formula for calculating the length, width or height of a cuboid when given its volume and the other two dimensions.

8. Have them try Practice on page 115 and discuss the answers with them.

9. Assign them to do Exercises A to D in the workbook on pages 91 to 94 as their homework.

5th – 7th hours (Relationships between units of volume and capacity)

1. Review their understanding of units of volume such as milliliter and liter.

2. Explain the connection between the units of volume and capacity. Then, show them how to convert liter to milliliter and milliliter to liter. Refer to pages 116 and 117.

3. Have them try Practice on page 117 and discuss the answers with them.

4. Assign them to do Exercise E in the workbook on page 95 as their homework.

8th – 10th hours (Solving word problems involving volumes and capacities of cuboids)

1. Review how to find the results of addition, subtraction, multiplication and division in decimals form.

2. Explain the concept of solving word problems involving volume and capacity and the conversion between units of volume and capacity written in decimal form. Refer to pages 118 and 119.

3. Have them try Practice on page 120 and discuss the answers with them.

4. Assign them to do Exercise F in the workbook on pages 96 and 97 as their homework.

11th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 120 (Part L).

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

3. Teacher may use different household packages for students to create word problems and to solve them.

4. Have them complete Mastery Practice in the workbook on pages 98 to 100.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 5
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 5

Assessment:

1. To assess cognitive behavior, test on page 120 (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 Rubrics.

Chapter 8 Lines and angles

Time: 14 hours

Strand 2: **Measurement & Geometry**

Standard M 2.2

Indicator:

M 2.2 Gr5/1 Construct straight lines or line segments paralleled to the given straight lines or line segments.

Learning objectives:

- Understand the properties of angles associated with transversal lines.
- Construct straight lines or line segments paralleled to the given straight lines or line segments.

Competency:

- Thinking capacity
- Communication capacity

Start up:

- Assess students' prior knowledge about lines and angles by asking what they knew and what they want to know more about lines and angles.
- Write all their prior knowledge)Part K(on page 121 and have them share what they know about lines and angles. Then ask them to write some questions which they want to know)Part W(on page 121.

Teaching/ learning activities:

1ˢᵗ – 5ᵗʰ hours (Corresponding, alternate, interior and exterior angles)

1. Explain what a transversal line is. There are 8 angles formed on transversal line that passes through two other lines. Inform students that we can classify the angles into corresponding angles, alternate angles, interior angles, and exterior angles.

2. Refer to pages 122 and 124 to explain the types of angles.

3. Refer to pages 124 and 125 for examples on calculating the angles.

4. Refer to Math Tips on page 126. Draw a transversal line passing through two parallel lines on the board. Ask the students to identify the angles.

   (a) Which angles are similar?

   (b) Which two angles have the sum of 180°?

5. Draw 2 straight lines crossing each other and ask the sum of two adjacent angles.

6. Draw a quadrilateral and ask the sum of the four angles in the quadrilateral.

7. Have them try Practice on pages 126 and 127 and discuss the answers with them.

8. Assign them to do Exercises A to F in the workbook on pages 103 to 106 as their homework.

6ᵗʰ – 7ᵗʰ hours (Perpendicular lines)

1. Explain to students the meaning of perpendicular lines and their symbols. Refer to page 128.

2. Ask them to look for perpendicular lines in their daily life or in their classroom.

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

4. Assign them to do Exercise G in the workbook on page 107 as their homework.

8ᵗʰ – 10ᵗʰ hours (Parallel lines)

1. Explain students meaning of parallel lines. Refer to page 129.

2. Tell students that we can determine if two or more lines are parallel lines by checking the sizes of the angles formed by the transversal line.

3. Reiterate they should have to be clear of the characteristics of the angles formed by a transversal line passing through the parallel lines.

4. Use the examples on pages 129 and 130.

5. Ask the students to try Practice on page 130. Discuss the answers with them.

6. Assign the students to do Exercises H to L on pages 108 to 111 of the workbook as their homework.

11th – 13th hours (Drawing parallel lines)

1. Explain how to draw parallel lines by using a set square step by step. Refer to page 131 to 133.

2. Guide them to draw arrowheads on the parallel lines or line segments which means that both lines are parallel.

3. Refer to Math Tips on page 134.

4. Elaborate their understanding by asking to solve the problem in Let's Think activity on page 134.

5. Ask the students to try Practice on page 135. Discuss the answers with them.

6. Assign the students to do Exercise M on pages 112 and 113 of the workbook as their homework

14th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 136 (Part L).

2. Guide the whole class to conclude the concept of parallel lines and pairs of angles with these simple activities:
   - Draw some two lines crossing two parallel lines on the board. Ask students to identity the types of angles and find the size of the angles.
   - Ask students to list things around them that are parallel lines.

3. Ask them to complete Mastery Practice in the workbook on pages 114 to 116.

Learning materials:

• Primary Education Smart Plus Mathematics Textbook Prathomsuksa 5

• Primary Education Smart Plus Mathematics Workbook Prathomsuksa 5

Assessment
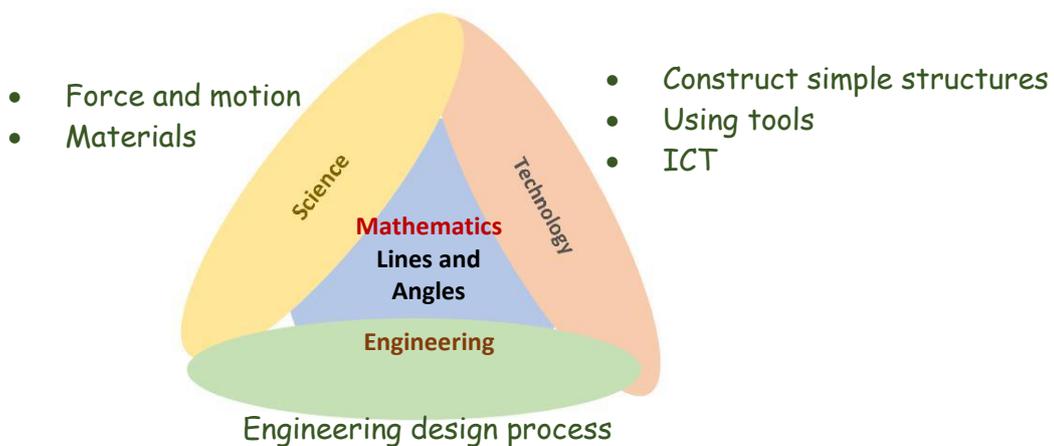
1. To assess cognitive behavior, test on page 136 (Part L column).

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 Rubrics.

STEM Activity: My playground

Overview

Most kids like playgrounds. It may be indoor but is typically outdoor. Students are required to design and create a 3-D geometric playground for 9 to 11-year-old students. The playground should include required components such as parallel lines, perpendicular lines and angles.

Subject integration

- Force and motion
- Materials

- Construct simple structures
- Using tools
- ICT

Mathematics
Lines and Angles

Engineering

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:

   - What is the engineering design process?

   - What are the steps of the engineering design process?

   - What are the purposes of the engineering design process?

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

Lesson development:

1. Assign students to read the situation on page 136. Then, lead students to discuss and identify a problem by answering these questions:

    (a) What are we required to do?

    (b) What are our missions?

    (c) What is the problem of this situation?

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

2. Then engage students to explore and make connections between science, technology, engineering and mathematics by posing some of these following questions:

    (a) Have you ever played in the playground?

    (b) Which playground equipment do you prefer?

    (c) What are angles, parallel lines and perpendicular lines?

    (d) What is your intended purpose for building this playground? Does it help in health development, brain development or both health and brain development of the players?

    (e) What mathematical knowledge is applied into this activity?

    (f) Have you ever played floor games? What are they?

    (g) Do you know how to make a floor game?

    (h) Can you use angles and lines for your floor game?

    (i) What are the rules of the game?

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

    (a) What are the achievement criteria?)Meet the requirements, provide functional and useful purposes, etc.(

    (b) How do we evaluate our success?)Achieve their goals, creative design, etc.(

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

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

   (a) Did it compose of three pairs of parallel lines, three pairs of perpendicular lines and angles?

   (b) Did your work meet the criteria?

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

   (d) What works or what does not work?

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

   (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. Get each group to prepare a presentation 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 their works, problems, how to test and improvement.(

Conclusion:

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

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

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

   (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 3-D geometric playground 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:

Scissors, glue, straws, newspaper, old magazine, chalk

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 9 Quadrilaterals

Time: 20 hours

Strand: Measurement & Geometry

Standard M. 2.1

Indicator:

M 2.1 Gr5/4   Show mathematical methods of finding the answers of word problems involving the perimeter of quadrilaterals and areas of parallelograms and rhombuses.

Standard M 2.2

Indicators:

M 2.2 Gr5/2   Classify quadrilaterals based on properties.

M 2.2 Gr5/3   Construct different types of quadrilaterals using given length of sides and angles or given length of diagonals.

Learning objectives:

- Identify types of quadrilaterals.
- Show diagonals of quadrilaterals.
- Draw quadrilaterals.
- Find perimeter and area of a quadrilateral.

Competency:

- Communication capacity
- Problem-solving capacity
- Technological application capacity

Start up

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

- Write all their prior knowledge (Part K) on page 138 and have students share what they know about quadrilaterals. Then ask students to write some questions which they want to know (Part W) on page 138.

Teaching/ learning activities

1st – 3rd hours (Types and properties of quadrilaterals)

1. Introduce six types of quadrilaterals – rectangles, squares, rhombuses, kites, parallelograms and trapeziums by drawing them on the board and asking students to name them. Refer to pages 139 and 140.

2. Ask them to observe and differentiate each types of quadrilaterals.

3. Ask a student to name two types of quadrilaterals and another two students to draw them on the board. Then, get a few to state the properties of the quadrilaterals.

4. Guide students to notice the symbols or marks on the sides of the quadrilaterals. What do they mean? Refer to Math Tips on page 140.

5. Have students try Practice on page 141 and discuss the answers with them.

6. Assign them to do Exercises A and B in the workbook on page 119 as their homework.

4th – 5th hours (Diagonals of quadrilaterals)

1. Explain what diagonal means. Refer to page 142.

2. Ask students to find out the diagonals of the quadrilaterals. Refer to pages 142 to 145.

   (a) Do all quadrilaterals have two diagonals?

   (b) Which diagonals divide the quadrilaterals into two equal parts?

   (c) Which quadrilaterals have equal diagonals?

   (d) Which quadrilaterals have diagonals that are also the axes of symmetry?

3. Have students try Practice on page 145 and discuss the answers with them.

4. Assign them to do Exercise C in the workbook on page 120 as their homework.

6th – 11th hours (Constructing quadrilaterals)

1. Guide students on how to construct quadrilaterals given the lengths of its sides and the sizes of its angles by using a compass and a protractor or a ruler. Refer to pages 146 to 148.

2. Guide students on how to construct quadrilaterals given the lengths of its diagonals. Refer to pages 148 to 149.

3. Have students try Practice on pages 149 and 150 and discuss the answers with them.

4. Assign them to do Exercise D in the workbook on page 120 as their homework.

12th – 13th hours (Perimeter of a quadrilateral)

1. Explain the concept of perimeter to students by using the example on page 151.

2. Guide them to find the perimeter of the quadrilateral. Refer to pages 151 and 152.

3. Have students try Practice on page 153 and discuss the answers with them.

4. Assign them to do Exercise E in the workbook on page 121 as their homework.

14th – 16th hours (Area of a quadrilateral)

1. Guide students on how to find the areas of parallelogram by using the formula on pages 154 and 155.

2. Have students try Practice on pages 156 and discuss the answers with them.

3. Assign them to complete Exercise F in the workbook on page 122 as their homework.

17th – 19th hours (Solving word problems involving quadrilaterals)

1. Review how to find perimeter and area of quadrilaterals.

2. Explain step by step how to solve word problems involving quadrilaterals. Refer to pages 157 and 158.

3. Have them try Practice on page 159 and discuss the answers with them.

4. Assign them to do Exercise G in the workbook on pages 123 and 124 as their homework.

20ᵗʰ hour (Conclusion)

1. Get students to tick what they have learned and understood on page 160 (Part L column).

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

3. Guide the whole class to conclude the concept of quadrilaterals with these sample activities:

   A. Think and say game

   • Choose a volunteer to draw a quadrilateral on the board. If a student wants to identify the quadrilateral drawn, he/she must raise his/her hand. When he or she answers correctly, discuss its characteristics with the class.

   • Walk around the classroom with a quadrilateral drawn on a card and randomly ask students to name it. Then ask students to state its characteristics 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 quadrilaterals and angles in the classroom, such as the board and the corners of the board, or the legs of a chair. Have them sort at least three types of quadrilaterals and angles.

4. Have them complete Mastery Practice in the workbook on pages 125 to 127.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 5
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 5
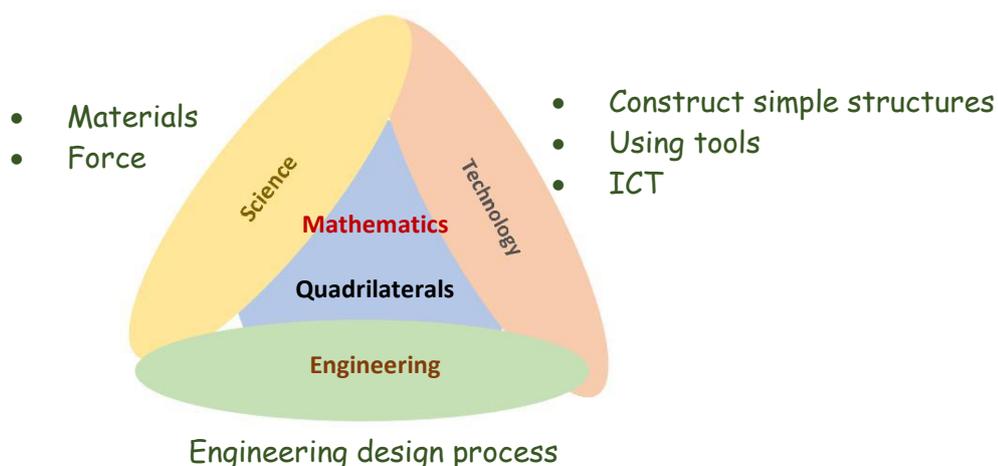- Quadrilaterals shape cards

Assessment:

1. To assess cognitive behavior, test on page 160 (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 Rubrics.

<h1 style="text-align:center; color:red">STEM Activity: Tablet cover</h1>

Overview

A tablet cover is not only for protection of the tablet but also as a standing tool. Some covers can be folded up to be an impromptu stand for convenient reading. In this activity, students need to apply the concept of angels and line segments, parallel lines and quadrilaterals when designing and creating a draft of a tablet cover.

Subject integration

- Materials
- Force

- Construct simple structures
- Using tools
- ICT

Science

Technology

Mathematics

Quadrilaterals

Engineering

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:

   - What is the engineering design process?

   - What are the steps of the engineering design process?

   - What are the purposes of the engineering design process?

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

Lesson Development:

1. Let students read the situation on page 160. Then, lead students to discuss and identify a problem by answering to 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. Show the students some tablet covers. Let them discuss.

   (a) Have you ever seen a tablet cover before?

   (b) What are the benefits of these tablet covers?

   (c) What are your possible solutions?

   (d) What is the size of tablet cover you and your team decide to make?

3. Then motivate students to explore and make connections between science, technology, engineering and mathematics by using some of these following questions:

   (a) What is the size of the tablet you want to make a cover for?

   (b) What is the shape of the tablet?

   (c) What is the geometry shape that can stand easily and is strong?

   (d) What are the benefits of a cover that is foldable?

   (e) How can you apply the concept of angels and line segments, parallel lines and quadrilaterals in your design?

   (f) Can you fold a piece of paper so that it can stand freely?

   (g) Can you fold a piece of paper into a triangle that is able to stand freely?

   (h) What materials should you consider?

   (i) What tools do you need?

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

   (a) What are the achievement criteria? (A tablet cover that can make the tablet stand freely.)

(b)　How we assess your success? (A tablet stand freely)

5.　Get the students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.

6.　After they have finished their work, ask them to assess tablet covers by using the criteria stated in no.4. Pose these following questions:

(a)　What works? What does not work?

(b)　Do you and your team feel satisfied with your work? Why?

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

7.　Let them improve their design. Point out their weak points and 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.)

8.　Get each group to prepare a presentation 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 their works, problems, how to test and improvement.)

Conclusion:

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

(a)　What did you learn from this activity?

(b)　What steps did you use to design and create your works?

(c)　Can you use those steps in your daily living?

Suggested materials:

Variety of cardboard or construction paper, scissors, cutting knife

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 10 Prisms

Time: 5 hours

Strand 2: Measurement and geometry

Standard M 2.2

Indicator:

M 2.2 Gr5/4 Tell the characteristics of the prism.

Learning objectives:

- Identify the characteristics of prisms.

- List examples of objects which are prisms.

Competency:

- Technological application capacity

- Communication capacity

Start up:

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

- Write all their prior knowledge)Part K(on page 162 and have students share what they know about prism. Then ask students to write some questions which they want to know)Part W(on page 162.

Teaching/ learning activities:

1ˢᵗ – 4ᵗʰ hours (Characteristics of prisms)

1. Explain the meaning of prisms and show them some figures.

2. Explain that a prism is a three-dimensional object which has flat surfaces. It is a solid with two identical polygon ends. The other faces are parallelograms.

3. Show them the types of prism such as cuboids, triangular prisms, pentagonal prisms, and hexagonal prisms. Refer to pages 163 and 165.

4. Ask them to search for any objects around them that are prisms.

5. Have them try Practice on page 166 and discuss the answers with them.

6. Assign them to do Exercises A to D in the workbook on pages 129 to 131 as their homework.

5th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 166 (Part L column).

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

3. Teacher may use different household packages for students to create word problems and then ask another group to solve them.

4. Have them complete Mastery Practice in the workbook on pages 132 to 134.

Learning materials:

• Primary Education Smart Plus Mathematics Textbook Prathomsuksa 5
• Primary Education Smart Plus Mathematics Workbook Prathomsuksa 5

Assessment:

1. To assess cognitive behavior, test on page 166 (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 Rubrics.

Chapter 11 Data presentation

Time: 10 hours

Strand 3: Statistics and Probability

Standard M 3.1

Indicators:

M 3.1 Gr5/1   Use data from line graphs to find the answers of word problems.

M 3.1 Gr5/2   Create bar charts by using data of counting numbers.

Learning objectives:

- Read and interpret bar charts with a jagged line and multiple bar charts.

- Construct bar charts with a jagged line and multiple bar charts.

- Read and interpret line graphs.

- Interpret bar charts and line graphs to solve word problems.

Competency:

- Problem-solving skills

- Communication skills

Start up:

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

- Write all their prior knowledge (Part K) on page 167 and have the students share what they know about fractions. Then ask the students to write some questions which they want to know (Part W) on page 167.

Teaching/ learning activities

1st – 3rd hours (Reading and drawing bar charts with a jagged line)

1. Show students a bar chart and explain the components of chart (x-axis and y-axis).

2. Use the two bar charts on page 168. One of the charts is the normal bar chart and the other is a bar chart with a jagged line. Explain the use of the jagged line in a bar chart. What does it mean? When do we use it?

3. Show students a bar chart with a jagged line and have them extract information from it.

4. Guide students on how to construct bar charts step by step. Refer to page 170 and remind them to use an interval scale consistently.

5. Have students try Practice on pages 171 and 172 and discuss the answers with them.

6. Assign them to do Exercises A and B in the workbook on pages 137 to 139 as their homework.

4th – 6th hours (Reading and drawing multiple bar charts)

1. Explain the concept of multiple bar charts that two or more sets of information represented on one chart. We can compare information easily from these charts.

2. Guide them to read and interpret multiple bar charts on page 173. Explain more using the multiple bar chart on page 174.

3. Guide students step by step on how to construct multiple bar charts on page 175. Notice that the information on multiple bar charts uses the same scale.

4. Have students try Practice on pages 176 and 177 and discuss the answers with them.

5. Assign them to do Exercises C and D in the workbook on pages 140 to 145 as their homework.

7ᵗʰ – 9ᵗʰ hours (Reading line graphs)

1. Explain the concept of line graphs that are joined by line segments to show the change in the values of data collected over a certain period of time.

2. Guide students to read and extract information from line graphs on page 178.

3. Explain more examples of line graphs that are related to students such as growth charts.

4. Ask the students to try Practice on pages 179 and 180. Discuss the answers with them.

5. Assign the students to work on Exercise E on pages 146 and 147 of the workbook as their homework.

10ᵗʰ hour (Conclusion)

1. Get students to tick what they have learned and understood on page 180 (Part L column).

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

3. Guide the whole class to conclude the concept of charts with these sample activities:

    *   Making a survey

        Assign students to carry out a survey based on their interests and present at least 5 issues in a multiple bar chart. Each group exchanges the chart and interpret it.

    *   Satisfaction survey

        Ask the whole class to create a survey project such as a satisfaction survey of lunch or favorite subjects among genders and classes. Ask them to present and explain about their findings to other classes using charts.

4. Have them complete Mastery Practice in the workbook on pages 148 to150.

Learning materials:

• Primary Education Smart Plus Mathematics Textbook Prathomsuksa 5

• Primary Education Smart Plus Mathematics Workbook Prathomsuksa 5

Assessment:

1. To assess cognitive behavior, test on page 180 (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 Rubrics.

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