Teacher's Guide

Mathematics

Primary
Education
Smart+
Prathomsuksa

2

PELANGI

Based on the Basic Education Curriculum B.E. 2551
(Revised Edition B.E. 2560)

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 3 Students

- Read, write numbers and numbers in words not exceeding 100,000 and 0, have number sense and skills in number operations; addition, subtraction, multiplication and division and apply the knowledge in various situations.

- Have fraction number sense with not more than 1 place and skills in fraction operations with the same denominator; addition and subtraction and apply the knowledge in various situations.

- Estimate and measure length, weight, capacity and volume, select the appropriate tools and units, tell the time and the amount of money and apply the knowledge in various situations.

- Distinguish and describe the features of polygons, circles, ellipses, rectangular prism, spheres, cylinders, and cones, draw polygons, circles and ellipses using models, identify geometric figures with axis of symmetry and the number of axis of symmetry and apply the knowledge in various situations.

- Read and write pictograms, one-way table and apply the knowledge in various situations.

Yearly Teaching Plan

Mathematics Prathomsuksa 2 (Grade 2)

11 chapters 200 hours

Learning areas	Time (hours)
1. Numbers up to 1,000 • Writing and reading numbers • Place value and expanded form • Comparing numbers • Ordering numbers • Odd and even numbers • Number sequences	30
2. Addition and subtraction within 1,000 • Addition without regrouping • Addition with regrouping • Subtraction without regrouping • Subtraction with regrouping • Using addition and subtraction to solve word problems • Combined operations (addition and subtraction) • Using combination of addition and subtraction to solve word problems • Creating addition and subtraction word problems	28
3. Multiplication • Meaning of multiplication • Multiplication of 1-digit numbers • Multiplication of 1-digit numbers by 10, 20, …, 90 • Multiplication of 1-digit numbers by 2-digit numbers • Solving word problems • Creating multiplication word problems	25

4. Division • Meaning of division • Division as the opposite of multiplication • Dividing by 1-digit divisors • Solving word problems • Creating division word problems	20
5. Combined operations • Combined operations • Solving word problems • Creating word problems involving combined operations	11
6. Time • Periods of time in a day • Telling time in hours and minutes • Duration of time • Comparing the time in hours and minutes • Reading a calendar • Solving word problems involving time	22
7. Length • Measuring length in meters and centimeters • Estimating length in meters • Relationships between units of length • Comparing lengths • Solving word problems involving length	15
8. Mass • Measuring mass in kilograms and grams • Measuring mass in kilograms and kheeds or hectograms • Estimating mass in kilograms • Relationships between units of mass • Comparing masses • Solving word problems involving mass	15

9. Volume and capacity • Measuring volume and capacity using non-standard units • Measuring volume and capacity in liters • Comparing volumes and capacities in teaspoons, tablespoons and cups • Comparing volumes and capacities in liters • Solving word problems involving volume and capacity in teaspoons, tablespoons and cups • Solving word problems involving volume and capacity in liters	18
10. Two-dimensional shapes • Polygons, circles and ellipses • Drawing two-dimensional (2-D) shapes • Repeating patterns	11
11. Pictograms • Pictograms	5

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

Chapter 1 Numbers Up to 1,000

Time: 30 hours

Strand 1: Numbers and Algebra

Standard M 1.1)Numbers(

Indicators:

M 1.1 Gr2/1 Tell the numbers of objects, show quantities of objects of given cardinals numbers. Read and write Hindu-Arabic and Thai numerals showing cardinal numbers not exceeding 1,000 and 0.

M 1.1 Gr2/2 Compare cardinal numbers not exceeding 1,000 and 0 by using comparison symbols: $= \neq > <$.

M 1.1 Gr 2/3 Arrange sequence of cardinal numbers not exceeding 1,000 and 0 from 3 to 5 numbers from different situations.

Learning objectives:

Students will be taught to:

- Read and count numbers up to 1,000.
- Read and write numbers in expanded form up to 1,000.
- Say place values of digits in numbers.
- Understand odd and even numbers.
- Understand and use the vocabulary of comparing and ordering numbers.
- Understand and use number patterns for counting forward and backward.
- Understand and use numbers to name positions.

Competency:

- Communication skills
- Thinking skills

Start Up

- Assess students' prior knowledge about numbers by asking what they knew and what they want to know more about numbers.
- Write all their prior knowledge in part Part K column on page 1 and have students share what they know about numbers. Then, ask them to write some questions which they want to know in Part W column on page 1.

Teaching/learning activities:

1st – 6th hours (Writing and reading numbers)

1. Ask students to count some objects in their classroom such as pencils, color pencils and others.
2. Then, list the number of students of each class in the school and ask them:
   (a) How many students are there in each grade?
   (b) How many students are there in the school?
3. Guide them to count numbers up to 1,000, in hundreds, tens and ones. You may tie sticks in bundles of 100 or place marbles in bags of 100.
4. Test students' spelling of the numbers from 0 to 99. They need to memorize them all including the words 'hundred' and 'thousand'.
5. Use the examples shown on pages 2 and 3.
6. Write a 3-digit number in both numerals and words on the board. Then, guide students to read them aloud.
7. Do a quiz on the number words. You may either write the numbers on the board and get students to read them, or you may get a student to read out a number and another one to write the number on the board in numeral and words.
8. Have students try Practice on page 4.
9. Assign them to do Exercises A to C on pages 3 and 4 of the Workbook as their homework.

7^{th} – 10^{th} hours (Place value and expanded form)

1. Write a 3-digit number on the board and explain the place value of each digit and its value. Emphasize that even a zero in a number has a place value.
2. Use the examples on page 5.
3. Get three students to write numbers of three or two digits. Then, get other students to state the place value of each digit in each number and its value.
4. Guide them to use a table of place values and from there guide them to write a number in its expanded form. Let them try a few numbers including numbers with zero.
5. Have the students try Practice on page 6.
6. Assign them to do Exercises D to H on pages 5 and 6 of the Workbook as their homework.

11^{th} – 15^{th} hours (Comparing numbers)

1. Remind students of the signs such as $=$, $\neq$, $<$ and $>$, and the terms used in comparison such as 'greater than', 'more than', 'fewer than', 'less than', 'smaller than', 'the greatest', 'the smallest', 'equal' and 'not equal to'.
2. Guide students to compare the number of digits in the numbers when comparing any numbers. The number with a greater number of digits is always larger.
3. Emphasize that when they are comparing numbers with the same number of digits, they should compare the value of the first or the leftmost digit before comparing the rest.
4. Use the examples shown on pages 10 and 11 for further explanation and have them try Practice on page 11.
5. Assign them to do Exercises I to K on page 7 of the Workbook as their homework.

16th – 19th hours (Ordering numbers)

1. Explain to students the meanings of ascending and descending.
2. Use the example on page 12.
3. Write a few numbers on the board and get some students to order them.
4. Use the examples shown on pages 12 to 14.
5. Have them try Practice on page 14.
6. Assign them to do Exercises L and M on page 8 of the Workbook as their homework.

20th – 23rd hours (Odd and even numbers)

1. Explain even numbers and odd numbers to students by using the examples on pages 15 to 17.
2. Show students some number cards and ask them these questions:
   (a) Which are even numbers?
   (b) Which are odd numbers?
3. Let students try Practice and Let's Think on page 17.
4. Assign them to do Exercises N and O on page 9 of the Workbook as their homework

24th – 29th hours (Number sequences)

1. Guide students to count forward by twos, fives, tens and hundreds.
2. Use the examples on pages 18 to 20 for further explanation.
3. Guide students to count backward by twos, fives, tens and hundreds.
4. Use the examples on pages 21 to 23 for further explanation.
5. Have students try Let's Think on pages 23 and 24.
6. Have students try Practice on page 24.
7. Assign them to do Exercises P and Q on pages 9 and 10 of the Workbook as their homework

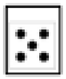
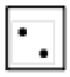
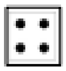
30th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 25)Part L(.

2. Guide the whole class to conclude the concept of numbers up to 1,000 with these activities:

(a) Let students play a number construction game.

- Give each student a board with a table of place values as shown below.
- Ask them to roll three die and place each dice on the table.

Hundreds	Tens	Ones
		

They should write the number as 524.

- Ask them to write the 3-digit number on their worksheet. Then, get them to write the number in its expanded form.

(b) Assign students to play this game in order to understand more.

- Ask students to get into groups of 4.
- Ask a team member to say out a 3-digit number. This is their team number.
- Ask every member to write a number which is greater than and another number which is smaller than their team number. There will be 9 numbers in total.
- Finally, ask them to arrange their numbers in ascending or descending order.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 2
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 2
- Objects for counting such as books, cubes, pencils and erasers
- Number cards
- Picture cards
- Dices

Assessment:

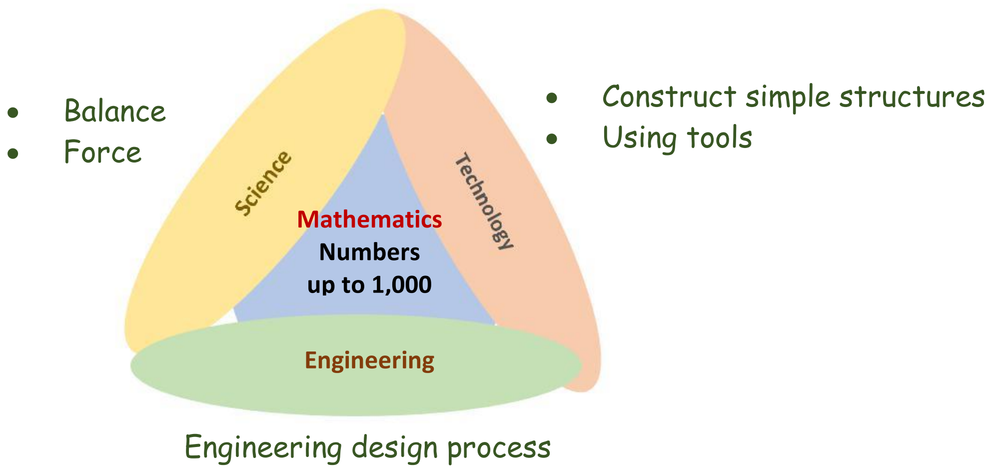
1. To assess cognitive behavior, test on page 25 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: Button building

Overview

This activity will challenge students' creativity and deepen their understanding of the engineering design process. Their task is to construct a tall building by using buttons and clay.

Subject integration



Activity Guide

Time: 3 hours

Start up:

1. Divide students into groups of 3 to 4 students.
2. Let them know that this is the first activity that they will apply science, technology, engineering, and mathematics concepts to design and create something. We call it the "STEM education".
3. Get them to recall the STEM activities they have done in Grade 1:
    - Which was their favorite activity? Why?
    - What did you get from those STEM activities?

Lesson Development:

1. Let students read the situation on page 25. Then, guide the whole class to discuss and identify the problem by answering to these questions:
   - What is the problem of this situation?
   - What will you have to do?
   - What are your missions?
   - What do you 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:
   - Can you stack the buttons?
   - What do you have considered about when you are stacking the buttons?
   - What usually will cause the stack of buttons to fall down?
   - If you have something like clay to stick the buttons, will it be easier to stack? Why?
   - Can you count 1 to 1,000?
   - What are the steps of the engineering design process?
   - Do you need any tools for this construction?
3. Ask students to think about how to assess their project. Lead them to discuss in class and set their criteria with these following questions:
   - What are the achievement criteria?)Time of completion, the height of the stack of buttons, the number of buttons, etc(
   - How do we evaluate our success?)The height of the building, durability, design, etc.(
4. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.
5. After they have finished their work, ask them to assess their buildings by using the criteria stated in no.3. Teacher may pose these following questions:
   - Did your work meet the criteria?

- What works? What does not work?
- How will you modify your solution to make it better?

6. Let them improve their design. Teacher may 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.(
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 teamwork, the product, the process, the problems, the evaluation and improvement.(

Conclusion:

1. End the lesson by asking students the following questions:
   (a) Did you all come up with the same design? Why? Why not? (They should answer that they all have different ideas, and this tells the importance of the role of diversity in engineering and problem solving. Engineering is a career that follows this design process for creating new things, offering solutions and providing conveniences for our life.(
   (b) What are the steps in the design process to create this button building? (It called "the engineering design process" that teacher should tell them.(
   (c) What are the benefits of this activity?

Suggested materials:

Varieties of colors, sizes, and shapes of buttons, clay

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 2 Addition and Subtraction within 1,000

Time: 28 hours

Strand 1: Numbers and Algebra

Standard M.1.1 (Numbers)

Indicators:

M 1.1 Gr2/4 Find the value of unknown in addition and subtraction number sentence of cardinal numbers not exceeding 1,000, and 0.

M 1.1 Gr2/8 Show mathematical methids to solve 2-step word problems of cardinal numbers not exceeding 1,000 and 0.

Learning objectives:

Students will be taught to:

- Learn to add and subtract two-digit and three-digit numbers within 1,000.
- Solve problems involving addition and subtraction within 1,000.
- Use addition and subtraction to solve word problems.
- Use combination of addition and subtraction to solve problems
- Use combination of addition and subtraction to solve word problems

Competency:

- Thinking skills
- Capacity for applying life skills

Start up

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

- Write all their prior knowledge in Part K column on page 27 and have students share what they know about addition and subtraction. Then, ask students to write some questions which they want to know in Part W column on page 27.

Teaching/Learning activities:

1st – 3rd hours (Addition without regrouping)

1. Remind students of the meaning of addition.
2. Write a question of addition without regrouping on the board and ask them to solve it.
3. Ask students to add by writing the numbers vertically. Emphasize that they have to add up digits of the same place values.
4. Write a few addition questions on the board and get a few students to answer them.
5. Guide them step by step on how to add two 3-digit numbers and how to verify the answers by using the examples on pages 28 and 29.
6. Have students try Practice on page 29 and discuss the answers with them.
7. Assign them to do Exercise A on page 14 of the Workbook as their homework.

4th – 6th hours (Addition with regrouping)

1. Write a few questions of addition with regrouping on the board and get a few students to solve them.
2. Explain them how to add two 3-digit numbers with regrouping step by step by writing the numbers vertically as shown on pages 30 and 31. Give them some more addition questions and have them practice.
3. Guide them on how to verify the answers.
4. Let students try Practice on page 31 and discuss the answers with them.
5. Assign them to do Exercise B on page 14 of the Workbook as their homework.

7th – 9th hours (Subtraction without regrouping)

1. Remind students of the meaning of subtraction.
2. Write a question of subtraction without regrouping on the board and ask them to solve.
3. Ask students to subtract without regrouping by writing the numbers vertically. Emphasize that they have to subtract digits of the same place values.
4. Write a few subtraction questions on the board and get a few students to answer them
5. Guide them step by step on how to subtract a number from a 3-digit number. Emphasize that subtracting must start from the ones, followed by the tens and lastly the hundreds.
6. Demonstrate how to verify the answers by using the examples on pages 32 and 33.
7. Have students try Practice on page 33 and discuss the answers with them.
8. Have students do Exercise C on page 15 of the Workbook as their homework.

10th – 12th hours (Subtraction with regrouping)

1. Write a few questions of subtraction with regrouping on the board and get a few students to answer them.
2. Explain to them step by step how to subtract two 3-digit numbers with regrouping by writing the numbers vertically as shown on pages 34 and 35.
3. Give them some more subtraction questions and have them practice. Emphasize that subtracting must start with the ones, followed by the tens and lastly the hundreds.
4. Demonstrate how to verify the answers to them by using the Examples on pages 34 and 35.
5. Have students try Practice on page 35 and discuss the answers with them.
6. Have students do Exercises D and E on pages 15 and 16 of the Workbook as their homework.

13^{th} – 16^{th} hours (Using addition and subtraction to solve word problems)

1. Explain to students step by step on how to solve the addition word problems. Refer to page 36.
2. Explain them step by step how to solve the subtraction word problem on page 31.
3. Have them try Practice on pages 37 and 38. Discuss the answers with them.
4. Have students do Exercise F on pages 17 and 18 of the Workbook as their homework.

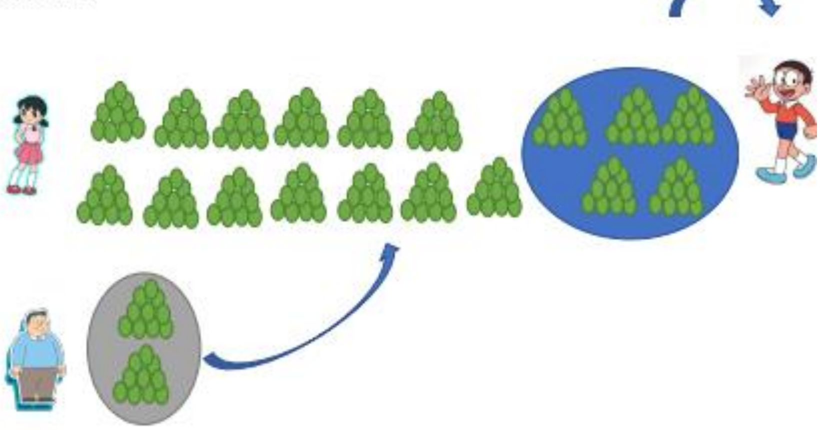
17^{th} – 20^{th} hours (Combined operations (addition and subtraction))

1. Use the examples on page 39 to demonstrate to students on how to solve combined operations with addition and subtraction.
2. Write a few questions of combined operations (addition and subtraction) on the board and get a few students to answer them.
3. Emphasize that we need to do the operation in the brackets first.
4. Have students try Practice on page 40 and discuss the answers with them.
5. Have students do Exercise G on pages 19 and 20 of the Workbook as their homework.

21^{st} – 24^{th} hours (Using combination of addition and subtraction to solve word problems)

1. Tell students a word problem by using pictures. For example, Mary has 180 eggs. She gives 50 eggs to her friend. Then her uncle gives 20 eggs to Mary. How many eggs Mary has now?

the board.



Ask them to write the question in a number sentence. Let them find out and verify the answers with them.

2. Use the example on page 41 to demonstrate clearly how to solve the word problem by using combined operations (addition and subtraction). Always emphasize them that they have to understand the question first before writing the number sentence and solving it. Guide them to read and understand the word problem.
3. Have them try Practice on page 42. Discuss the answers with them.
4. Have students do Exercise H on page 21 of the Workbook as their homework.

25th – 27th hours (Creating addition and subtraction word problems)

1. Using the example on page 43, guide them to create a word problem.
2. Write an addition problem on the board. Get a student to find out the answer and another to create a word problem based on the problem.
3. Have them try Practice on page 43 and discuss the answers with them.
4. Using the example on page 44, guide them to create a word problem.
5. Write a subtraction problem on the board. Get a student to find out the answer and another to create a word problem based on the problem.
6. Ask them to work in pairs. One should give some addition and subtraction problems and the other one should create a word problem based on the given problems.

7. Have them try Practice on page 44 and discuss the answers with them.
8. Have students do Exercise I on page 22 of the Workbook as their homework.

28th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 45 (Part L column).
2. Give students a few numbers or number sentences of addition or subtraction and ask them to solve them.
3. Give students a few combined operations involving addition and subtraction. Get them to solve them.
4. Let them create their own word problems and find out the answers.

Materials

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 2
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 2
- Number cards
- Picture cards

Assessment:

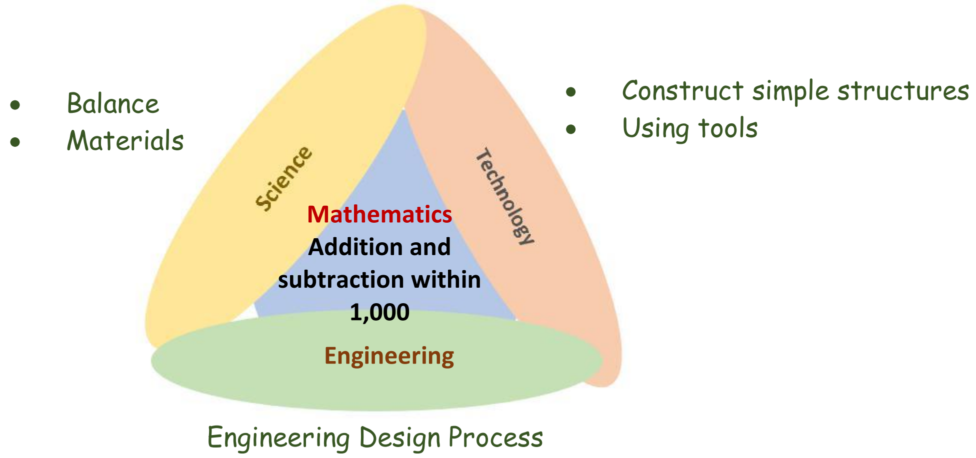
1. To assess cognitive behavior, test on page 45 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: Paper stands up

Overview

In this activity, student will use an engineering design process to construct a paper tower. They will learn about shapes and their relative standing abilities. They will observe many objects around them and find out how to construct a tower from a piece of paper that can stand for at least 10 minutes.

Subject integration



Activity guide

Time: 3 hours

Start up:

1. Divide students into groups of 3 to 4 students.
2. Talk about their previous STEM activity by asking the following questions:
   - What did you design? How was it?
   - Did you work alone or work with your team members? How was your team?
   - What did you help your team? Are you a good team member?

Lesson development:

1. Let students read the situation on page 45. Then, guide the whole class to discuss and identify the problem by answering to these questions:
   - What is the situation about?
   - What will you have to do?
   - What are your missions?
   - What do you need to know to get started?
2. Motivate the students to explore and make connections between science, technology, engineering and mathematics by posing some of these following questions:
   - Have you ever observed the legs of your table? What shape are they?
   - Can you use other shapes instead?
   - What other shapes you can use?
   - Can you fold a piece of paper to make it stand?
   - What kind of shapes can you fold?
   - What are the steps of engineering design process?
   - Do you need any tools for this construction?
3. Ask students to think about how to assess their project. Lead them to discuss in class and set their criteria with these sample questions:
   - What are the achievement criteria? (Ability to finish on time, the height of a tower, the length of time used, etc.)
   - How do we evaluate our success? (height, stability)
4. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.
5. After they have finished their work, ask them to assess their tower by using the criteria stated in no.3. Teacher may pose these following questions:
   - Did your work meet the criteria?
   - What works? What does not work?

- 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 teamwork, the product, the process, the problems, the evaluation, and improvement.)

Conclusion:

1. End the lesson by asking students the following questions:
   - What are the benefits of this activity?
   - Did every team have the same design? Why? Why not?
   - What did you learn from this activity?
   - What subject knowledge did you apply into this activity?
   - What will happen if you build the paper tower without a proper plan and design?

Suggested materials:

A4 paper

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 3 Multiplication

Time:25 hours

Strand 1 Numbers and Algebra

Standard M.1.1 Numbers

Indicator:

M 1.1 Gr 2/5 Find the value of unknown in multiplication equations of 1-digit numbers by not more than 2-digit numbers.

Learning objectives:

Students will be taught to:

- Understand multiplication as the repeated addition.
- Understand and use the operation of multiplication.
- Solve problems involving multiplication of 1-digit numbers by 2-digit numbers.
- Solve word problems involving multiplication of 1-digit numbers by 2-digit numbers.
- Create multiplication word problems.

Competency:

- Thinking skills
- Problem – solving skills
- Capacity for applying life skills

Start up:

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

- Let students write all their prior knowledge in Part K column on page 47 and have students share what they know about multiplication. Then ask students to write some questions which they want to know in Part W column on page 47.

Teaching/Learning activities:

1st – 3rd hours (Meaning of multiplication)

1. Show students some picture cards of items.

   Teacher may use the picture cards shown above and ask them these questions:
   (a) How many groups of orange are there?
   (b) How many oranges are there in each group?
   (c) Does each group have the same number of oranges?
   (d) How many oranges are there altogether?
   (e) Can you write a number sentence of addition based on the cards?
2. Explain the meaning of multiplication as repeated addition. Use the examples on pages 48 and 49 for further explanation.
3. Guide them how to write and read number sentences of multiplication.
4. Draw groups of items on the board and ask students to write the relevant number sentences.
5. Have the students try Practice on page 50 and discuss the answers with them.
6. Lead the whole class to conclude and give more examples of the concept of multiplication.
7. Have students do Exercises A and B on pages 27 and 28 of the Workbook as their homework.

4th – 9th hours (Multiplication of 1-digit numbers)

1. Introduce multiplication tables of 1 to 5 to students by using their body parts, items or pictorial representations.
2. Help students to memorize the multiplication tables using multiplication flashcards. (This activity needs to be practiced daily until they can remember them.)
3. Randomly ask a few students to recall the multiplication tables quickly and smoothly.
4. Guide them to write number sentences in the standard written method by using the multiplication tables on pages 51 to 54.
5. Then, introduce them to multiplication of two numbers on page 55 and continue with the multiplication tables of 6 to 9. Refer pages 56 to 59.
6. Ensure that students can recall all the multiplication tables of 2 to 9 rapidly.
7. Have students try Practice on pages 56 to 59 and discuss the answers with them.
8. Guide them to carry out Activity Corner on page 60.
9. Have students do Exercises C to E on pages 29 and 31 of the Workbook as their homework.
10. Clarify the three properties of multiplication to them by using the examples on page 61.
11. Ask students to try Practices on page 62.
12. Have students do Exercise F on page 32 of the Workbook as their homework.

10th – 13th hours (Multiplication of 1-digit numbers by 10, 20, …, 90)

1. Write two sentences of multiplication (3 x 10 and 3 x 20) on the board, and ask students these questions:
   (a) Can you find out the answers?
   (b) What can you say about the answers?

Explain the relation between multiplying 3 with 10 and 3 with 20 by using the repeated addition. Then guide them to multiply by ignoring the zero and adding back the zero to the answer later. Refer pages 63 and 64.

2. Do a quiz. Randomly ask students the multiplication of 1-digit numbers by 10, 20,…, 90.
3. Have them try Practice on page 64.
4. Have students do Exercise G on page 32 of the Workbook as their homework.

14th – 17th hours (Multiplication of 1-digit numbers by 2-digit numbers)

1. Demonstrate the steps in multiplication without regrouping in the standard written method using the examples on pages 65 and 66. Remind them to always multiple the ones first before multiplying the tens.
2. Show them how to verify the answers.
3. Explain to them how to multiply with regrouping. You may use the examples on page 66 and 67.
4. Get students to try Practice on page 68.
5. Have students do Exercises H to K on pages 33 and 34 of the Workbook as their homework.

18th – 21st hours (Solving word problems)

1. When solving any word problems, always ask students to understand the problems first and then write the number sentences.
2. Use the example on page 69. Guide them step by step. Guide them how to verify the answers.
3. Have students try Practice on page 70 and discuss the answers with them.
4. Have students do Exercise L on pages 35 and 36 of the Workbook as their homework.

22^{nd} – 24^{th} hours (Creating multiplication word problems)

1. Use the example on page 71 to explain to students the steps to create multiplication word problems.
2. Write a number sentence involving multiplication on the board. Ask a few students to make up a word problem based on that number sentence.
3. Have students try Practice on page 71 and discuss the answers with them.
4. Have students do Exercises M and N on page 37 of the Workbook as their homework.

25^{th} hour (Conclusion)

1. Get students to tick what they have learned and understood on page 72 (Part L column).
2. Guide the whole class to conclude the concept of multiplication with these activities:
   (a) Give students a few multiplication questions and ask them to solve and verify their answers.
   (b) Let a group of students create their own word problems involving multiplication and ask the other group to find out the answers.
   (c) Ask them to work in pairs. One should give a multiplication equation and the other one should create a word problem based on it.

Materials

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 2
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 2
- Picture cards
- Multiplication flashcards

Assessment:

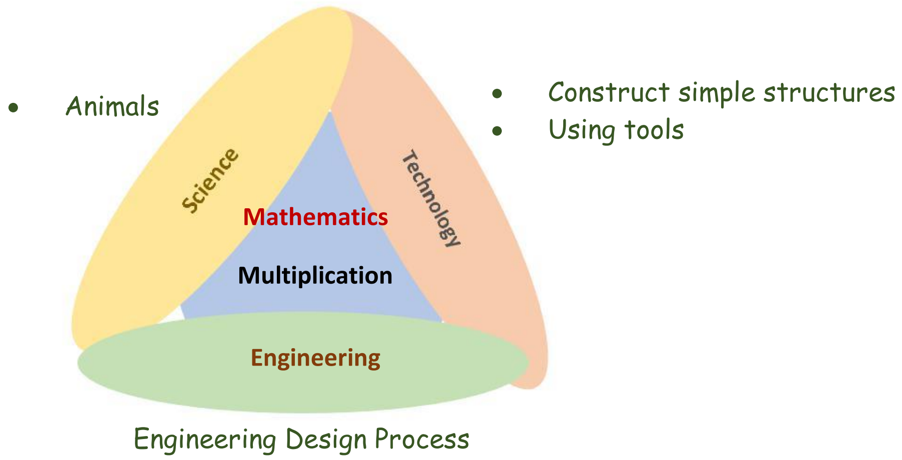
1. To assess cognitive behavior, test on page 72 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: Snake and ladder game (multiplication)

Overview

Games are fun. This chapter will challenge students to design and create a new snake and ladder board game. They should have done it in Prathomsuksa 1 but now they need to add in multiplication problems. Adding multiplication problems in their game will make the game more interesting and motivate students to practice their multiplication skills. Adding question and answer cards will make the game more fun as well.

Subject integration



Activity guide

Time: 3 hours

Start up:

1. Divide students into groups of 3 to 4 students.
2. Talk about their previous STEM activity by asking the following questions:
   - What is the process of creating the balance scale? How was it?
   - Are you satisfied? Why? Why not?
   - Did you work alone or work with your team members? How was your team?

- Did your team work collaboratively?
- What did you help your team? Are you a good team member?

Lesson development:

1. Let students read the situation on page 72. Then, guide the whole class to discuss and identify the problem by answering to these questions:
   (a) Do you still remember the snake and ladder game that you have created when you were in Prathomsuksa 1?
   (b) Was it fun? Why? Why not?
   (c) Explain the snake and ladder game.
   (d) What will we have to do?
   (e) What are your missions?
   (f) What do you 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) Can you add any interesting steps in your game?
   (b) Can you put multiplication problems in your snake and ladder game?
   (c) Can you add question cards in your game? How?
   (d) Can we choose other animals instead of snakes? What will you choose?
   (e) Why do you choose the particular animal? What are the suitable characteristics of the animal to replace the snakes?
   (f) Do you need any tools for this project?
3. Ask 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? (Multiplication problems added in game, satisfaction, etc.)
   (b) How do you evaluate our success? (Satisfaction survey)

4. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.
5. After they have finished their work, ask them to assess their snake and ladder game by using the criteria stated in no.3. Teacher may pose these following questions:
   (a) Did your work meet the criteria?'
   (b) What works? What does not work?
   (c) How will you modify your solution to make it better?
6. Let them improve their design. Teacher may point out their weak points and then motivate them to think 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 teamwork, the product, the process, the problems, the evaluation, and improvement.)

Conclusion:

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

Suggested materials:

Cardboard, ruler, pencil, dice, crayons

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 4 Division

Time: 20 hours

Strand 1 Numbers and Algebra

Standard M.1.1 Numbers

Indicators

M 1.1 Gr 2/6 Find the value of unknown in division equations that dividend is not more than 2 digits and divisor is 1 digit and the quotient is 1 digit with and without remainder.

Learning objectives:

Students will be taught to:

- Understand division as sharing equally or grouping.
- Solve word problems involving division.
- Understand and use the operation of division.

Competency:

- Thinking skills
- Problem – solving skills

Start up:

- Assess students' prior knowledge about division by asking what they knew and what they want to know more about division.
- Let students write all their prior knowledge in Part K column on page 74 and have students share what they know about division. Then, let students to write some questions which they want to know in Part W column on page 74.

Teaching/Learning activities:

1^{st} – 4^{th} hours (Meaning of division)

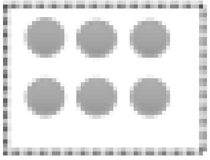
1. Introduce the meaning of division by showing students the picture cards of 6 objects such as 6 eggs. Then, ask them these following questions:
   (a) How many eggs are there all together?
   (b) If we want to have 2 eggs in each group, how many groups can we get?
   (c) If we want to have 3 eggs in each group, how many groups can we get?
2. Explain the meaning of division as sharing equally or grouping. Use the examples on pages 75 and 76.
3. Guide them on how to read and write number sentences involving division. Label the number sentences.
4. Have them try Practice on page 77.
5. Have students do Exercises A and B on pages 40 and 41 of the Workbook as their homework.

5^{th} – 7^{th} hours (Division as the opposite of multiplication)

1. Draw 10 similar objects on the board. Ask a student to circle the objects to make two groups with the same number of objects. Then, ask another student to write a division equation based on the grouping and another student to write a multiplication equation based on the grouping. Ask the class what they understand.
2. Tell students that division is the opposite of multiplication.
3. Use the example on page 78 for further explanation.
4. Write a few number equations involving division. Ask a few students to rewrite them as multiplication equations.
5. Let them try Practice on page 78 and discuss the answers with them.
6. Have students do Exercise C on page 42 of the Workbook as their homework.

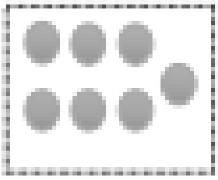
8^{th} – 13^{th} hours (Dividing by 1-digit divisors)

1. Use picture cards to demonstrate the concept of dividing by 1-digit divisors. Teacher may use this following example.

   Ask them to group the balls into 2 groups. Ask them:

   - How many balls are there in each group?
   - Do we have any remainders?

   Ask them to group the balls into 2 groups. Ask them the same questions as before:

   - How many balls are there in each group?
   - Do we have any remainders?

2. To divide easily, students need to remember the multiplication tables very well.
3. Use the examples on page79 for further explanation.
4. Have them try Practice on page 79.
5. Have students do Exercise D on page 43 of the Workbook as their homework.
6. Explain the differences between the division without remainder and the division with a reminder to students. Refer pages 80 and 81.
7. Guide students on how to check the accuracy of the answers. Refer pages 81 and 82.
8. Have students try Practice on page 82.
9. Have students do Exercise E on page 44 of the Workbook as their homework.

14th – 16th hours (Solving word problems)

1. Explain to students how to solve word problems and reiterate the importance of writing the number sentence before solving it.
2. Guide them on how to check the answers and use the example on page 83 for further explanation.
3. Have students try Practice on page 84 and discuss the answers with them.
4. Have students do Exercise F on pages 45 and 46 of the Workbook as their homework.

17th – 19th hours (Creating division word problems)

1. Tell them a story based on the division equation. You may use some pictures such as pictures of 8 cakes and 2 plates. Ask them to solve the problem.
2. Explain how to create division word problems step by step. Refer page 85.
3. Write a number sentence involving division on the board. Get a few students to make up some word problems based on that number sentence and find out the answers.
4. Have students try Practice on page 85 and discuss the answers with them.
5. Have students do Exercise G on page 46 of the Workbook as their homework.

20th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 86 (Part L column).
2. Guide the whole class to conclude the concept of division with these activities:
   (a) Give students a few division equations and ask them to solve and verify their answers.
   (b) Let them create their own word problems involving division and find out the answers.
   (c) Ask them to work in pairs. One should give a division equation and the other one should create a word problem based on it

Learning materials

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 2
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 2
- Number cards
- Picture cards

Assessment:

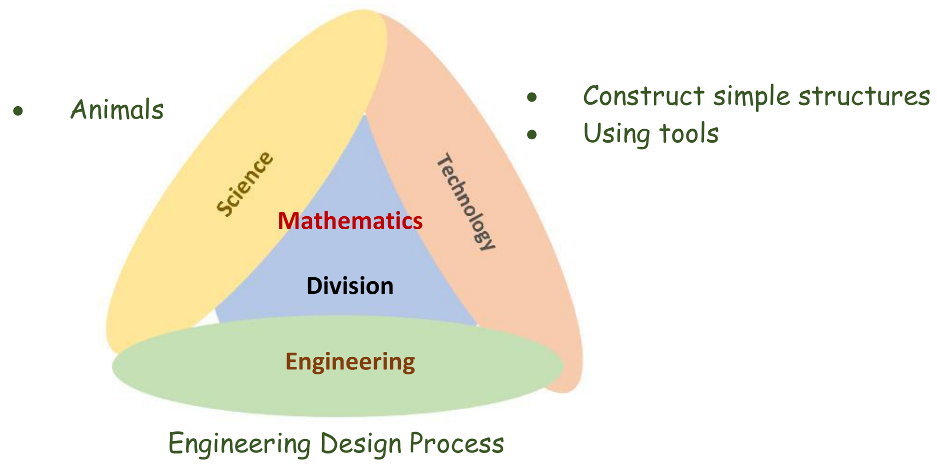
1. To assess cognitive behavior, test on page 86 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: Snake and ladder game (division)

Overview

After conducting the satisfaction survey and receiving some comments on their previous game, students will learn how to analyze their survey results and improve their game based on the comments in this activity. They will also understand more about how to design and create something new that meets their needs.

Subject integration



Activity guide

Time: 3 hours

Start up:

1. Ask students to work in the same group as done in the previous chapter.
2. Talk about their previous snake and ladder game by asking the following questions:
   - Did you like your snake and ladder game in the previous activity? Why?
   - Would you change the team members for this activity? Why?
   - Why should you be on the same team?

Lesson development:

1. Let students read the situation on page 86. Then, guide the whole class to discuss and identify the problem by answering these questions:
   (a) What will you have to do?
   (b) What are your missions?
   (c) What do you need to know to get started?
   (d) What did you learn from your last activity?
   (e) What did your friends comment on your game?
   (f) Which parts of your game should you improve to make it more fun?
2. Motivate students to explore and make connections between science, technology, engineering and mathematics by posing these following questions:
   (a) What else can you add more besides the division problems?
   (b) What suggestions did your friends give?
   (c) Should you add both easy problems and difficult problems? Why?
   (d) Will you change your rules of play? How? Why?
   (e) Will you add more decoration in your game such as the animals and the board?
   (f) Can you search for more information about the animals and their lives?
   (g) What is favorite animal among 8-year-old kids?
   (h) Do you need any tools for this project?
3. Ask 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 variety of division problems, etc.)
   (b) How do we evaluate our success? (A satisfaction survey)
4. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.
5. After they have finished their work, ask them to assess their snake and ladder game by using the criteria stated in no.3. Teacher may pose these following questions:

(a) Did your board game meet the criteria?

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

(c) What works? What does not work?

(d) 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 by:

7. Engage students to analyze their friends' opinions and encourage them to use the data from their survey for improvement.

8. Enhance other groups to give more suggestions or share their ideas in order to develop thinking skills. (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.)

9. 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 teamwork, the product, the process, the problems, the evaluation, and improvement.)

Conclusion:

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

   (a) In this activity, what are the reasons for designing and creating the new snake and ladder game?

   (b) What are the benefits of conducting a satisfaction survey?

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

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

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

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

   (g) What did you learn from this activity?

   (h) What are the steps in the design process? (Teacher should tell them that it is called "the engineering design process".)

Suggested materials:

Cardboard, ruler, pencils, dice, crayons

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 5 Combined operations

Time: 11 hours

Strand 1: Numbers and Algebra

Standard M 1.1 Numbers

Indicator:

M 1.1 Gr2/7 Find the results of mix addition, subtraction, multiplication and division of cardinal numbers not exceeding 1,000 and 0.

M 1.1 Gr2/8 Show mathematical methods to solve 2-step word problems of cardinal numbers not exceeding 1,000 and 0.

Learning objectives:

Students will be taught to:

- Perform combined operations involving addition, subtraction, multiplication and division.
- Creating word problems in daily life involving combined operations.

Competency:

- Problem – solving skills
- Creative thinking skills

Start up:

- Assess students' prior knowledge about combined operations by asking what they knew and what they want to know more about combined operations.
- Let students write all their prior knowledge in Part K column on page 88 and have students share what they know about combined operations. Then, ask students to write some questions which they want to know in Part W column on page 88.

Teaching/Learning activities:

1st – 4th hours (Combined operations)

1. Explain to students that combined operations involve more than one operation.
2. Emphasize that for any combined operations, they need to do the operations in the brackets first.
3. Using the examples on page 89, guide them to solve combined operations.
4. Ask the students to try Practice on page 90 and discuss the answers with them.
5. Have students do Exercises A and B on pages 48 and 49 of the Workbook as their homework.

5th – 7th hours (Solving word problems)

1. Demonstrate how to solve word problems step by step using the examples on page 91.
2. Write a word problem involving combined operation on the board and then have a few students to solve.
3. Have students try Practice on pages 92, then discuss the answers with them.
4. Have students do Exercise C on page 50 of the Workbook as their homework.

8th – 10th hours (Creating word problems involving combined operations)

1. Review with students how to solve a word problem.
2. Write a number sentence involving combined operation on the board and then have a few students to create word problems based on the given number sentence.
3. Use the example on page 93 to explain further.
4. Have students try Practice on pages 93, then discuss the answers with them.
5. Have students do Exercise D on page 51 of the Workbook as their homework.

11th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 94 (Part L column).
2. Guide the whole class to conclude the concept of combined operations with these activities:

   Activity 1

   (a) Ask them to form groups of 3 to 4 students.

   (b) Give them a piece of A4 paper and then ask them to create 2 to 3 word problems including pictures. The problems should be different.

   (c) Teacher will randomly exchange the word problems among the groups and the group that receives it need to solve it.

   Activity 2

   (a) Ask them to form groups of 3 to 4 students

   (b) Give them a piece of A4 paper. Fold it to 4 equal parts.

   (c) Ask each group create 2 word problems and 2 combined operation problems. Then, give this paper to another group to practice and solve problems.

   (d) Place all activity sheets on the wall, assign each group to check their peers' answers.

   (e) Put ✓ if they think that it is correct.

   (f) Put × if they think that it is wrong.

   (g) Put ? if they are not sure.

   (h) Teacher will discuss the answers in class.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 2
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 2
- Objects for counting such as books, cubes, pencils and erasers
- A4 paper

Assessment:

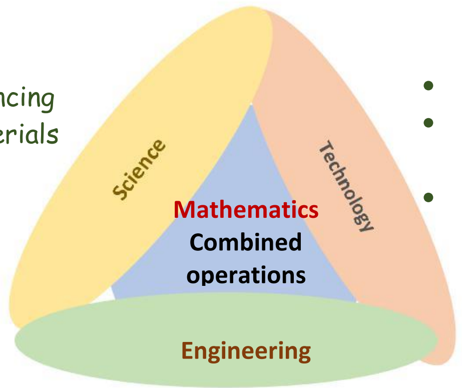
1. To assess cognitive behavior, test on page 94 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: Tower of building blocks

Overview

Wooden blocks are a kind of toys that young kids prefer. Building constructions with wooden blocks can stimulate many skills such as creative thinking skills, motor skills, language skills and social skills. In this activity, students will be challenged to build a strong tower that can stand firmly for at least 15 minutes with the minimum budget.

Subject integration



Engineering Design Process

Activity guide

Time: 3 hours

Start up:

1. Divide students into groups of 3 to 4 students.
2. Talk about their previous STEM activity by asking the following questions:
   (a) What was the process of creating the snake and ladder game? How was it?
   (b) Are you satisfied? Why?
   (c) Did you work alone or work with your team members? How was your team?
   (d) Did your team work collaboratively?
   (e) What did you help your team? Are you a good team member?

Lesson development:

1. Assign students to read the situation on page 94. Then, lead students to discuss and identify the problem by answering these questions:
   (a) What will you have to do?
   (b) What are your missions?
   (c) What do you need to know to get started?
   (d) What is the problem of this situation?
2. Motivate students to explore and make connections between science engineering and mathematics by posing these following questions:
   (a) What are the shapes of the wooden blocks?
   (b) Do the shapes of the wooden blocks affect the stability of the structure?
   (c) Which shape makes the structure stable?
   (d) What is a tower?
   (e) How does a tower look like?
   (f) Can you search for more information about tower? How?
   (g) What will your tower look like? Why?
   (h) What wooden blocks do you need?
   (i) How many wooden blocks do you need?
   (j) What are the benefits of using wooden blocks instead of other materials such as plastic?
   (k) Do you need any tools for this construction?
   (l) How much should you budget for this project?
   (m) Can you design the tallest tower by limited wooden blocks?
3. Ask students to think 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? (Completion time, cost, stability etc.)
   (b) How do we evaluate our success? (The height of the tower, creativity, style of the tower)

4. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.
5. After they have finished their work, ask them to assess their wooden block tower by using the criteria stated in no.3. Teacher may pose these following questions:
   (a) Did your tower meet the criteria?
   (b) Do you and your team feel satisfied with your work? Why?
   (c) What works? What does not work?
   (d) How will you modify your solution to make it better?
6. Let them improve their design. Teacher may 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.)
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 teamwork, the product, the process, the problems, the evaluation, and improvement.)

Conclusion:

1. End the lesson by asking students the following questions:
   (a) What is the engineering design process? Did you apply the engineering design process into your work?
   (b) Did each team come up with the same design? Why?
   (c) Do you think that teamwork is important? Why?
   (d) What are the key success factors that affect your group work? (Teamwork, creative thinking, etc.)
   (e) What subject knowledge did you apply into this activity?
   (f) What are the benefits of this activity?
   (g) What will happen if you build the tower without a proper plan and design?
   (h) What did you learn from this activity?

Suggested materials:

A variety of wooden building blocks

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 6 Time

Time: 22 hours

Strand 2: Measurement and Geometry

Standard M.2.1 Time

Indicator:

M 2.1 Gr2/1 Show mathematical operations in word problems involving time with one and the same standard unit.

Learning objectives:

Students will be taught to:

- Understand, read and write the time.
- Understand the units of time.
- Compare time in hours and minutes.
- Solve word problems involving time.

Competency:

- Technological application skills

Start up:

- Assess students' prior knowledge about time by asking what they knew and what they want to know more about time.
- Ask students to write all their prior knowledge in Part K column on page 96 and have them share what they know about time. Then, ask the students to write some questions which they want to know in Part W column on page 96.

Teaching/Learning activities:

1st hour (Periods of time in a day)

1. Show students picture of period of time in a day on page 97 and then explain that a day is divided into daytime and night-time.
2. Based on the picture, ask students some question such as
   (a) When does a day start? When does a day end?
   (b) When do morning, afternoon and evening start?
   (c) Do we use this format every season?
   (d) Do American use this period of time in a day every season?
   (e) Ask students the activities they do during each period of time. Engage them to give more examples that are different from the book. Refer to page 98.
3. Assign students to do Practice on page 99.
4. Have students do Exercises A and B on page 60 of the Workbook as their homework.

2nd – 6th hours (Telling time in hours and minutes)

1. Show students an analog clock and ask them about the clock components.
2. Ask students to identify the minute hand, hour hand and second hand.
3. Emphasize the differences between the hour hand and the minute hand.
4. Guide students to read the time in hours both in the early morning and in the morning. Refer to page 100.
5. Do a quiz by showing the time in hours on a clock and ask students to read them out.
6. Use an analog clock to make students understand that the time shown on the clock can be showing different times of the day. Explain how to read both times in day time and night time. Refer to page 101.
7. Give them more examples. Ask them to read the times. Refer to page 102.
8. Ask the students to try Practice on page 102.

9. Explain the minutes on the clock and the relationship between hours and minutes.
10. Emphasize that each small mark on the clock represents a minute.
11. Guide students to read the time to the five minutes intervals. Guide them how to read the time in many ways for example ‘forty-five minutes past ten’, ‘ten forty-five’, ‘a quarter to eleven’, ‘fifteen minutes to eleven’, ‘half past ten’ and ‘ten thirty’.
12. Ask students to read aloud the times shown on pages 104 and 105.
13. Show them how to write the time both in numerals and in words and check their spellings.
14. Have a quiz. Tell them a time and have a student to draw the time on the board and another student to read the time in another way. Repeat a few times.
15. Ask them to be extra care when reading time. Refer to Let’s Think on page 105.
16. Carry out the Activity Corner on page 106. Then share their findings to the class.
17. Ask students to try Practice on pages 107 and 108 and discuss the answers with them.
18. Have students do Exercises C to G on pages 61 to 64 of the Workbook as their homework.

7th – 10th hours (Duration of time)

1. Show students the time table of the class. Then, ask them some questions:
   (a) For the first period, at what time does it start and end?
   (b) Do you know how long each period lasts? How do you know? (Students may use different of solving the problem)
2. Show students a clock and how to calculate duration of time. Explain more. Refer to pages 109 and 110.
3. Divide the class into a few groups. Ask each group to create a problem for other groups to solve.

4. Ask students to try Practice on page 111 and discuss the answers with them.
5. Have students do Exercises H and I on pages 65 to 67 of the Workbook as their homework.

11th – 14th hours (Comparing the time in hours and minutes)

1. Review the previous knowledge about how to solve problems of duration of time in the previous part.
2. Explain to them how to compare the time in hours and minute by using example from pages 112 and 113.
3. Ask students to make an example of their activities on weekend and ask them to compare which activity they spend the longest time and why.
4. Ask students to try Practice on page 114 and discuss the answers with them.
5. Have students do Exercise J on pages 68 and 69 of the Workbook as their homework.

15th - 17th hours (Reading a calendar)

1. Show students a calendar and ask them what calendar can tell us.
2. Guide students to read the calendar correctly. For example, 1 May is read as the first of May; 2 June is read as the second of June; 3 August is read as the third of August; 4 of December is read as the fourth of December.
3. Have students fill up the blanks on pages 115 to 116.
4. Ask students to try Practice on page 117 and discuss the answers with them.
5. Have students do Exercises K to O on pages 69 to 73 of the Workbook as their homework.

18^{th} - 21^{st} hours (Solving word problems involving time)

1. Review the previous knowledge about how to solve problem of duration of time and comparing the time in hours and minutes.
2. Explain how to solve word problem by using a clock and the refer to pictures on page 118. Encourage them to draw clocks.
3. Divide them into groups. Ask each group to create a word problem for other group to solve.
4. Ask them to try Practice on page 119 and discuss the answers with them.
5. Have students do Exercise P on page 74 of the Workbook as their homework.

22^{nd} hour (Conclusion)

1. Get the students to tick what they have learned and understood on page 120 (Part L column).
2. Guide the whole class to conclude the concept of time.
3. Some students may get confused. Teacher should use a real clock to explain instead of a picture.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 2
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 2
- Picture of clock
- A clock with 2 hands

Assessment:

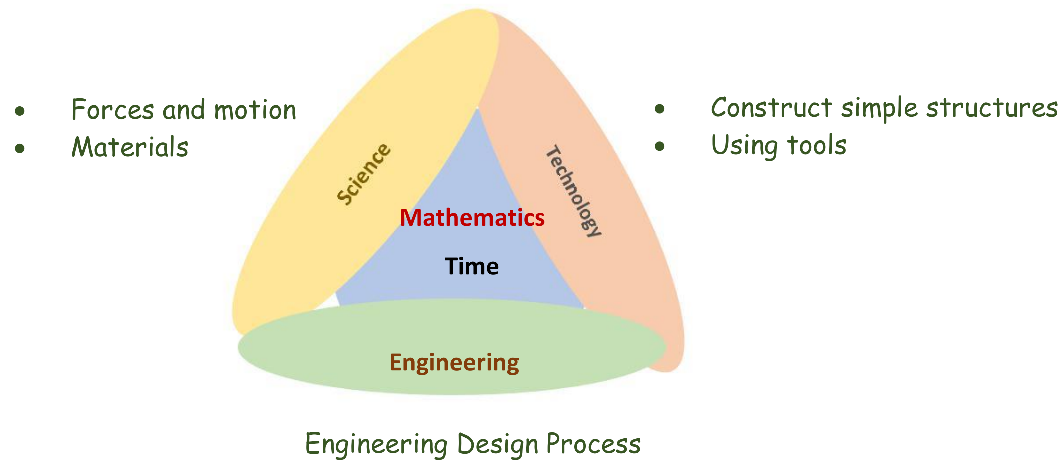
1. To assess cognitive behavior, test on page 120 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: Paper airplanes

Overview

In this activity, students will use the engineering design process to construct a paper airplane. They will search for more information about how to make a paper airplane flying in the air for as long as possible. In the competition, they will apply their understanding of time to measure how long their airplane can fly in the air and compare it with their friends.

Subject integration



Activity guide

Time: 3 hours

Start up:

1. Divide students into groups of 3 to 4 students.
2. Talk about their previous STEM activity:
   (a) What is the process of creating the tower of building blocks? How was it?
   (b) Are you satisfied? Why?
   (c) Did you work alone or work with your team members? How was your team?
   (d) Did your team work collaboratively?
   (e) What did you help your team? Are you a good team member?

Lesson development:

1. Let students read the situation on page 120. Then, guide the whole class to discuss and identify the problem by answering to these questions:
   (a) What will you have to do?
   (b) What are your missions?
   (c) What do you need to know to get started?
   (d) What is the problem of this situation?
2. Engage students to explore and make connections between science, technology, engineering and mathematics by posing these sample questions:
   (a) Have you ever made a paper airplane before? How?
   (b) What makes a paper airplane fly?
   (c) How do you make a paper airplane fly?
   (d) What are the factors that affect the duration of the airplane in the sky? (Size, shape, shape of the airplane wings, wing size, etc.)
   (e) Which one can fly in the air for a longer time – a big or a small airplane?
   (f) What types of airplane wings can help the plane stay in the air for a longer period of time - big or small wings?
   (g) What types of paper can make a paper airplane fly for a long period of time - thick or thin paper?
   (h) Can you search for more information about paper airplanes?
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? (Duration of the airplane in the air, etc.)
   (b) How do you evaluate our success? (Creativity, the length of time of the airplane in the air)
4. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.
5. After they have finished their work, ask them to assess their paper airplane by using the criteria stated in no.3. Teacher may pose these following questions:

(a) Did your paper airplane meet the criteria?

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

(c) What works? What does not work?

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

6. Let them improve their design. Teacher may 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.)

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 teamwork, the product, the process, the problems, the evaluation, and improvement.)

Conclusion:

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

(a) What is the engineering design process? Did you apply the engineering design process into your work?

(b) Did each team come up with the same design? Why?

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

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

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

(f) What are the benefits of this activity?

(g) What will happen if you build the paper airplane without a proper plan and design?

(h) What did you learn from this activity?

Suggested materials:

Various types of paper with different sizes and thickness, clock or stopwatch

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 7 Length

Time: 15 hours

Strand 2: Measurement & Geometry

Standard M 2.1 Length

Indicator

M 2.1 Gr2/2 Measure and compare lengths in meters and centimeters.

M 2.1 Gr2/3 Show mathematical operations in addition and subtraction word problems involving length in meters and centimeters.

Learning Objective:

Students will be taught to:

- Measure and compare lengths in meters and centimeters.
- Estimating length in meters.
- Compare length in same and different units.
- Solve word problems in addition and subtraction involving length in meters and centimeters.
- Create addition and subtraction word problem involving length in meters and centimeters.

Competency

- Applying life skills
- Technological application skills

Start up:

- Assess students' prior knowledge about length by asking what they knew and what they want to know more about length.
- Ask them to write all their prior knowledge in Part K column on page 122 and have students share what they know about length. Then ask students to write some questions which they want to know in Part W column on page 122.

Teaching/Learning activities:

1^{st} – 4^{th} hours (Measuring length in meters and centimeters)

1. Ask students to use their body parts such as hands and arms to measure the length of a desk. Then, ask them whether their answers are the same. Discuss.
2. Briefly explain what length and height are and their differences.
3. Show them how long a meter is and present some standard measuring tools such as meter rulers, rulers, measuring tapes and metal measuring tapes.
4. Guide them on how to use these tools for measuring lengths.
5. Introduce them that meter is the standard unit of length and its abbreviation is m.
6. Ask students to measure the lengths of the window or the bookshelf in the classroom using standard measuring tools in meters. Refer to page 123 and 124.
7. Introduce centimeters and its abbreviations and explain the relationship between meters and centimeters. Refer to page 124.
8. Ask students to measure the lengths of small objects such as books and pencils by using standard measuring tools in centimeters.
9. Explain to them how to measure the length of an object which is more than 100 cm. Refer to page 125.
10. Engage students to think about measurement in meters and centimeters. Ask them when to use meter and when to use centimeters. Discuss with them.
11. Guide them to answer the question in Let's Think activity on page 126.
12. Have students try Practice on page 126 and 127.
13. Have students do Exercises A and B on pages 78 and 79 of the Workbook as their homework.

5^{th} – 6^{th} hours (Estimating length in meters)

1. Let students do some of the following activities:
   (a) Show some objects and ask students to estimate their lengths or heights. The answer may be right or wrong. Ask them how to get the accurate answers by measuring them.

(b) Ask students to estimate length of blackboard by comparing with length of table. The answer may be right or wrong. Ask them how to get the accurate answers by measuring them.

Remind student of using the proper measuring tools in different situations.

2. Explain more to make them understand by using examples on page 128.
3. Have students carry out the activity in Activity Corner on page 129.
4. Have students try Practice on page 130.
5. Have students do Exercise C on page 80 of the Workbook as their homework.

7th – 8th hours (Relationships between units of length)

1. Ask them to list the units of length and their relationships.
2. Guide them on how to convert between the units of length using the examples on page 131.
3. Divide the class into two groups. Write a few measurements of different units of length on the board and ask them to convert either to a larger unit or a smaller unit within a time frame. The group with the most correct answers wins.
4. Ask students to try Practice on page 131 and discuss the answers with them.
5. Have students do Exercises D and E on pages 81 and 82 of the Workbook as their homework.

9th – 11th hours (Comparing lengths)

1. Review their knowledge of comparing and measuring again. Ask a student to measure the heights of two students and ask the rest of the students these questions: Who is taller? Who is shorter?
2. Then, measure the heights of three students and ask the rest of the students these questions: Who is the tallest? Who is the shortest?
3. Explain more by using more examples. Refer to pages 132 and 133.
4. Have students try Practice on page 134 and discuss the answers with them.

5. Have students do Exercises F and G on pages 82 and 83 of the Workbook as their homework.

12^{th} – 14^{th} hours (Solving word problems involving length)

1. Explain how to solve word problems step by step using the examples on page 135.
2. Write some word problems on the board and get a few students to solve them. Discuss the answers with them and guide them to verify the answers.
3. Have students try Practice on page 136 and discuss the answers with them.
4. Have students do Exercise H on pages 83 to 85 of the Workbook as their homework.

15^{th} hour (Conclusion)

1. Get students to tick what they have learned and understood on page 137 (Part L column).
2. Guide the whole class to conclude the concept of length with these activities:
   (a) Give students some objects with different lengths and ask them to measure in meters and/ or in centimeters. Let them compare the lengths.
   (b) Let them create their own word problems involving length or distance and find out the answers.

Learning materials

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 2
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 2
- Objects for measuring length such as books, ball, blackboard, door

Assessment:

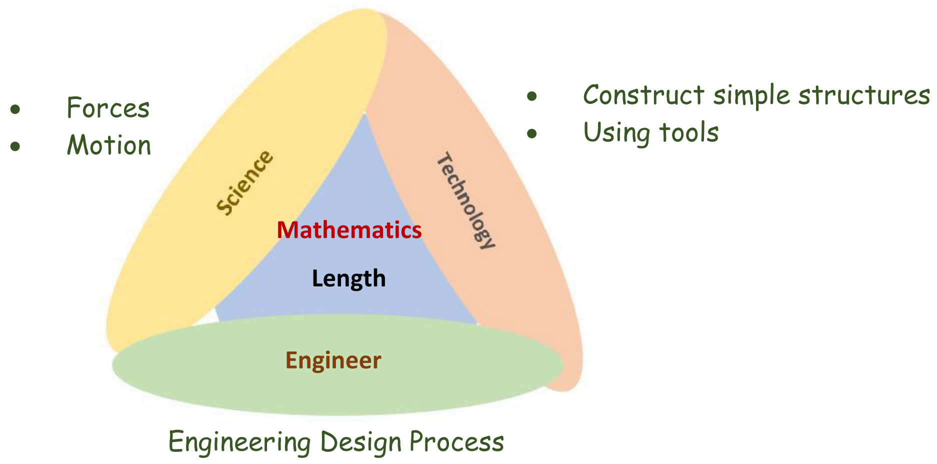
1. To assess cognitive behavior, test on page 137 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: A great racing ramp

Overview’

In this activity, students will design and create a racing ramp. They will understand the concept of forces more after this activity. They will discover the factors affecting the traveling distance of the toy cars after sliding down the ramps.

Subject integration



Activity guide

Time: 3 hours

Start up:

1. Divide students into groups of 3 to 4.
2. Talk about their previous STEM activity:
   - What was the process of creating the paper airplanes?
   - Did you work alone or work with your team member members?
   - Did your team work collaboratively?
   - What did you help your team? Are you a good team member?

Lesson development:

1. Let students read the situation on page 137. Then, guide the whole class to discuss and identify the problem by answering to 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. Encourage students to explore and make connections between science, technology, engineering and mathematics by posing some of these following questions:
    (a) What are the steps of the engineering design process?
    (b) What is a ramp?
    (c) Can you make a ramp by yourself? How?
    (d) What tools do you need to design and create a ramp?
    (e) What materials do you need to make a ramp?
    (f) Can you create 4 to 5 ramps with different heights?
    (g) How do you measure the distance of the toy cars traveled after sliding down the ramps?
    (h) Does the length of the distance of the toy cars traveled depend on the height of the ramp? Can you design a great racing ramp and find out the result?
    (i) Do you need any tools and materials for this experiment?
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? (The greatest distance, etc.)
    (b) How do we evaluate our success? (Measuring)
4. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.
5. After they have finished their work, ask them to assess their castle by using the criteria stated in no.3. Teacher may pose these following questions:
    (a) Did your work meet the criteria?

(b) What works? What does not work?

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

6. Let them improve their design. Teacher may point out their weak points. 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 racing ramp 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 teamwork, the product, the process, the problems, the evaluation, and improvement.)

Conclusion:

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

Suggested materials:

Wooden blocks, a rail or wooden plank, toy cars, ruler

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 8 Mass

Time: 15 hours

Strand 2: **Measurement & Geometry**

Standard M 2.1 Weight

Indicator:

M 2.1 Gr2/4 Measure and compare weight in kilograms and grams/ kilograms and kheeds (hectograms).

M 2.1 Gr2/5 Show mathematical operations in addition and subtraction word problems involving weight in kilograms and grams/ kilograms and kheeds (hectograms).

Learning objectives:

Students will be taught to:

- Measure mass in kilograms and kheeds or hectograms.
- Estimate mass in kilograms.
- Compare and convert between units of mass.
- Solve word problems involving mass.

Competency

- Applying life skills
- Technological application skills

Start up:

- Assess students' prior knowledge about mass by asking students what they knew and what they want to know more about mass.
- Let students write all their prior knowledge in Part K column on page 139 and have students share what they know about mass. Then ask the students to write some questions which they want to know in Part W column on page 139.

Teaching/Learning activities:

1st – 2nd hours (Measuring mass in kilograms and grams)

1. Show students a book and a water bottle and ask them these questions:
   (a) How do we know which one is heavier – the book or the water bottle?
   (b) Which one is lighter?
2. Review their knowledge of mass and show students some standard measuring tools such as balance scales, spring scales, digital scales, bathroom scales and platform scales.
3. Introduce the standard units of mass and the relationship between kilograms and grams including their abbreviations based on pages140 to 142.
4. Let students feel how heavy a kilogram and a gram of objects are.
5. Ask students to measure the mass of books, bags or other items they can find in the classroom by using the standard measuring tools in kilograms and grams. Teach them how to read the tools.
6. Let them try Practice on pages 142 and 143. Discuss the answers with them.
7. Have students do Exercises A and B on pages 89 and 90 of the Workbook as their homework.

3rd – 4th hours (Measuring mass in kilograms and kheeds or hectograms)

1. Introduce the relationships between kilogram, kheed or hectogram to students by using the examples on page 144.
2. Explain how to read scales in kilograms and kheeds or hectograms. Refer to page 144.
3. Have students try Practice on page 145 and discuss the answers with them.
4. Have students do Exercises C and D on page 91 of the Workbook as their homework.

5^{th} – 6^{th} hours (Estimating mass in kilograms)

1. Show some objects such as fruits and ask students to estimate their masses. The answer may be right or wrong. Ask them how to get the accurate answers by weighing them.
2. Explain more by using the examples on pages 146 and 147.
3. Have students carry out activity in Activity Corner on page 148.
4. Have students try Practice on page 148.
5. Have students do Exercises E and F on pages 92 and 93 of the Workbook as their homework.

7^{th} – 8^{th} (Relationships between units of mass)

1. Remind students of using the proper measuring tools in different situations such as measuring the mass of fruits, the mass of paper and the mass of a small stone.
2. Ask them to list the units of length and their relationships.
3. Guide them on how to convert between the units of mass using the examples on page 149.
4. Have a quiz. Divide the class into two groups. Write a few measurements of different units of mass on the board and ask them to convert either to a larger unit or a smaller unit within a time frame. The group with the most correct answers wins.
5. Ask students to try Practice on page 149 and discuss the answers with them.
6. Have students do Exercise G on page 94 of the Workbook as their homework.

9^{th} – 11^{th} hours (Comparing masses)

1. Review their knowledge of comparing and measuring again. Measure the mass of two similar sized-fruits (watermelon and pomelo). Ask the rest of students these questions:
   (a) Which is heavier?
   (b) Which is lighter?

(c) What is the difference in mass between them?

Then, measure the mass of a third item such as a water bottle. Ask these questions:

(d) Which is the heaviest?

(e) Which is the lightest?

(f) Can you arrange the items starting from the lightest in sequence?

2. Explain more. Refer to pages 150 and 151.
3. Have students try Practice on page 152 and discuss the answers with them.
4. Have students do Exercises H to J on pages 95 to 97 of the Workbook as their homework.

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

1. Explain the steps on how to solve word problems involving mass using the examples on page 153.
2. Have students try Practice on page 154 and discuss the answers with them.
3. Have students do Exercise K on page 98 of the Workbook as their homework.

15th hour (Conclusion)

1. Get the students to tick what they have learned and understood on page 155 (Part L column).
2. Guide the whole class to conclude the concept of mass with these sample activities:
   (a) Give students some objects of different masses and ask them to measure their masses in kilograms and/or in grams. Let them compare the masses using the vocabulary of comparison.
   (b) Let them create their own word problems involving mass and find out the answers.
   (c) Ask them to work in pairs. One should create a word problem involving mass and the other solves it.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 2
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 2
- Objects for measuring such as books, fruits and stones

Assessment:

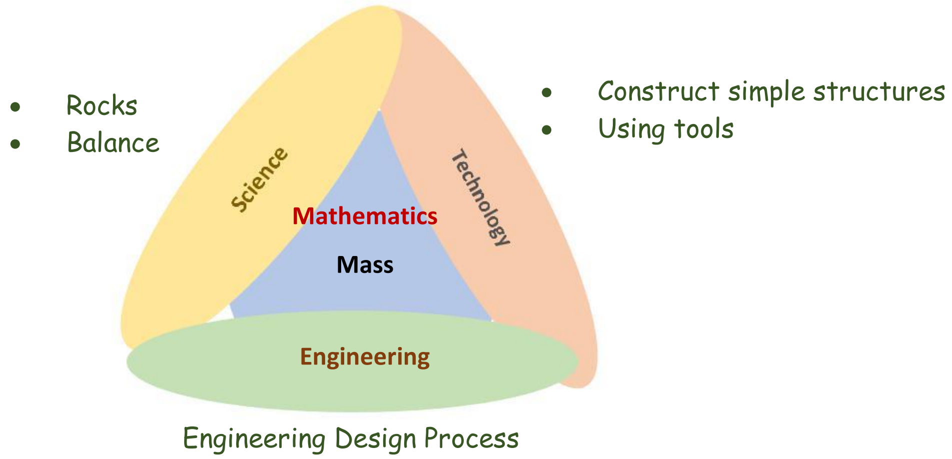
1. To assess cognitive behavior, test on page 155 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: Light rocks?

Overview

In this activity, students will use the engineering design process to design and create their own balance scale and sort some rocks based on their masses.

Subject integration



Activity guide

Time: 3 hours

Start up:

1. Divide students into groups of 3 to 4.
2. Talk about their previous STEM activity:
    - What is the process of creating the racing ramp? How was it?
    - Are you satisfied? Why? Why not?
    - Did you work alone or work with your team members? How was your team?
    - Did your team work collaboratively?
    - What did you help your team? Are you a good team member?

Lesson development:

1. Let students read the situation on page 155. Then, guide the whole class to discuss and identify the problem by answering these questions:
   (a) What will you have to do?
   (b) What are your missions?
   (c) What do you need to know to get started?
   (d) What is the problem of this situation?
2. Motivate students to explore and make connections between science, technology, engineering and mathematics by posing some of these following questions:
   (a) What is the characteristic of a balance scale?
   (b) Can you use wooden sticks to make a balance scale?
   (c) What is the unit of measuring mass in this chapter?
   (d) Can you use sand bags or other objects as the unit of mass measurement?
   (e) If you want to change from sand bags to other objects, what are the characteristics of those objects that you have to concern about?
   (f) How many groups of rocks do you want to sort into?
   (g) What kinds of tools and materials do you need for this project?
3. Ask students to think about how to assess their project. Lead them to discuss in class and set their criteria with these sample questions:
   (a) What are the achievement criteria? (Accuracy of measurement, maximum capacity, accuracy of reading the tools, etc.)
   (b) How do you evaluate your success? (Its functions, durability, mobility, etc.)
4. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.
5. After they have finished their work, ask them to assess their balance scale by using the criteria stated in no.3. Teacher may pose these following questions:
   (a) Did your balance scale meet the criteria?
   (b) Do you and your team feel satisfied with your work? Why? Why not?
   (c) What works? What does not work?

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

6. Let them improve their design. Teacher may point out their weak points and 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 teamwork, the product, the process, the problems, the evaluation, and improvement.)

Conclusion:

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

Suggested materials:

A variety of similar-sized rocks, wooden stick or wooden ruler, string, plastic bag

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 9 Volume and capacity

Time: 18 hours

Strand 2: Measurement & Geometry

Standard M 2.1 Volume and capacity

Indicator:

M 2.1 Gr2/6 Measure and compare volume and capacity in liters.

Learning objectives:

Students will be taught to:

- Measure volume and capacity using non-standard units.
- Measure and compare volume in liters.
- Measure and compare capacity in liters.
- Solve word problems involving volume and capacity.

Competency:

- Applying life skills
- Technological application skills

Start up:

- Assess students' prior knowledge about volume and capacity by asking what they knew and what they want to know more about volume and capacity.
- Ask them to write all their prior knowledge (Part K column) on page 157 and have students share what they know about volume and capacity. Then ask them to write some questions which they want to know (Part W column) on page 157.

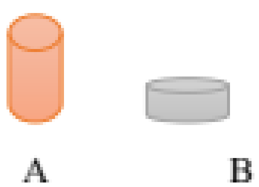
Teaching/Learning activities:

1st – 3rd hours (Measuring volume and capacity using non-standard units)

1. Prepare some containers of different shapes that contain the same level of colored water. Then ask
   (a) Which container has the most water? Why?
   (b) Which container has the least water? Why?
   (c) Do you have any measuring tools for finding out your answer?
2. Let students fill and empty some containers with colored water. Describe these words to them '*empty*', '*full*', '*half- full*', '*more*' and '*less*'.
3. Explain and differentiate the concept of volume and capacity to students using the examples on pages 158 and 159.
4. Explain to them how to measure volume using non-standard units refer to pages 159 and 160.
5. Explain them how to measure capacity using non-standard units refer to pages 160 and 161.
6. Ask them to carry out the activity in Activity Corner on page 162.
7. Let them try Practice on pages 162 and 163 and discuss the answers with them.
8. Have students do Exercise A on page 103 of the Workbook as their homework.

4th – 6th hours (Measuring volume and capacity in liters)

1. Introduce the concept of volume to students by showing them two containers of different shapes. Challenge them to find out which container can contain more water.



   Then, ask them the way that will give the most accurate and reliable answer. Why?
2. Show students some standard measuring tools such as measuring cylinders and beakers. Briefly explain how to use them by referring to the examples on pages 164 and 165.

3. Explain the unit liter and its abbreviation. Show them how much a liter of water is.
4. Ask them to carry out Activity Corner on page 165.
5. Give students two different containers filled with water. Ask them to measure the volume of water in liters in the containers and compare them.
   (a) Which container contains a greater amount of water?
   (b) Which container contains a smaller amount of water?
6. Use the example on page 166 to further explain.
7. Have the students try Practice on page 167.
8. Have students do Exercise B on page 104 of the Workbook as their homework.

7th – 9th hours (Comparing volumes and capacities in teaspoons, tablespoons and cups)

1. Prepare a few containers of different shapes and sizes such as cups, jugs, milk cartons and drinking bottles and review the concept of volume and capacity with them. Ask them which container can hold more water and which can hold the most water. Let them predict. Get them to brainstorm on how to compare and find out the answers.
2. Fill three similar containers with different amounts of colored water and guide them to say:
   (a) The volume of colored water in container A is **less / greater than** the volume of colored water in container B.'
   (b) 'The volume of colored water in container A is **the least / the greatest**.'
   (c) 'Both containers have the **same volume** of colored water.

   Ask them to read aloud the text on pages 168 and 169.
3. Then, fill three containers of different sizes with colored water until the levels of water reach the same height for the three containers. Get them to compare and find out which one contains the least or the greatest colored water by using a cup to measure. Refer page 170.

4. Referring to page 171, fill up three different containers with colored water and let the whole class guess the capacity of containers. Then ask three students to measure the volumes of water using a tablespoon. Guide students to describe the capacity of the containers.
5. Using examples on page 172 and 173, explain more so that they understand better about comparing capacity.
6. Have students try Practice on page 174 and discuss the answers with them.
7. Have students do Exercises C and D on pages 105 and 106 of the Workbook as their homework.

10th – 11th (Comparing volumes and capacities in liters)

1. Have students measure and compare the volumes of water in different containers and ask them these questions:
   (a) Which one has more water?
   (b) Which one has less water?
2. Use the example on page 175 to explain further on comparing volumes.
3. Get students to compare the capacities of different containers and ask them these questions:
   (a) Which one has the greatest capacity?
   (b) Which one has the smallest capacity?
4. Explain further on comparing capacities using the example on page 175
5. Ask the students to try Practice on page 176 and discuss the answers with them.
6. Have students do Exercises E to G on pages 107 to 109 of the Workbook as their homework.

12th – 14th hours (Solving word problems involving volume and capacity in teaspoons, tablespoons and cups)

1. Use the examples on page 177 and demonstrate to students how to solve them.

2. Have the students try Practice on page 178 and discuss the answers with them.

3. Have students do Exercise H on page 110 of the Workbook as their homework.

15th – 17th hours (Solving word problems involving volume and capacity in liters)

1. Use the examples on page 179 and demonstrate to the students how to solve them.
2. Have the students try Practice on page 180 and discuss the answers with them.
3. Have students do Exercise I on pages 111 and 112 the Workbook as their homework.

18th hours (Conclusion)

1. Get students to tick what they have learned and understood on page 181 (Part L column).
2. Guide the whole class to conclude the concept with these activities:
   (a) Give students some different containers filled with some water. Ask them to measure the volumes and capacities in liters. Let them compare them using the vocabulary of comparison.
   (b) Have them create their own word problems involving volume and capacity and find out the answers.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 2
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 2
- Objects for counting such as books, cubes, pencils and erasers

Assessment:

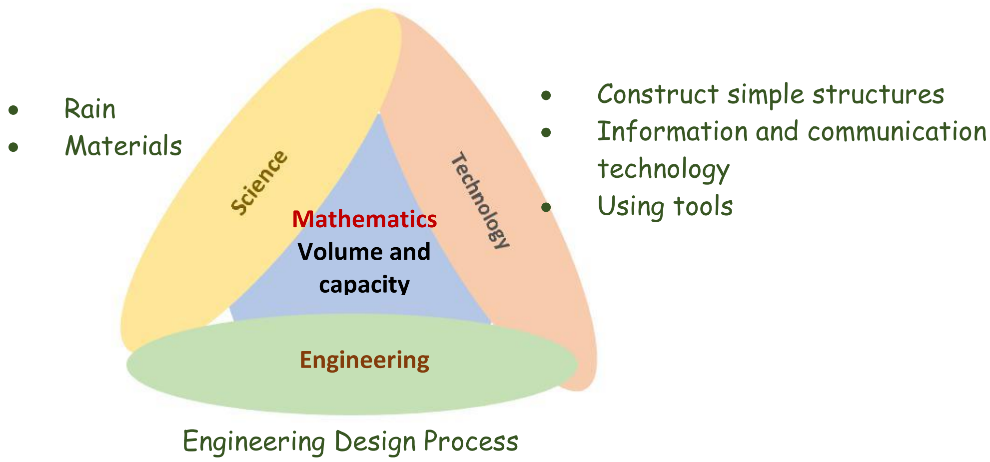
1. To assess cognitive behavior, test on page 181 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: Rain gauge

Overview

This activity will challenge students to apply their knowledge of volume and capacity into their daily life. They are required to design and create a rain gauge to collect and measure the amount of rainfall. Therefore, this activity needs to be done during a rainy season.

Subject integration



Activity guide

Time: 3 hours

Start up:

1. Divide students into groups of 3 to 4 students.
2. Talk about their previous STEM activity by asking the following questions:
    - What is the process of creating the balance scale? How was it?
    - Are you satisfied? Why or why not?
    - Did you work alone or work with your team members? How was your team?
    - Did your team work collaboratively?
    - What did you help your team? Are you a good team member?

Lesson development:

1. Let students read the situation on page 181. Then, guide the whole class to discuss and identify the problem by answering to these questions:
   (a) What will you have to do?
   (b) What are your missions?
   (c) What do you need to know to get started?
   (d) What is the problem of this situation?
2. Motivate students to explore and make connections between science, technology, engineering and mathematics by posing these following questions:
   (a) When is the rainy season in Thailand?
   (b) Have you ever listened to the weather forecast? How do they report about the rainfall?
   (c) How do they know the amount of rainfall?
   (d) What are the benefits of knowing the amount of rainfall?
   (e) What kinds of materials should you use to collect the rain?
   (f) What is the proper unit of the volume of the rainfall to use?
   (g) What tools can help you to measure the quantity of rainfall? How?
   (h) Do you need any tools and materials for this project?
3. Ask 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? (Reliability of the rain gauge, time of completion, etc.)
   (b) How do we evaluate your success? (Comparing with other rain gauges, its functions etc.)
4. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.
5. After they have finished their work, ask them to assess their rain gauge by using the criteria stated in no.3. Teacher may pose these following questions:
   (a) Did your rain gauge meet the criteria?

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

(c) What works? What does not work?

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

6. Let them improve their design. Teacher may 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.)

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 teamwork, the product, the process, the problems, the evaluation, and improvement.)

Conclusion:

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

    (a) What is the engineering design process? Did you apply the engineering design process into your work?

    (b) Did each team come up with the same design? Why?

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

    (d) What are the key success factors that affected your group work?

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

    (f) What are the benefits of this activity?

    (g) What will happen if you build the rain gauge without a proper plan and design?

    (h) What did you learn from this activity?

Suggested materials:

Unwanted plastic bottles or any other containers, marker pens, ruler

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 10 Two-dimensional shapes

Time: 11 hours

Strand 2: Measurement & Geometry

Standard M 2.2 Two-dimensional geometric figures

Indicator

M 2.2 Gr2/1 Distinguish and describe the features of polygons and circles

Learning objectives:

Students will be taught to:

- Understand and use terms related to 2-D and 3-D shapes.
- Draw two-dimensional (2-D) shapes.
- Understand the shape patterns.

Competency:

- Thinking skills
- Capacity for applying life skills

Start up:

- Assess students' prior knowledge about geometric shapes by asking what they knew and what they want to know more about 2-D shapes.
- Ask students to write all their prior knowledge (Part K column) on page 183 and have students share what they know about 2-D shapes. Then ask students to write some questions which they want to know (Part W column) on page 183.

Teaching/Learning activities:

1^{st} – 4^{th} hours (Polygons, circles and ellipses)

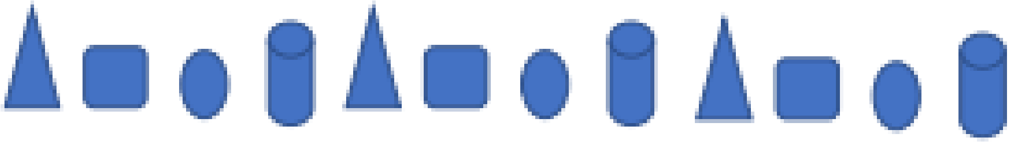
1. Let students identify the geometric shapes drawn on the board. Then discuss about the geometric shapes. What do they look like?
2. Review what they have learned about 2-D shapes such as triangles, rectangles, squares, circles and ovals by using the examples on pages 184 to 186.
3. Draw a triangle, quadrilateral, pentagon, hexagon, heptagon and octagon (2-D shapes) on the board and ask the students to identify their parts such as the corner, flat face, and straight sides. Refer to pages 184 to 186.
4. Draw a circle and an ellipse on the board. Ask students to identify their parts such as curved sides and flat face. Refer to page 187.
5. Say 2-D shapes and ask a few students to draw them out on the board. Get them to name their parts.
6. Let them look at polygons and circles and then compare their parts. Refer to page 188.
7. Ask students to try Practice on pages 188 and 189 and discuss the answers with them.
8. Have students do Exercises A to D on pages 116 to 119 of the Workbook as their homework.

5^{th} – 6^{th} hours (Drawing two-dimensional (2-D) shapes)

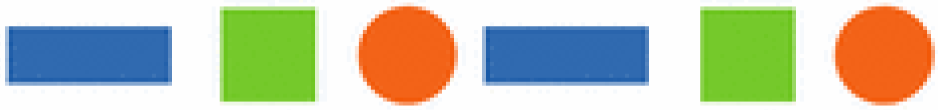
1. Guide students to draw 2-D shapes using a coin to draw a circle and a pencil box to draw a rectangle. Refer to page 190.
2. Ask students to observe some objects around them and use it to draw 2-D shape.
3. Ask students to carry out Activity Corner to use 2D shapes to form pictures. Refer to page 190.
4. Have students do Exercise E on page 120 of the Workbook as their homework.

7th – 10th hours (Repeating patterns)

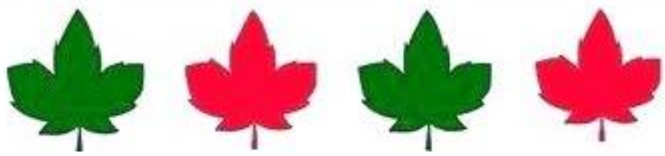
1. Introduce the concept of patterns by using the picture shown below. Ask students to identify patterns and find the relationship among these shapes.



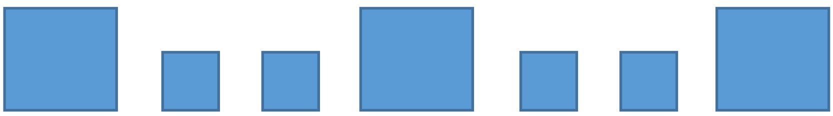
2. Explain that there is a shape change in the pattern. Refer to page 191.
3. Cut many pieces of different shapes. Ask one of the students to arrange them into a pattern with a shape change and ask the rest to guess the next shape.
4. Explain that there are patterns with a shape and color change. Refer to the pattern below. Refer to page 191.



5. Cut many pieces of different shapes and colors. Ask one of the students to arrange them into a pattern with a shape and color change and ask the rest to guess the next shape.
6. Explain that there is a color change in the pattern. Refer to page 191.
7. Draw alternate pictures. Guide students to identify the pattern.



8. Explain that there is a size change in patterns. Refer to page 192.
9. Draw alternate squares in different sizes. Guide students to identify the pattern.



10. Try a few more simple shape patterns and have students guess the following shape.
11. Ask them to do find the pattern in Let's Think on page 192.

12. Have students try Practice on page 193 and discuss the answers with them.
13. Have students do Exercises F and G on pages 121 and 122 of the Workbook as their homework.

11th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 194 (Part L column).
2. Guide the whole class to conclude the concept of geometric shapes with these activities:
   - Give students some objects of different shapes and ask them to write the names of the geometric shape on the board.
   - Ask them to work in pairs. One should draw some 2-D shapes and another one should name their parts.
   - Let them create their own patterns of shapes and ask their friends to find the missing shapes

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 2
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 2
- 2-D and 3-D shape flashcards
- 3-D objects in everyday life such as dices, pencil boxes, balls and cans

Assessment:

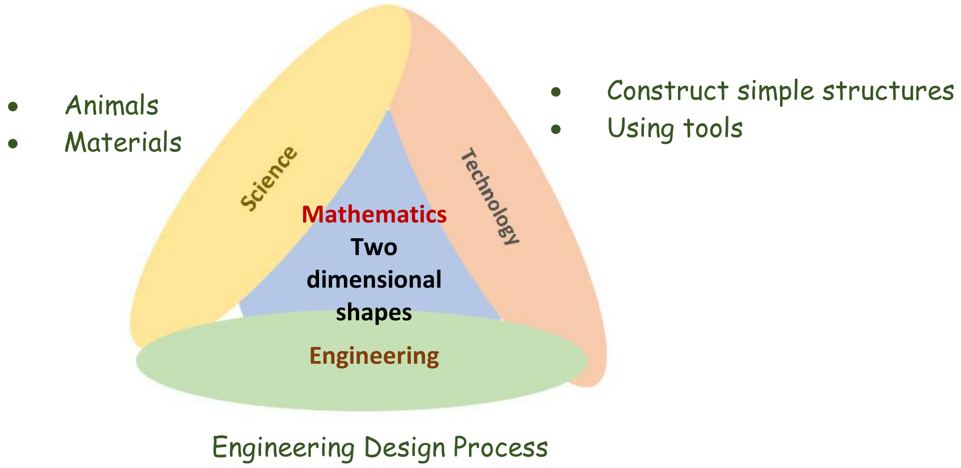
1. To assess cognitive behavior, test on page 194 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: Monsters

Overview

Young kids often imagine, draw and paint the pictures of monsters. Imagination can facilitate creativity. This activity will challenge students not only to imagine but also to apply the engineering design process into their monster creations. The characteristics of the monster should be explained scientifically. In addition, the basic concept of 2-D or 3-D shapes will be used in this project.

Subject integration



Activity Guide

Time: 3 hours

Start up:

1. Divide students into groups of 3 to 4 students.
2. Talk about their previous STEM activity by asking the following questions:
    - What is the process of creating the rain gauge? How was it?
    - Are you satisfied? Why?
    - Did you work alone or work with your team members? How was your team?
    - Did your team work collaboratively?
    - What did you help your team? Are you a good team member?

Lesson development:

1. Let students read the situation on page 194. Then, guide the whole class to discuss and identify the problem by answering to these questions:
   (a) What will you have to do?
   (b) What are your missions?
   (c) What do you need to know to get started?
   (d) What is the problem of this situation?
2. Motivate students to explore and make connections between science, technology, engineering and mathematics by posing these following questions:
   (a) What is a monster? What does a monster look like?
   (b) Can you find any monsters in your daily life? Why?
   (c) Do monsters have different body parts? Can you give some examples?
   (d) Does your monster look like a human?
   (e) Where does your monsters live – in a cave, a house, in the sea or in a tree?
   (f) If you have to classify your monsters according to the food they eat, what are they - carnivores, herbivores, or omnivores?
   (g) What are the differences between 2-D and 3-D geometric shapes?
   (h) Do you need any materials and tools for this construction?
3. Ask 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? (Completion time, using various geometric shapes, etc.)
   (b) How do we evaluate our success? (Creativity, interesting characteristics of monsters, etc.)
4. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.
5. After they have finished their work, ask them to assess their monster by using the criteria stated in no.3. Teacher may pose these following questions:

(a) Did your monster meet the criteria?

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

(c) What works? What does not work?

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

6. Let them improve their design. Teacher may 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.)

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 teamwork, the product, the process, the problems, the evaluation, and improvement.)

Conclusion:

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

   (a) What is the engineering design process? Did you apply the engineering design process into your work?

   (b) Did each team come up with the same design? Why?

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

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

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

   (f) What are the benefits of this activity?

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

   (h) What did you learn from this activity?

   Teacher leads students to conclude that we apply knowledge of many subjects in our daily day life.

Suggested materials:

Clay, cardboard, straws

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 11 Pictograms

Time: 5 hours

Strand 3: Statistics and Probability

Standard M 3.1 Representing data

Indicator

M 3.1 Gr2/1 Use data from pictograms to find the answers of word problems where each picture represents 2 units, 5 units and 10 units.

Learning objectives:

Students will be taught to:

- Read and interpret pictograms

Competency

- Thinking skills
- Capacity for applying life skills

Start up:

- Assess students' prior knowledge about pictograms by asking what they knew and what they want to know more about pictograms.
- Ask students to write all their prior knowledge (Part K column) on page 196 and have students share what they know about pictograms. Then ask them to write some questions which they want to know (Part W column) on page 196.

Teaching/Learning activities:

1st – 4th hours (Pictograms)

1. Use the example on page 197 to explain about pictograms.
2. Emphasize that the pictures used in a pictogram represent quantities. For instance, in this pictogram, each picture represents 2 cupcakes.

3.
4. Guide students to analyze the pictogram.
5. Show them more examples of pictograms on pages 198 and 199. Then explain more how to analyze or interpret the pictograms.
6. Have students try Practice on pages 200 to 202 and discuss the answers with them.
7. Have students do Exercises A to E on pages 124 to 128 of the Workbook as their homework.

5th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 203 (Part L column).
2. Guide the whole class to conclude the concept of data analysis and presentation with these simple activities:
   (a) Show them a pictogram and a bar chart presenting the favorite colors of a group of kids and then ask:
      - How many kids are there?
      - How many kids like green color?
      - What is the most popular color?

   (b) Divide the class into two. Assign each group to collect data of their favorite drinks and favorite food respectively and construct a relevant pictogram. Ask the groups to create word problem based the pictograms. Get some students to find out the answers.

   (c) Assign each group to choose their own topic, collect data and construct a relevant pictogram.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 2
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 2

Assessment:

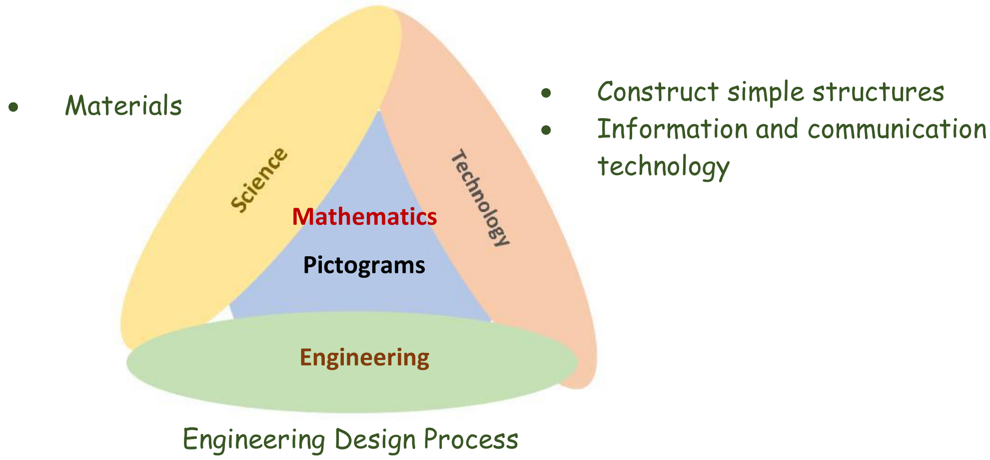
1. To assess cognitive behavior, test on page 203 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubric.

STEM Activity: My candy bag

Overview

Packaging plays a vital role in terms of protection, storage and handling of a product. Some of the packaging is designed by engineers. In this activity, students will act as employees of a candy company. They will be required to design and create a packaging to contain some candy. Before starting to work on their projects, they need to collect data regarding their classmates' preference of packaging.

Subject integration



Activity guide

Time: 3 hours

Start up:

1. Divide students into groups of 3 to 4 students.
2. Discuss about their school activities that connect to data analysis such as the number of male/ female students, students' council election, the 5 most common hobbies among students, the most popular hobby among students, etc.

Lesson development:

1. Assign students to read the situation on page 2033. Then, lead students to discuss and identify the problem by answering these questions:
   (a) What will you have to do?
   (b) What are your missions?
   (c) What do you need to know to get started?
   (d) What is the problem of this situation?
2. Motivate students to explore and make connections between science, technology, engineering and mathematics by posing these following questions:
   (a) What type of candies do you want to design the packaging for?
   (b) What are the aspects of a packing that are important in order to contain candy or other goods? Why?
   (c) Does packaging have any impact on the selling price?
   (d) What do you usually consider when you want to buy some candies? Is it the packaging, taste or price?
   (e) Are pictures on the packaging important? How do the colors affect your packaging?
   (f) What details should be included on the packaging – picture of the candy, price, nutrition facts, name of candy, etc.?
   (g) What size of a candy packaging is appropriate?
   (h) What materials should be used in order to hold and keep candies for a longer time - plastic or paper? Why?
   (i) What factors can make the packaging more attractive - colors, pictures or the choice of letters used?
   (j) Can you search for more information about candy packaging?
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? (Satisfaction, finish on time, functions etc.)
   (b) How do you evaluate your success? (Survey form)

4. Get students to brainstorm and draw their design. They need to list the materials and label their design. Then, let them execute their plan.
5. After they have finished their work, ask them to assess their candy packaging by using the criteria stated in no.3. Teacher may pose these following questions:
   (a) Did your candy packaging meet the criteria?
   (b) Do you and your team feel satisfied with your work? Why?
   (c) What work? What does not work?
   (d) How will you modify your solution to make it better?
6. 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.)
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 the students the following questions:
   (a) What is the engineering design process? Did you apply the engineering design process into your work?
   (b) Did each team come up with the same design? Why? Why not?
   (c) Do you think that teamwork is important? Why? Why not?
   (d) What are the key success factors that affect your group work? (Teamwork, creative thinking, etc.)
   (e) What subject knowledge did you apply into this activity?
   (f) What are the benefits of this activity?
   (g) What will happen if you build the packaging without a proper plan and design?
   (h) What did you learn from this activity?

Suggested materials:

Candy, cardboard, construction paper, glue, boxes, sticky tape, scissors, ruler

Assessment:

Refer to Scoring Rubric for STEM Activities.

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