Teacher's Guide

Mathematics

Primary
Education
Smart+
Prathomsuksa
6

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 6 Students

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

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

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

Yearly Teaching Plan

Mathematics Prathomsuksa 6 (Grade 6)

12 chapters 160 hours

Learning areas	Time (hours)
1. Factors • Factors of a whole number • Prime numbers and prime factors • Factorization of a whole number • Highest common factor (HCF) • Lowest common multiple (LCM) • Solving word problems involving HCF and LCM	20
2. Fractions • Comparing and ordering fractions • Addition and subtraction of fractions • Combined operations of fractions • Solving word problems involving fractions	16
3. Decimals • Relationship between fractions and decimals • Division of decimals • Performing combined operations on decimals • Solving word problems involving combined operations on decimals	14
4. Percentage • Finding the percentage of a number out of another • Finding profit or loss as a percentage • Percentage change • Solving word problems involving percentages	18

5. Ratios and proportions • Ratios • Proportions • Solving word problems involving ratios and proportions	11
6. Volume • Volumes of shapes made up of cuboids • Solving word problems involving volumes of shapes made up of cuboids	9
7. Circles • Parts of a circle • Drawing circles • Circumference of a circle • Area of a circle • Solving word problems involving circumference and area of a circle	15
8. Triangles • Types and properties of triangles • Drawing triangles • Interior angles of a triangle • Perimeter of a triangle • Area of a triangle • Solving word problems involving perimeter and area of a triangle	20
9. Polygons • Interior angles of a polygons • Perimeter of a polygon • Area of a polygon • Solving word problems involving perimeter and area of a polygon	14
10. Three-dimensional shapes • Types and properties of three-dimensional shapes • Nets of 3-D shapes	8

11. Patterns • Geometric patterns and number patterns • Solving problems involving patterns	9
12. Pie charts • Reading pie charts	6

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 Factors

Time: 20 hours

Strand: Numbers and Algebra

Standard M.1.1

Indicators:

M.1.1 Gr6/4 Find the highest common factor of cardinal numbers not more than 3 numbers.

M.1.1 Gr6/5 Find the lowest common multiple of cardinal numbers not more than 3 numbers.

M.1.1 Gr6/6 Show mathematical methods of finding the answers of word problems by using the knowledge of the highest common factor and the lowest common multiple.

Learning objectives:

- Understand what factors, prime numbers, prime factors and factorization are.
- Factorize whole numbers.
- Find the highest common factor (HCF) of a set of numbers.
- Find the lowest common multiple (LCM) of a set of numbers.
- Solve word problems involving HCF and LCM.

Competency:

- Thinking capacity
- Problem-solving capacity
- Apply life skills capacity
- Technological application capacity

Start up:

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

Teaching/ learning activities:

1^{st} – 4^{th} hours (Factors of a whole number)

1. Explain what a factor is in Mathematics. Write this equation $12 \div 3 = 4$ on the board and ask them if 12 is divisible by 3. If yes, then 3 is a factor of 12. Try with other numbers. Refer to page 2.
2. Use page 3 for further explanation. Write the number 15 on the board and ask students to list all the factors for 15. Try with other numbers.
3. Refer to Math Tips on page 3.
4. Inform students that we can use factors to find products too. Refer to the example on page 4. Use it to explain to the students.
5. Ask students to answer the question in Let's Think on page 4.
6. Tell students that we can use factors to find quotients too. Refer to the examples on page 5.
7. Ask students to try Practice page 6. Discuss the answers with them.
8. Have students work on Exercises A to C on pages 4 and 5 of the workbook as their homework.

5^{th} – 7^{th} hours (Prime numbers and prime factors)

1. Inform students that a prime number can be divided, without remainder, only by itself and by 1. This number has only 2 factors – that is 1 and itself. Zero and 1 are not considered as prime numbers.

2. Use the example on page 7 to explain prime numbers. In order to prove that a number is a prime number, try to divide it by 2 and see if you can get a whole number. If you can, then the number is not a prime number. Next try divide by other prime numbers such as 3, 5, 7, 11…. If it is a prime number, you should not get a whole number as the quotient.
3. Refer to the Math Tips on page 7.
4. Ask students to list all the prime numbers between 2 and 20.
5. Inform students that prime factors are the factors of a whole number that are prime numbers too. We can get the prime factors of a whole number by listing all the factors and then determining the prime numbers from the factors.
6. Use the example on page 8 to guide students.
7. Ask students to try Practice on page 8. Discuss the answers with them.
8. Have the students work on Exercises D to F on pages 5 and 6 of the workbook as their homework

8^{th} – 10^{th} hours (Factorization of a whole number)

1. Inform students that finding the prime factorization of a whole number is finding the prime numbers that multiply together to make that whole number. Use the example on page 9 to explain.
2. Briefly explain how to find the prime factorization using division. Refer to page 10. Always divide with the smallest prime numbers first.
3. Explain to students how to use exponents to represent multiplication of a number a few times.
4. Guide them to find prime factorization using a factor tree. Refer to page 11 to explain.
5. Ask students to try Practice on page 11. Discuss the answers with them.
6. Have students work on Exercises G to I on pages 7 and 8 of the workbook as their homework.

11^{th} - 13^{th} hours (Highest common factor)HCF((

1. Guide students to understand that the common factors of two or more whole numbers are the factors for the numbers. Use the example on page 12.
2. Let them know that the highest common factor of two or more whole numbers is the greatest common factor of the numbers. They can find the highest common factor using three methods – by listing all the factors, by prime factorization and by division algorithm.
3. Use the examples on pages 12 to 14 to guide students to find the highest common factor.
4. Write four numbers on the board and ask three students to find the highest common factor using the three different methods.
5. Ask the students to try Practice on pages 14 and 15. Discuss the answers with them.
6. Have students to work on Exercises J to L on pages 9 to 11 of the workbook as their homework.

14^{th} – 16^{th} hours (Lowest common multiple)LCM((

1. Explain that the multiples of a whole number are the products of the number with another whole number. Ask students to list multiples of 2 and 3.
2. Inform them that the common multiples of two or more whole numbers are the multiples of both numbers. Ask a student to list the common multiples of 2 and 3.
3. Use the examples on page 16 to explain.
4. Guide students to understand that the lowest common multiple)LCM(of two or more whole numbers is the common multiple with the least value.
5. Inform students that they can find LCM by three methods – by listing the multiples, by prime factorization and by division algorithm.
6. Use the examples on pages 16 to 18 to guide students to find LCM.
7. Ask students to try Practice on pages 18 and 19. Discuss the answers with them.

8. Have the students work on Exercises M to P on pages 12 to 14 of the workbook as their homework.

17^{th} – 19^{th} hours (Solving word problems involving HCF and LCM)

1. Use the examples on pages 20 and 21 to guide students solve word problems involving HCF and LCM.
2. Guide students when to use HCF and LCM to solve word problems referring to the Math Tips on page 21.
3. Ask students to try Practice on page 22. Discuss the answers with them.
4. Have the students work on Exercise Q on pages 15 and 16 of the workbook as their homework.

20^{th} hour (Conclusion)

1. Get students to tick what they have learned and understood on page 23 (Part L).
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.
3. Guide the whole class to conclude the concept of factors with these simple activities:
   Give each student an index card or piece of paper with a word problem. Each of them needs to solve the problem. As they leave the class, they deposit their slips face down in a box placed at the doorway.
4. Ask them to complete Mastery Practice in the workbook on pages 17 and 18.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 6
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 6

Assessment:

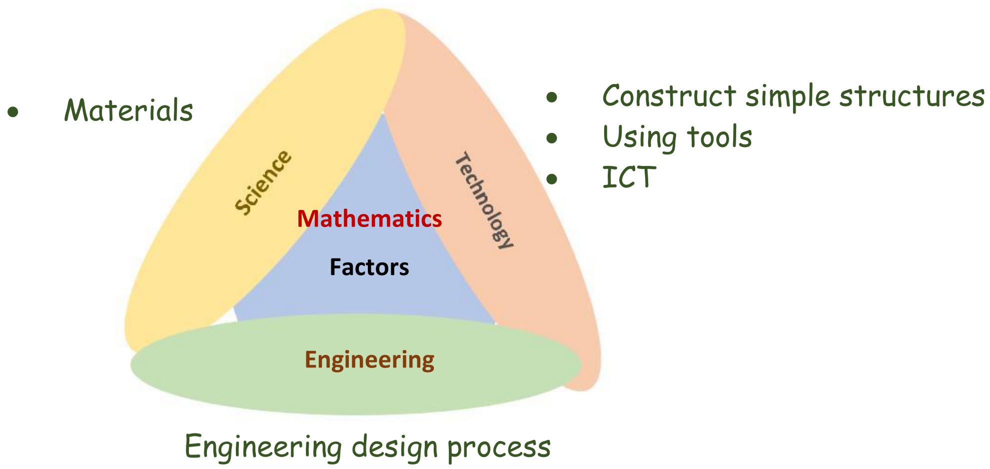
1. To assess cognitive behavior, test on page 23 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

STEM Activity: Mathonopoly game)part 1(

Overview

Monopoly game has been entertaining families since 1935. It is very fun. We can change this game into a new game to practice our Mathematical and Scientific skills. Students are challenged to design and create a new version of monopoly board game. This monopoly game will help the students to practice their mathematical and science skills.

Subject integration



Activity Guide

Time: 3 hours

Start up:

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

Lesson Development:

1. Let students read the situation on page 23. 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 start?
   (d) What are required components of your work?
2. Then motivate students to explore and make connections between science, technology, engineering and mathematics by using some of these following questions:
   (a) Have you ever played monopoly board game? How was it?
   (b) The size of your board is 28 cm by 30 cm. You have to use square tiles at its edges.
      i. How many squares will there be at the edges?
      ii. What is the largest tile you can use?
   (c) Think about the rules of the game:
      i. Mathematics or science problems
      ii. Number of players
      iii. Using a dice or spinning a spin board
   (d) How will you decorate it to make it more interesting?
   (e) Will you put more math or science problems?
   (f) Can you search more information of monopoly game?
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:
   (a) What are the achievement criteria? (Similarity to the monopoly game, the size of your board, the use of square tiles at its edges, the practice students can do)
   (b) How do we assess our success? (The size of the squares at the edge)
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 board game by using the criteria stated in no.3. Pose these following questions:
   (a) What works? What does not work?
   (b) Do you and your team feel satisfied with your work? Why?
   (c) How will you modify your solution to make it better?
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 students the following questions:
   (a) What did you learn from this activity?
   (b) What subject knowledge did you apply for your work?
   (c) What steps you used to design and create your work?
   (d) What are benefits of designing before creating?

Suggested materials:

Cardboard, scissors, crayons, cards, dice

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 2 Fractions

Time: 16 hours

Strand: Numbers and Algebra

Standard M 1.1:

Indicators:

M 1.1 Gr.6/1 Compare and arrange a sequence of fractions and mixed numbers from various situations.

M 1.1 Gr.6/7 Find the results of mix addition, subtraction, multiplication and division of fractions and mixed numbers.

M 1.1 Gr.6/8 Show mathematical methods of finding the answers of 2- to 3-step word problems involving fractions and mixed numbers.

Learning objectives:

- Compare and order fractions and mixed numbers.
- Find the results of addition, subtraction, multiplication and division of fractions and mixed numbers.
- Find the results of combined operations of fractions and mixed numbers.
- Show mathematical methods of finding the answers of 2- to 3-step word problems involving fractions.

Competency:

- Thinking capacity
- Problem-solving capacity
- Apply life skills capacity

Start up:

- Assess students' prior knowledge about fractions by asking what they knew and what they want to know more about fractions.
- Ask students to write all their prior knowledge)Part K(on page 25 and have them share what they know about fractions Then ask them to write some questions which they want to know)Part W(on page 25.

Teaching/ learning activities:

1st- 4th hours (Comparing and ordering fractions)

1. Start the lesson with this word question.

   Annie had two boxes of cookies. Each box contained 8 cookies. She ate $\frac{1}{2}$ of the first box of cookies. She wanted to divide the rest of the cookies equally among her four friends. How many cookies will each friend get?

   Encourage them to work out the answer. Their answers maybe correct and maybe not.
2. Inform students that when we compare fractions with different numerators and denominators, we should equalize the denominators first. We can do so by finding the LCM for the denominators. Then, the fraction with greater numerator is the greater fraction.
3. Use the examples on pages 26 and 27 to guide students to compare.
4. Remind students that when we want to arrange a set of fractions in an order, we need to compare them first. These fractions should be converted into equivalent fractions with the same denominator. Use LCM to look for the same denominator.
5. Use the examples on pages 28 and 29 to guide students to order.
6. Ask students to try Practice on page 30. Discuss the answers with them.
7. Assign students to do Exercises A to D on pages 21 to 23 of the workbook as their homework.

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

1. Write an addition problem of fractions with like denominator. Get a student to answer it.
2. Then, write an addition problem of fractions with unlike denominators and introduce the concept of LCM)lowest common multiple(to students. Make sure students understand how to find common multiples, and together, practice solving several problems that involve adding and subtracting of fractions with unlike denominators.
3. Explain that when we add or subtract fractions with different denominators, we need to equalize the denominators first. We use LCM to find the common denominator.
4. Use the examples on pages 31and 32 to guide students to add and subtract.
5. Inform students that when we add or subtract mixed numbers, we need to change them into improper fractions first. Then find equivalent improper fractions that have the same denominator before adding or subtracting.
6. Remind students that when performing any combined operations, we should always perform the operations in the brackets first.
7. Use the examples on page 33.
8. Ask students to try Practice on page 34. Discuss the answers with them.
9. Assign the students to do Exercise E on pages 24 and 25 of the workbook as their homework.

9^{th} - 12^{th} hours (Combined operations of fractions)

1. Remind students to always perform the operations in the brackets first when we perform combined operations.
2. Use examples on pages 35 and 36.
3. Ask students to try Practice on page 37. Discuss the answers with them.
4. Assign students to work on Exercise F on pages 26 and 27 of the workbook as their homework.

13^{th} – 15^{th} hours (Solving word problems involving fractions)

1. Remind students to always remember when solving word problems involving combined operations of fractions, we should analyze the questions first and write the number sentences.
2. Use the examples on pages 38 and 39 to guide students on how to solve word problems involving fractions.
3. Ask the students to try Practice on pages 40 and 41. Discuss the answers with them.
4. Assign students to work on Exercise G on pages 28 to 30 of the workbook as their homework.

16^{th} hour (Conclusion)

1. Get students to tick what they have learned and understood on page 42)Part L(.
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.
3. Guide the whole class to conclude the concepts of fractions with this simple activity:

   Pass out an index card to each student and ask them to fold the cards into halves. Each student should write a number sentence that involves either addition or subtraction of fractions with unlike denominators on the first half of the card and its answer on the second half of the card. Ask students to cut the card into two. Collect all the card from students, keeping the questions in one container and the answers in another.

   Divide the class in half. Randomly distribute the questions to one half of the class and the answers to another half. Get students with the question cards to work out the answers.

   On your signal, get students with the question cards to walk over to students with the answer cards and look for the matching answer cards. Students should then sit down next to each other to indicate they have found their match.

Facilitate a discussion with the whole class regarding any remaining students who cannot find a match.

4. Ask them to complete Mastery Practice in the workbook on pages 31 to 33.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 6
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 6
- Index cards

Assessment:

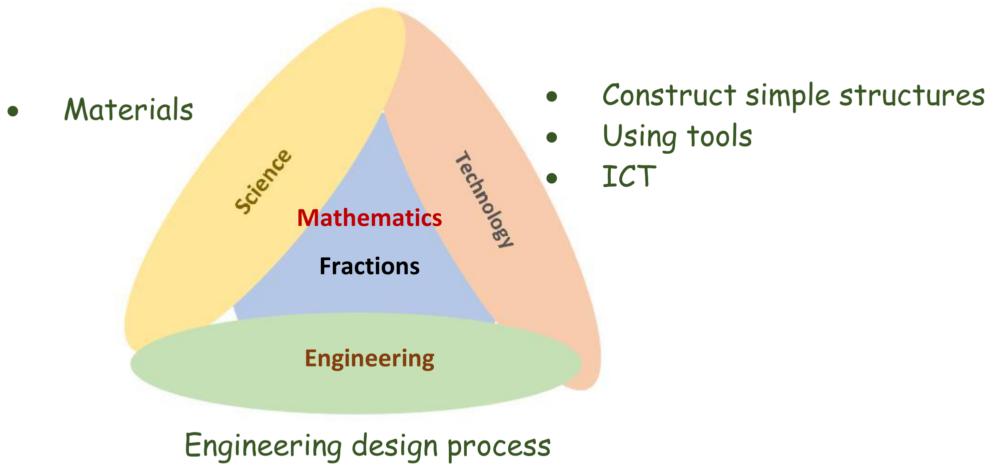
1. To assess cognitive behavior, test on page 42 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

STEM Activity: Mathonopoly game)part 2(

Overview

After the previous activity, students will understand more on how to design and create a better and new version of monopoly.

Subject integration



Activity Guide

Time: 3 hours

Start up:

1. Divide students into groups or allow them to self-select their groups. One group should compose of 3 to 4 students.
2. Review their prior knowledge or prior experiences of the engineering design process:

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

Lesson Development:

1. Let students read the situation on page 42. Then, guide the whole class to discuss and identify the problem by answering these questions:
   (a) What is the problem of this situation?
   (b) What will you have to do?
   (c) What are your missions?
   (d) What do you need to know to get started?
2. Discuss about their monopoly game in the previous chapter. Encourage students to explore and make connections between science, technology, engineering and math by using some of these following questions;
   (a) How was your Mathonopoly game?
   (b) Did your friends like it?
   (c) Do they have any comments on it?
   (d) Do you have any new ideas to create a new one that uses less space for storing?
   (e) How will a Mathonopoly game that is made up of two or four pieces of boards look like?
   (f) How many square tiles are there on the edge of each piece of the boards?
   (g) Which is better – a board game with 2 pieces or 4 pieces of boards?
   (h) What is the height of the boards when they are stacked up for storing?
3. Ask students to think about how to assess their project. Lead them to discuss in class and set their criteria with these questions:
   (a) What are the achievement criteria?)Mathonopoly board game that is made up of two or four pieces of boards.(
   (b) How do you evaluate your 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 new mathonopoly game by using the criteria stated in no.3. Teacher may pose these following questions:
   (a) What was successful about the game?

(b) What would you improve?

(c) If you were to redo this activity, what would you do differently?

(d) What works? What does not work?

(e) How much weight it can hold?

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

(g) 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 students the following questions:
   (a) What did you learn from creating a mathonopoly game?
   (b) What did you learn from playing your classmates' mathonopoly games?
   (c) What did you learn from this activity?
   (d) What steps you used to design and create your works?
   (e) Can you use those steps in your daily living?
   (f) What are benefits of designing before creating?

Suggested materials:

Cardboard, scissors, crayons, cards, dice

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 3 Decimals

Time: 14 hours

Strand: Numbers and Algebra

Standard M 1.1:

Indicators:

M 1.1 Gr.6/9 Find the result of the decimals which divisors and the results has no more than 3 decimal places.

M 1.1 Gr.6/10 Show mathematical methods of finding the answers of 3-step word problems involving addition, subtraction, multiplication and division of decimals.

Learning objectives:

- Understand the relationship between fractions and decimals.
- Perform division of decimals.
- Perform combined operations of decimals.
- Solve word problems involving combined operations of decimals.

Competency:

- Thinking capacity
- Problem-solving capacity
- Apply life skills capacity

Start up:

- Assess students' prior knowledge about decimals by asking what they knew and what they want to know more about decimals.
- Ask students to write all their prior knowledge)Part K(on page 44 and have them share what they know about decimals. Then ask students to write some questions which they want to know)Part W(on page 44.

Teaching/ learning activities:

1st – 3rd hours (Relationship between fractions and decimals)

1. Use the examples on pages 45 to 47 to show students on how to write decimals as fractions.
2. Inform them that we can easily convert a decimal into a fraction by analyzing the number of decimal place the decimal has. If the decimal has 2 decimal places such as 12.89, then the fraction will have 100 as its denominator and its fraction is $12\frac{89}{100}$.
3. If the decimal has 3 decimal places such as 0.108, then the fraction has 1000 as its denominator and its fraction is $\frac{108}{1000}$.
4. Tell students that it is easy to convert fractions with 10, 100 and 1000 as their denominators into decimals.
5. However, if the fractions or mixed numbers do not have 10, 100 or 1000 as their denominators, we will have to change to them into fractions with those denominators before converting into decimals.
6. Ask students to try Practice on page 47. Discuss the answers with them.
7. Assign students to work on Exercises A and B on page 35 of the workbook as their homework.

4th – 7th hours (Division of decimals)

1. Inform students that we can divide decimals by whole numbers using 2 methods, by using the relationship between decimals and fractions method and by using the long division method. Refer to page 48.
2. Explain a repeating decimal and a non-terminating decimal by using example on page 49.
3. Explain Math Tips on page on page 49. Guide students to round off decimals. When rounding off decimals, always look at the digit on the right of the digit that will be rounded. Use the examples on page 50 for students to practise.
4. Guide students to answer the question in Let’s Think on page 49.

5. Explain how to divide decimals by decimals step by step. Refer to pages 51 and 52. Explain to students that we can rewrite the division as a fraction first.
6. Ask the students to try Practice on pages 53. Discuss the answers with them.
7. Have students work on Exercises C to E on pages 36 to 41 of the workbook as their homework.

8^{th} – 10^{th} hours (Performing combined operations on decimals)

1. Remind students that when we perform any combined operations, we need to do the operations in the brackets first.
2. Use the examples on page 54.
3. Ask the students to try Practice on pages 55. Discuss the answers with them
4. Have the students work on Exercise F on pages 42 and 43 of the workbook as their homework.

11^{th} – 13^{th} hours (Solving word problems involving combined operations on decimals)

1. Guide students to use addition, subtraction, multiplication and division to solve word problems involving decimals.
2. Refer to the examples on page 56.
3. Ask students to try Practice on pages 57 and 58. Discuss the answers with them.
4. Have students work on Exercise G on pages 44 to 46 of the workbook as their homework.

14^{th} hour (Conclusion)

1. Get students to tick what they have learned and understood on page 59)Part L(.
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.
3. Guide the whole class to conclude the concepts of operations of decimals with these simple activities:

(a) Paired activity

A student in each group writes five problems involving decimals on a piece of paper. Randomly exchange the paper with other groups.

The first student in each group will work on the first problem. Then, the paper will be passed to the second student who will check the first problem and work on the second problem. The paper will be passed to the first student and this continues until the problems are completed.

(b) Group activity

Group students into a few groups. Each group needs to prepare five word problems and the answers in separate pieces of paper. Then, they need to exchange the paper with the questions with other groups and work on them.

When all groups are finished, they have to ask for the answers from the owner of the problems and check the answers. They get 1 point for one problem solved correctly. If the owner does any mistake in the answers, the owner group will lose 1 point. The winner is the team that gets the most points.

4. Ask them to complete Mastery Practice in the workbook on pages 47 and 48.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 6
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 6

Assessment:

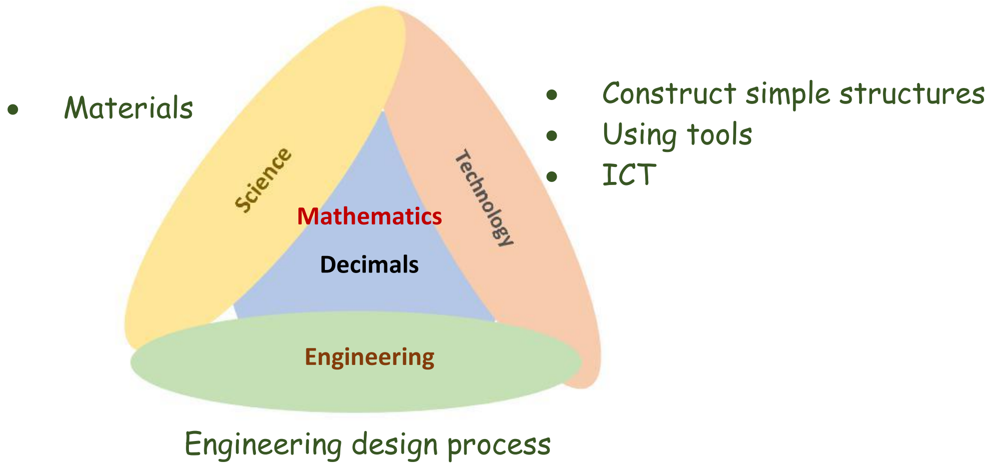
1. To assess cognitive behavior, test on page 59 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

STEM Activity: Mathonopoly game)part 3(

Overview

This activity is next part of the previous activity. In last two activities, students created their mathonopoly game. In this activity, they are required to design and create a box to carry the mathonopoly board game. They have to decide if they want the box to carry the mathonopoly game)part 1(or mathonopoly game)part 2(.

Subject integration



Activity Guide

Time: 3 hours

Start up:

1. Assign students into teams as in the previous activity. They can select their own team leader. One group should compose of 3 to 4 students.

Lesson Development

1. Let students read the situation on page 59. Then, guide the whole class to discuss and identify the problem by answering to these questions:
   (a) What is the problem of this situation?
   (b) What will you have to do?
   (c) What are your missions?

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

2. Then, motivate students to explore and make connections between science, technology, engineering and math by using some of these following ideas:
    (a) Larger boxes are more expensive to produce than the smaller ones.
    (b) Usually sellers prefer square boxes because the boxes take up less shelf space.
    (c) Try to keep the cost as low as possible by using less materials.
    (d) Thicker cardboard is more expensive than thinner cardboard)A 200-g to 250-g of cardboard costs 1.50 Baht per square inch and a much thicker one costs 2.50 Baht per square inch.(
    (e) Light material will make it easy to carry.
    (f) Should the box protect the game inside? What material can protect your game?
    (g) Should the box have some parts visible so that you can see the content?
    (h) What material should you consider?
    (i) Does the box need a handle?
    (j) Can you search for more information of other packages or boxes?
    (k) Should the box have some details of the game such as a picture, rules or other interesting details?
3. Ask students to think about how to assess their project. Lead them to discuss in class and set their criteria with these questions:
    (a) What are the achievement criteria?)the box(
    (b) How do you evaluate your 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 packaging by using the criteria stated in no.3. Teacher may pose these following questions:
    (a) What works? What does not work?
    (b) Do you and your team feel satisfied with your work? Why?
    (c) How will you modify your solution to make it better?

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 teamwork, product, journey of their works, problems, how to test and improvement.(

Conclusion:

1. End the lesson by asking students the following questions:
   (a) What did you learn from this activity?
   (b) What steps you used to design and create your works?
   (c) Can you use those steps in your daily living?
   (d) What are benefits of designing before creating?

Suggested materials:

Cardboard, scissors, crayons, cards, dice

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 4 Percentage

Time: 18 hours

Strand: Numbers and Algebra

Standard M 1.1:

Indicator:

M 1.1 Gr.6/12 Show mathematical methods of finding the answers of 2- to 3-step percentages word problems.

Learning objectives:

- Find the percentage of a number out of another.
- Solve 2- to 3-step word problems involving word problems.

Competency:

- Thinking capacity
- Problem-solving capacity
- Apply life skills capacity

Start up:

- Assess students' prior knowledge about percentage by asking what them knew and what they want to know more about percentage.
- Ask students to write all their prior knowledge)Part K(on page 61 and have students share what they know about percentage Then ask them to write some questions which they want to know)Part W(on page 61.

Teaching/ learning activities:

1^{st} – 4^{th} hours (Finding the percentage of a number out of another)

1. Start the lesson with a daily example. For example:

If a student gets 80 marks out of the full marks of 100, what is the mark obtained in percentage?

Encourage students to answer. Their answers may be correct or not.

2. Explain how to find the percentage of a number out of another number. Write the first number as the numerator and the second number as the denominator of a fraction. Then multiply the fraction by 100%. Refer to pages 62 and 63.

3. Ask students to try Practice on page 64. Discuss the answers with them.

4. Have students work on Exercises A and B on pages 50 and 51 of the workbook as their homework.

5^{th} – 9^{th} hours (Finding profit or loss as a percentage)

1. Guide students to understand some terms such as cost, selling price, profit and loss. Create some situations such as below:

Situation 1: Jane bought some apples for 1,200 Baht. She sold all the apples to Mike at 1,500 Baht.

Situation 2: Ake bought some oranges for 500 Baht. He sold the oranges to Mimi at 450 Baht.

Ask these questions for each situation:

What is the cost?

What is the selling price?

Did Jane / Ake make a profit or a loss?

How much was the profit or the loss?

2. Inform students that they need to understand the meaning of a percentage of profit and a percentage of loss. These percentages are based on the cost price, not the selling price. Refer to the notes on page 65.

3. Refer to the examples on pages 66 to 68 to guide students to find the profit, selling price, cost and loss. There are a few methods to solve them and the understanding of the whole concept is essential.
4. Explain how to find the profit or loss as a percentage. Remind them that we can express the profit or loss as a percentage of the cost price Refer to page 69.
5. Explain how to find cost price and selling price when given the percentage of profit or loss. Refer to page 70.
6. Ask students to try Practice on pages 71 and 72. Discuss the answers with them.
7. Have students work on Exercises C to F on pages 52 to 56 of the workbook as their homework.

10th – 14th hours (Percentage change)

1. Explain that we can find the percentage increase or decrease when we compare the change in quantity with the original amount. Use the examples on page 73.
2. Remind them that using a diagram can make them understand easily. Refer to examples on pages 74 and 75.
3. Ask students to try Practice on page 75. Discuss the answers with them.
4. Have students work on Exercises G and H on pages 56 to 58 of the workbook as their homework.

15th – 17th hours (Solving word problems involving percentages)

1. Use examples on pages 76 and 77 to explain how to solve word problems involving percentages.
2. Always emphasize that they have to understand the question first before writing the number sentence and solving it.
3. Ask students to try Practice on pages 77 and 78. Discuss the answers with them.
4. Have students work on Exercise I on pages 59 and 60 of the workbook as their homework.

18th hours (Conclusion)

1. Get students to tick what they have learned and understood on page 79)Part L(.
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.
3. Guide the whole class to conclude the concept of percentage with these simple activities:
   (a) Paired work

   Pair students and ask them to convert percentage to fractions and decimals. Also review the method of calculating discounts, selling prices, costs and changes. Allow students to give feedback about the exercise and any difficulties they may have faced.

   (b) Group work

   Divide students into groups of 10. Give each group a bag of sweets and then ask them to sort the sweets based on the colors. Count the number of sweets of each color and record the data. Have students compute fractions and percentage for each color of sweets in their bag. Have the students share their group's information.
4. Have them complete Mastery Practice in the workbook on pages 61 and 62.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 6
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 6

Assessment:

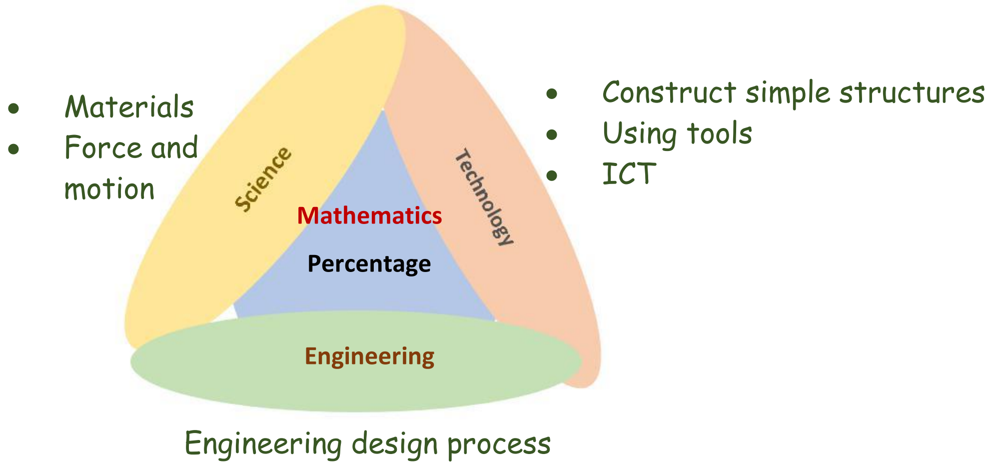
1. To assess cognitive behavior, test on page 79 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

STEM Activity: A marble drop

Overview

A pom pom drop is an activity aimed to develop fine motor skills for toddlers. It can also help toddlers to understand the concept of the cause and effect. In this chapter, students will design and create a marble drop instead of a pom pom drop. They will have to make the marble travels for more than 10 seconds through the tunnels. At the end, the marble should drop into a container.

Subject integration



Activity Guide

Time: 3 hours

Start up:

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

3. Lead them to talk about what they have learned about percentages and how they use it in their daily life.

Lesson development:

1. Assign students to read the situation on page 79. Then, lead students to discuss and identify a problem by answering these questions:
   (a) What are we required to do?
   (b) What are our missions?
   (c) What is the problem of this situation?
   (d) What do we need to know to get started?
2. Then motivate students to explore and make connections between science, technology, engineering and mathematics by posing some of these following questions:
   (a) Have you ever seen a pom pom drop? How does it look like?
   (b) What causes a pom pom to move? Gravity?
   (c) Does a pom pom move downward faster than a marble? Why or why not?
   (d) What should you do to make the marble travel further?
   (e) How do you calculate the percentage of your marble falling into the container?
   (f) What should we use to make a tunnel?
   (g) Should we connect all tubes closely together or leave a little bit of distance between each tube? Why or why not?
   (h) What are the good points and weak points if we connect each tube closely together?
   (i) How do you assess your work by using statistics?
3. Ask students to think about how to assess their project. Guide them to discuss in class and set their criteria by these following questions:
   (a) What are the achievement criteria?)A marble travels through the tunnels for more than 10 seconds, the marble can drop into a container many times.(

(b) How do we evaluate our success?)Test it for 10 times and find out the percentage of your marble falling into the container(

4. Get students to brainstorm. Let them decide and choose their best solution. They should draw their design including label of materials and draft method. Then, let them create and follow their plan.
5. After they have finished their work, ask them to assess their marble drop by using the criteria stated in no.3. Teacher may pose these following questions:
   (a) Did your work meet the criteria?
   (b) Do you and your team feel satisfied with your work? Why? Why not?
   (c) What works or what does not work?
   (d) Can you figure out the weak points of your work?
   (e) Does a marble travel through the tunnels for more than 10 seconds?
   (f) Do the marbles drop into a container?
   (g) What is the percentage of your marble falling into the container? Are you satisfied?
   (h) How will you modify your solution to make it better?
6. Let them improve their design. Teacher may point out their weak points, then motivate them to think about how to improve it.)Teacher may skip this step due to time constraint and may ask them to explain the need to do so and how to do it instead.(
7. Get each group to prepare a presentation of their work and explain their journey of creating it.)Teacher may suggest them a suitable type of presentation and/or assign them the topics for presentation such as team members, product, journey of their works, problems, how to test and improvement.(

Conclusion:

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

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

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

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

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

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

(h) What are the benefits of this activity?

(i) What did you learn from this activity?

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

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

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

Suggested materials:

A variety of paper tubes)long and short(, sticky tape, marble, container

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 5 Ratios and proportions

Time: 11 hours

Strand: Numbers and Algebra

Standard M 1.1:

Indicator:

M 1.1 Gr.6/11 Show mathematical methods of finding the answers of ratio word problems.

Learning objectives:

- Write ratios to compare two quantities.
- Find ratios equivalent to the given ratios.
- Determine if two ratios are in proportion.
- Solve word problems involving ratios and proportions.

Competency:

- Problem-solving capacity
- Apply life skills capacity

Start up:

- Assess students' prior knowledge about ratios and proportions by asking them what knew and what they want to know more about ratios and proportions.
- Ask them to write all their prior knowledge)Part K(on page 81 and have students share what they know about ratios and proportions Then ask them to write some questions which they want to know)Part W(on page 81.

Teaching/ learning activities:

1^{st} – 4^{th} hours (Ratios)

1. The ratio of two quantities is the comparison of the two quantities of the same kind. We usually write the ratio in the form a : b or $\frac{a}{b}$. We read it as 'a to b'. Draw on the board to explain what ratio is. Refer to page 82.
2. Remind them that the units are left out when the two quantities are expressed as a ratio. A ratio has no units.
3. Use the examples on page 83 to explain further.
4. Equivalent ratios are ratios that have the same value. If two ratios can be made to be the same, they are equivalent. Refer to page 84
5. We can find equivalent ratios by multiplying or dividing both sides of the ratio by the same number. Explain and show them how to find the unknown when we know the equivalent ratio. Refer to page 85.
6. Ask students to try Practice on page 86. Discuss the answers with them.
7. Have students work on Exercises A to F on pages 64 to 68 of the workbook as their homework.

5^{th} – 7^{th} hours (Proportions)

1. When two ratios are equal, they are in proportion. Explain them what proportion is. Refer to page 87.
2. A pair of quantities is proportional to another pair of quantities if the ratios of the two pairs of quantities are the same. Use the examples on pages 88 and 89 to explain. Using pictures to explain will make them understand easily.
3. Ask students to try Practice on pages 89 and 90. Discuss the answers with them.
4. Have students work on Exercise G and H on pages 68 to 70 of the workbook as their homework.

8^{th} – 10^{th} hours (Solving word problems involving ratios and proportions)

1. Using the examples on pages 91 and 92 to explain how to solve word problems involving ratios and proportions.
2. Always emphasize that they have to understand the question first before writing the number sentence and solving it.
3. Ask students to try Practice on pages 92 and 93. Discuss the answers with them.
4. Have students work on Exercise I on pages 71 and 72 of the workbook as their homework.

11^{th} hour (Conclusion)

1. Get students to tick what they have learned and understood on page 93 (Part L).
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.
3. Guide the whole class to conclude the concept of ratios and proportions by using their real-life numbers such as numbers of boys and girl in class or school, number of students in each grade level.
4. Have them complete Mastery Practice in the workbook on pages 73 and 74.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 6
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 6

Assessment:

1. To assess cognitive behavior, test on page 93 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

Chapter 6 Volume

Time: 9 hours

Strand: Measurement & Geometry

Standard: M 2.1

Indicator:

M 2.1 Gr.6/1 Show mathematical methods of finding the answers of word problems involving volume of three-dimensional geometric shapes that are made of cuboids.

Learning objectives:

- Find volumes by counting cubes.
- Find volumes by using the formula.
- Find volumes of shapes made up of cuboids.
- Solve word problems involving volumes of three-dimensional geometric shapes that are made of cuboids.

Competency:

- Problem-solving capacity
- Apply life skills capacity

Start up:

- Assess students' prior knowledge about volume by asking what they knew and what they want to know more about volume.
- Ask students to write all their prior knowledge)Part K(on page 94 and have them share what they know about volume. Then ask them to write some questions which they want to know)Part W(on page 94.

Teaching/ learning activities:

1^{st} – 4^{th} hours (Volumes of shapes made up of cuboids)

1. Review the concept of the volume of a solid.
2. Ask students to build 3-D shapes by using 1-cm wooden cubes and find the volumes of the shapes in term of the number of unit cubes.
3. Use the examples on pages 95 and 96 for further explanation of finding volume by counting the cubes.
4. We also can apply a formula to find the volume of a cuboid. Use the example on page 96 to explain further.
5. Ask students to build 3-D shapes by using 1-cm wooden cubes and find the volumes of the shapes by counting the cubes and using the formula. Compare both methods.
6. Use the examples on page 97 to guide students to do so.
7. Have students try Practice on pages 98 and discuss the answers with them.
8. Assign them to complete Exercises A to E in the workbook on pages 76 to 78 as their homework.

5^{th} – 8^{th} hours (Solving word problems involving volumes of shapes made up of cuboids)

1. Guide students step by step to solve word problems involving volumes of shapes made up of cuboids by using the examples on page 99 and 100.
2. Have students try Practice on pages 101 and 102 and discuss the answers with them.
3. Assign them to do Exercise F in the workbook on pages 79 and 80 as their homework.

9^{th} hour (Conclusion)

1. Get students to tick what they have learned and understood on page 102 (Part L).
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.

3. Have them complete Mastery Practice in the workbook on pages 81 to 83.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 6
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 6

Assessment:

1. To assess cognitive behavior, test on page 102 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

Chapter 7 Circles

Time: 15 hours

Strand 2: Measurement & Geometry

Standard M 2.1

Indicator:

M 2.1 Gr. 6/3 Show mathematical methods of finding the answers of word problems involving circumference and area of a circle.

Learning objectives:

- Identify and explain parts of a circle.
- Use a compass to draw circles.
- Find the circumference and area of a circle.
- Solve word problems involving the circumference and area of a circle.

Competency:

- Thinking capacity
- Problem-solving capacity
- Apply life skills capacity
- Technological application capacity

Start up:

- Assess students' prior knowledge about circles by asking what they knew and what they want to know more about circles.
- Ask students to write all their prior knowledge)Part K(on page 103 and have them share what they know about circles. Then ask them to write some questions which they want to know)Part W(on page 103.

Teaching/ learning activities:

1st – 2nd hours (Parts of a circle)

1. Use a compass to draw a big circle on the board. Explain the parts of the circle such as the center, diameter, radius and circumference.
2. Refer to page 104.
3. Give each group a picture of a circle and ask them to identify the parts of the circle.
4. Ask them to differentiate between radius and diameter of a circle.
5. Have students try Practice on page 105 and discuss the answers with them.
6. Assign them to do Exercises A to C in the workbook on pages 90 and 91 as their homework.

3rd – 5th hours (Drawing circles)

1. Guide them how to draw a circle using a compass step by step. Refer to page 106.
2. Ask each group to draw their circles with given different information such as diameter, radius and center.
3. Have students try Practice on page 107 and discuss the answers with them.
4. Assign them to do Exercise D in the workbook on page 92 as their homework.

6th – 8th hours (Circumference of a circle)

1. Help students to recall what the circumference of a circle is.
2. Show them how to find the circumference of a circle by using the formula. Refer to page 108.
3. Explain more on how to find the circumference by using the examples on page 109.
4. Have students try Practice on pages 109 and 110 and discuss the answers with them.
5. Assign them to do Exercises E and F in the workbook on pages 93 and 94 as their homework.

9^{th} – 11^{th} hours (Area of a circle)

1. Let students carry out Activity Corner on page 111 in order to understand how we find the area of a circle.
2. Explain how to find the area of a circle using the formula.
3. Refer to the examples on page 112.
4. Have students try Practice on pages 112 and 113 and discuss the answers with them.
5. Assign them to do Exercises G and H in the workbook on pages 94 to 96 as their homework.

12^{th} – 14^{th} hours (Solving word problems involving circumference and area of a circle)

1. Guide students step by step to solve the word problems involving the circumference and area of a circle by using the examples on page 114.
2. Have students try Practice on page 115 and discuss the answers with them.
3. Assign them to do Exercise I in the workbook on pages 96 and 97 as their homework.

15^{th} hour (Conclusion)

1. Get students to tick what they have learned and understood on page 116 (Part L).
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.
3. Have them complete Mastery Practice in the workbook on pages 98 to 100.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 6
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 6

Assessment:

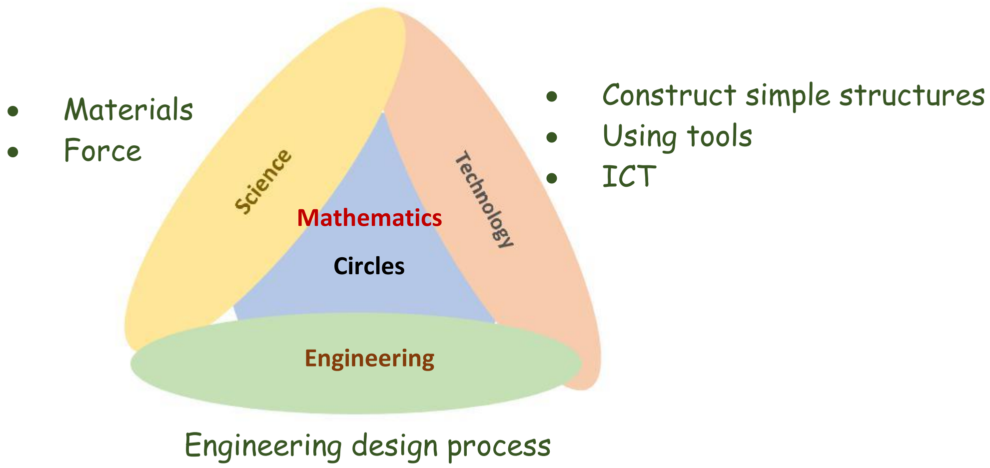
1. To assess cognitive behavior, test on page 116 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

STEM Activity: My Frisbee)Part 1(

Overview

A Frisbee or a flying disc is a disc-shaped gliding toy that is thrown and caught for recreation. Throwing a Frisbee is the classic beach or park pastime. In this activity, students are required to design and create a Frisbee. They need to make a set of rules for a flying Frisbee competition in the school.

Subject integration



Activity Guide

Time: 3 hours

Start up:

1. Assign students into groups of 3 and 4 students.

Lesson Development:

1. Let students read the situation on page 116. Then, lead students to discuss and identify the problem by answering these questions:
   (a) What is a Frisbee or a flying disc?
   (b) Have you ever seen or played one before?
   (c) What are you required to do?
   (d) What will have to do?
   (e) What are your missions?

(f) What do you need to know to get start?

2. Show them a Frisbee or let them watch a VDO clip of Frisbee by scanning the QR code below:

Let the whole class discuss about the Frisbee.

(a) How is a Frisbee able to fly through the air so well?

(b) What are the forces acting on a flying Frisbee?

(c) What is the scientific theory behind a flying Frisbee?

(d) Does the Frisbee travel far if it is thrown without a spin?

(e) If the Frisbee spins faster, will it stay longer in the air?

(f) Do the sizes and shapes of the Frisbee affect its ability to fly?

(g) Which travels further – a big Frisbee or small Frisbee?

(h) Is there a relationship between the launching angle and travelled distance?

(i) Does a Frisbee look similar to an airplane wing from the side view? Why?

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

(a) How do you draw the circle?

(b) How do you draw a ring?

(c) What kind of material is the Frisbee made of?

(d) What is its diameter?

(e) Is it a solid disc or a ring?

(f) How thick is the Frisbee? How heavy is it?

(g) Does a 7" Frisbee fly the same distance as a 10" Frisbee?

(h) How does a disc fly compare to a ring?

(i) What is the best throwing stance?

(j) What materials should you consider?

(k) What tools will you need?

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

(a) What are the achievement criteria?)A Frisbee and the rules(

(b) How do you evaluate your success?)A Frisbee that can fly well(

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

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

(a) What works? What does not work?

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

(c) Should you change your Frisbee's shape or size?

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

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

8. Get each group to prepare a presentation of their work and explain their journey of creating it.)Teacher may suggest them a suitable type of presentation and/or assign them the topics for presentation such as team members, product, journey of their works, problems, how to test and improvement.(

Conclusion:

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

(a) What did you learn from this activity?

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

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

Suggested Materials:

Variety of cardboard, EPS foam sheets, plastic sheets, scissors, crayons, cutter

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 8 Triangles

Time: 20 hours

Strand: Measurement & Geometry

Standard M 2.2

Indicators:

M 2.2 Gr.6/ 1 Classify triangles based on properties.

M 2.2 Gr.6/ 2 Construct triangles using given length of sides and angles.

Learning objectives:

1. Identify and classify types and properties of triangles.
2. Draw triangles with given lengths of sides and angles.
3. Find the interior angles of a triangle.
4. Find the perimeter of a triangle.
5. Find the area of a triangle.
6. Solve word problems involving perimeter and area of a triangle.

Competency:

- Thinking capacity
- Technological application capacity

Start up:

1. Assess students' prior knowledge about triangles asking what they knew and what they want to know more about triangles.
2. Ask them to write all their prior knowledge)Part K(on page 118 and have them share what they know about triangles. Then ask students to write some questions which they want to know)Part W(on page 118.

Teaching/ learning activities:

1^{st} – 3^{rd} hours (Types and properties of triangles)

1. Ask them to trace and complete a geometric shape with a given angle on the board.
2. Have them draw a triangle on a colored paper. Then, ask them to cut it out and paste it on the board. Let them group the triangles. They may use any criteria for grouping.
3. Explain to students that triangles can be classified based on their sides. There are three types of triangles based on the sides – equilateral triangles, isosceles triangles and scalene triangles. Refer to page 119.
4. Moreover, there are three types of triangles based on their angles – acute triangles, obtuse triangles and right triangles. There are also triangles based on both the angles and sides at the same time. Use the examples on page 120 for further explanation.
5. Draw a few triangles on the board and ask students to identify and group them.
6. Let students answer the question in Let's Think on page 121.
7. Guide them to understand the properties of a triangle. Refer to page 121.
8. Draw a triangle on the board and ask students to identify its base, vertex, base angles and the height of the triangle.
9. Have students try Practice on pages 121 and 122 and discuss the answers with them.
10. Assign them to complete Exercises A and B in the workbook on pages 103 and 104 as their homework.

4^{th} – 7^{th} hours (Drawing triangles)

1. Demonstrate step by step how to draw a triangle using a compass and a ruler. Use the examples on pages 123 to 126 to explain further.
2. Get students to work in pairs. Ask a student to draw a triangle with specific lengths and angles. Ask the other one to check the triangle. Then, have students exchange the roles and ask them to draw a few other triangles.
3. Have students try Practice on pages 126 and 127 and discuss the answers with them.
4. Assign them to do Exercise C in the workbook on page 105 as their homework.

8^{th} – 10^{th} hours (Interior angles of a triangle)

1. Introduce the concepts of interior and exterior angles to students. Refer to page 128. Emphasize that the sum of the interior angles of any triangle is always 180°.
2. Ask them to draw any triangles and measure the sum of the interior angles. Then guide them on how to find the size of the angle using the examples on page 128.
3. Have students try Practice on page 129 and discuss the answers with them.
4. Assign them to do Exercise D in the workbook on page 106 as their homework.

11^{th} – 13^{th} hours (Perimeter of a triangle)

1. Use the examples on page 130 to explain the concept of the perimeter of a triangle.
2. Ask them to draw some triangles and measure the perimeter of triangles. Then guide them on how to find the sum of the perimeter of triangles using the example on page 130.
3. Have students try Practice on page 131 and discuss the answers with them.
4. Assign them to do Exercises E and F in the workbook on page 107 as their homework.

14^{th} – 16^{th} hours (Area of a triangle)

1. Introduce the formulae to find the area of a triangle on page 132 to students.
2. Use the examples on pages 133 and 134 to demonstrate how to use the formulae.
3. Have students try Practice on page 134 and discuss the answers with them.
4. Assign them to complete Exercise G in the workbook on page 108 as their homework.

17^{th} – 19^{th} hours (Solving word problems involving perimeter and area of a triangle)

1. Guide students step by step to solve word problems involving perimeter and area of a triangle using the examples on page 135.

2. Have students try Practice on pages 136 and 137 and discuss the answers with them.
3. Assign them to do Exercises H and I in the workbook on pages 109 and 110 as their homework.

20th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 138 (Part L).
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.
3. Guide the whole class to conclude the concept of triangles with these sample activities:

   (a) Paper airplane

   Challenge them to fold a paper airplane and then discuss the shape of the airplane and the features of the airplane (speed, strength, etc.). Brainstorm about where we can find triangular shapes and how we use triangles in our real world.

   (b) Triangle artwork

   Assign them to prepare a variety of triangles of colored paper. Then use those colorful triangles to create an artwork.
4. Have them complete Mastery Practice in the workbook on pages 111 to 113.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 6
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 6

Assessment:

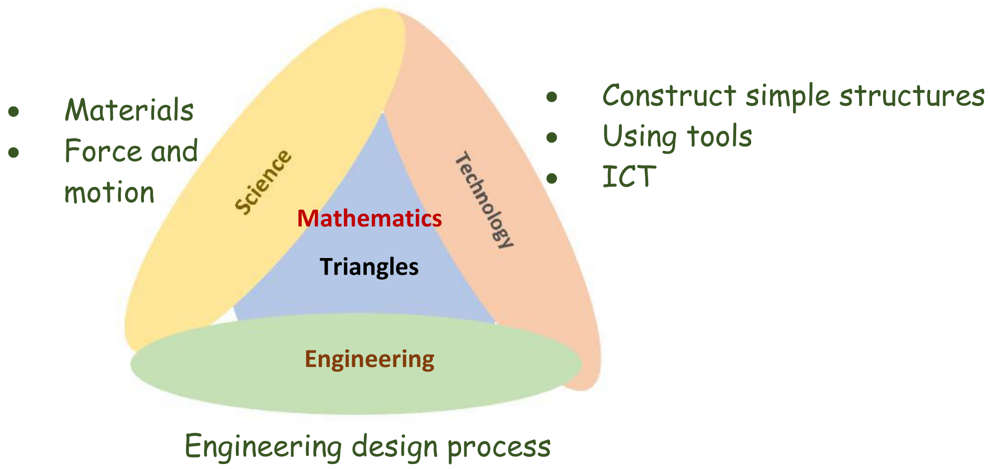
1. To assess cognitive behavior, test on page 138 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

STEM Activity: A triangular tower

Overview

A triangle is one of the basic shapes in geometry and in constructions. There are thousands of different constructions that find a special point associated with a triangle. With the advancement in technology, triangular shapes are becoming increasingly prevalent as parts of the buildings and as the primary shape for some skyscrapers as well as building materials. In this activity, students will apply the knowledge of triangles to design and create a triangular tower by folding paper.

Subject integration



Activity Guide

Time: 3 hours

Start up:

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

Lesson development:

1. Assign students to read the situation on page 138. Then, lead students to discuss and identify a problem by answering to these questions:
   (a) What are we required to do?
   (b) What are our missions?
   (c) What is the problem of this situation?
   (d) What do we need to know to get started?
2. Then engage students to explore and make connections between science, technology, engineering and mathematics by posing some of these following questions:
   (a) What are the characteristics of triangles?
   (b) What are the benefits of using triangles in constructions?)Teacher shows the pictures or video clips about triangles in constructions.(
   (c) Can paper be strengthened by folding paper in the shape of a triangle?
   (d) How do you connect each piece of folded paper?
   (e) What type of triangles should you use for your tower?
   (f) What shape is becoming increasingly prevalent as parts of the buildings and as the primary shape for some skyscrapers? Why?
   (g) What shape provides a great deal of strength?
3. Ask students to think about how to assess their project. Guide them to discuss in class and set their criteria by these following questions:
   (a) What are the achievement criteria?)A strong triangular tower, height, etc.(
   (b) How do we evaluate our success?)Stand freely at least 15 minutes.(
4. Get students to brainstorm. Let them decide and choose their best solution. They should draw their design including label of materials and draft method. Then, let them create and follow their plan.
5. After they have finished their work, ask them to assess their triangular tower by using the criteria stated in no.3. Teacher may pose these following questions:
   (a) Did your work meet the criteria?
   (b) Do you and your team feel satisfied with your work? Why? Why not?

(c) What works or what does not work?

(d) Can it stand freely?

(e) Does folding the paper help the tower to stand freely? Why?

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

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

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

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

Conclusion:

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

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

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

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

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

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

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

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

(h) What are the benefits of this activity?

(i) What did you learn from this activity?

(j) What will happen if you fold the triangular tower without a proper plan and design?

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

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

(m) What did you learn from this activity?

Suggested materials:

A4 paper)reused or new paper(

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 9 Polygons

Time: 14 hours

Strand: Measurement & Geometry

Standard M2.1

Indicator:

M 2.1 Gr.6/ 2 Show mathematical methods of finding the answers of word problems involving perimeters and areas of polygons.

Learning objectives:

- Find the interior angles of a polygon.
- Find the perimeter of a polygon.
- Find the area of a polygon.
- Solve word problems involving perimeter and area of a polygon.

Competency:

- Problem solving capacity
- Technological application capacity

Start up:

- Assess students' prior knowledge about polygons by asking what they knew and what they want to know more about polygons.
- Ask them to write all their prior knowledge)Part K(on page 140 and have them share what they know about polygons. Then ask students to write some questions which they want to know)Part W(on page 140.

Teaching/ learning activities:

1st – 4th hours (Interior angles of polygons)

1. A polygon is a two-dimensional shape with three or more straight sides. Explain and point out where the interior angles of polygons are. Refer to page 141. Guide them on how to find an angle in a triangle.
2. Explain the interior angles of regular quadrilaterals, pentagons, hexagons, heptagons, and octagons. Refer to pages 142 to 145.
3. Explain the formula of finding the sum of interior angles and the size of each angle. Using examples on page 146.
4. Ask students to answer the questions in Let's Think on page 146.
5. Have students try Practice on pages 147 and 148 and discuss the answers with them.
6. Assign them to do Exercises A to D in the workbook on pages 117 to 119 as their homework.

5th – 7th hours (Perimeter of a polygon)

1. Draw a polygon and ask them to find out its perimeter.
2. Lead to discuss and conclude that we can find the perimeter of a polygon by adding up all the lengths of the sides. Use the examples on pages 149 and 150.
3. Ask each group to draw a polygon and give to another group to find its perimeter.
4. Have students try Practice on page 150 and discuss the answers with them.
5. Assign them to do Exercises E and F in the workbook on pages 120 and 121 as their homework.

8th – 10th hours (Area of a polygon)

1. Explain what the apothem of a polygon is. Refer to page 151.
2. Guide them to find the area of a polygon by using the example on page 151.
3. Show them how to use the formula to find the areas of polygons. Refer to page 152.
4. Have students try Practice on page 153 and discuss the answers with them.
5. Assign them to do Exercises G and H in the workbook on pages 122 and 123 as their homework.

11^{th} – 13^{th} hours (Solving word problems involving perimeter and area of a polygon)

1. Guide students step by step to solve word problems involving perimeter and area of a polygon by using the examples on pages 154 and 155.
2. Have students try Practice on pages 155 and 156. Discuss the answers with them.
3. Assign them to do Exercise I in the workbook on pages 124 and 125 as their homework.

14^{th} hour (Conclusion)

1. Get students to tick what they have learned and understood on page 157 (Part L).
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.
3. Have them complete Mastery Practice in the workbook on pages 126 to 129.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 6
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 6

Assessment:

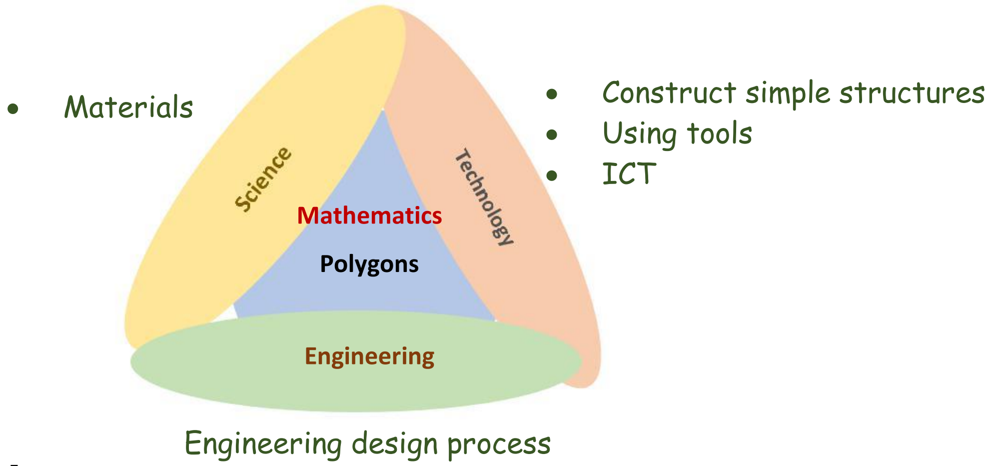
1. To assess cognitive behavior, test on page 157 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

STEM Activity: Biodome for future life

Overview

A biodome is a controlled, human-made environment, which can help scientists learn about the interactions between living and non-living things. In this activity, students will design and build a hexagonal hemisphere biodome. Then they are required to calculate the number of triangles to make a hexagon and write it in the form of fraction, decimal and percentage. They are also required to calculate the area of your dome.

Subject integration



Activity Guide

Time: 3 hours

Start up:

1. Divide the students into groups of 3 to 4 students.
2. Talk about their previous STEM activities by asking the following questions:

- Do you like those activities? Why or why not?
- Which one is your favorite activity? Why?
- Did you learn from those activities? Can you tell about it?
- Did you work alone or work as a team? How was your team?
- Did your team work collaboratively?
- What did you help your team? Are you a good team member?

- What is the process that you used to design and create your works?
- Can you apply it in your daily life?

Lesson development:

1. Assign students to read the situation on page 157. Then, lead students to discuss and identify a problem by answering these questions:
   (a) What are we required to do?
   (b) What are our missions?
   (c) What is the problem of this situation?
   (d) What do we need to know to get started?
2. Then engage students to explore and make connections between science, technology, engineering and mathematics by posing some of these following questions:
   (a) What is a hemisphere?
   (b) What is a hexagon? Teacher may suggest students to draw a hexagon and ask them to find the relation between triangles and hexagons. How many triangles are needed to make a hexagon? Ask them to draw a hexagon and measure the area. Suggest students to build triangles in order to construct a hexagon dome.
   (c) How can you measure the area of a hexagon?
   (d) Are straws strong enough to build some figures? What is the purpose of doing that?
   (e) Can you put pipe cleaners inside the straws? What are the properties of pipe cleaners?
   (f) How do you fix each triangle to each other?
3. Ask students to think about how to assess their project. Guide them to discuss in class and set their criteria by these following questions:
   (a) What are the achievement criteria?)A complete hexagonal dome, etc.(

(b) How do we evaluate our success?)The strength and the symmetry of the dome, the accuracy of writing the percentage, fraction and decimal numbers, calculation of the area of the dome.(

4. Get students to brainstorm. Let them decide and choose their best solution. They should draw their design including label of materials and draft method. Then, let them create and follow their plan. Teacher can give some suggestions if some students may not understand well about hexagonal shape.
5. After they have finished their work, ask them to assess their biodome by using the criteria stated in no.3. Teacher may pose these following questions:
   (a) Did your work meet the criteria?
   (b) Do you and your team feel satisfied with your work? Why? Why not?
   (c) What works or what does not work?
   (d) Can it stand freely?
   (e) Can you figure out the weak points of your biodome?
   (f) How will you modify your solution to make it better?
6. Let them improve their design. Teacher may point out their weak points, then motivate them to think about how to improve it.)Teacher may skip this step due to time constraint and may ask them to explain the need to do so and how to do it instead.(
7. Get each group to prepare a presentation of their work and explain their journey of creating it.)Teacher may suggest them a suitable type of presentation and/or assign them the topics for presentation such as team members, product, journey of their works, problems, how to test and improvement.(

Conclusion:

1. End the lesson by asking students the following questions:
   (a) Do you think that you have acted as an engineer? Why or why not?
   (b) What is the engineering design process?
   (c) Did you apply the engineering design process into your work?

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

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

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

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

(h) What are the benefits of this activity?

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

(j) What did you learn from this activity?

Suggested materials:

Pipe cleaners, straws, scissors

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 10 Three-dimensional shapes

Time:8 hours

Strand: Measurement & Geometry

Standard M 2.3

Indicator:

M 2.2 Gr.6/3 Describe the characteristics of different types of three-dimensional geometric shapes.

M 2.2 Gr.6/4 Identify three dimensional geometric shapes that made up from unfolded pictures and identify unfolded pictures of three-dimensional geometric shapes.

Learning objectives:

- Identify the characteristics of different types of three-dimensional geometric shapes.
- Identify the nets of three-dimensional geometric shapes.
- Identify three-dimensional geometric shapes from their nets.

Competency:

- Thinking capacity
- Apply life skills capacity
- Technological application capacity

Start up:

- Assess students' prior knowledge about three-dimensional shapes by asking what students knew and what they want to know more about three-dimensional shapes.
- Ask them to write all their prior knowledge)Part K(on page 159 and have students share what they know about three-dimensional shapes. Then ask them to write some questions which they want to know)Part W(on page 159.

Teaching/ learning activities:

1st – 4th hours (Types and properties of three-dimensional shapes)

1. Show students pictures of objects of 3-D shapes such as balls, books, tables and pictures of objects of 2-D shapes such as squares, circles and triangles. Then let them compare the 3-D shapes and 2-D shapes. Brainstorm and encourage them to differentiate between 2-D and 3-D shapes.
2. Draw a few shapes on the board and ask students to identify the three-dimensional shapes.
3. Help students to recall what three-dimensional shapes are. How are they different from two-dimensional shapes?
4. Help students to recall the parts and types of 3-D shapes. Refer to pages 160 and 161. There are standard 3-D shapes such as spheres, cylinders, cones, prisms)cuboids, triangular prisms and hexagonal prisms(, cuboids, cubes and pyramids)square pyramids and hexagonal pyramids(.
5. Have students try Practice on page 162 and discuss the answers with them.
6. Assign them to do Exercises A to D in the workbook on pages 133 to 135 as their homework.

5th – 7th hours (Nets of 3-D shapes)

1. Show/Draw some 3-D shapes. Ask students these questions:
   (a) What shape is it?
   (b) What are the 2-D shapes that can make this 3-D shape?
2. Ask students to bring any boxes to school. Ask them to open up the boxes and lay them flat on the table. Explain to them that those open-up boxes are the nets of the boxes.
3. Show them some examples of 2-D and 3-D shapes, such as a circle and a sphere.
4. Use the examples on pages 163 and 164 to explain further.
5. Tell students that they should be able to imagine the 3-D shapes formed from folded nets. Refer to pages 164 and 165.

6. Ask students to do the Activity Comer on page 166.
7. Try Practice on page 166. Discuss the answers with them.
8. Assign the students to work on Exercises E to G on pages 136 and 137 of the workbook as their homework.

8th hour (Conclusion)

1. Get students to tick what they have learned and understood on page 167 (Part L).
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.
3. Have them complete Mastery Practice in the workbook on pages 138 to 140.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 6
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 6

Assessment:

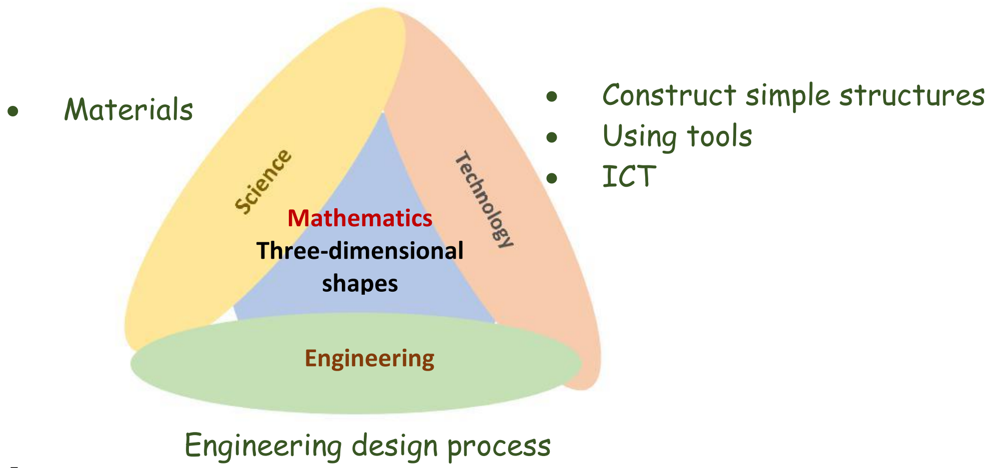
1. To assess cognitive behavior, test on page 167 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

STEM Activity: My Frisbee)Part 2(

Overview

This activity is connected to the previous activity. In this activity, students are required to design and create a package for their Frisbee created in the previous chapter. 3-D shapes should be used in this challenge.

Subject integration



Activity Guide

Time: 3 hours

Start up:

1. Assign students into the same group as the previous activity.

Lesson Development:

1. Assign students to read the situation on page 167. Then, lead students to discuss and identify the problem by answering these questions:
   (a) How was your Frisbee in the previous chapter? Was it fun?
   (b) Suppose you are a company owner and you want to sell your Frisbee to another province. What will you do? How will your package look like?
   (c) What are you required to do?
   (d) What will have to do?
   (e) What are our missions?

(f) What do you know?

(g) What do you need to know to get start?

2. Show students several packages and discuss about the important of packages.

   (a) What is a package?

   (b) What are benefits of a good package? For protection of the product, making product attractive, etc.

   (c) What are the functions of a package?

   (d) How do we use 3-D shapes to appeal to customers?

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

   (a) What shape is suitable for a Frisbee's package?

   (b) How much will it cost?

   (c) What materials should you consider if you want the customer can see the content?

   (d) How should the package represent your Frisbee?

   (e) Should your package have an appealing look?

   (f) What should you write on your package?

   (g) Should you consider eco-friendly materials?

   (h) What tools will you need?

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

   (a) What are the achievement criteria?)A Frisbee's package(

   (b) How do you evaluate your success?)A Frisbee's package that can protect the product from damage(

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

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

   (a) What works? What does not work?

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

(c) Should you change your Frisbee’s shape or size?

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

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

8. Get each group to prepare a presentation of their work and explain their journey of creating it.)Teacher may suggest them a suitable type of presentation and/or assign them the topics for presentation such as team members, product, journey of their works, problems, how to test and improvement.(

Conclusion:

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

   (a) What did you learn from this activity?

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

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

Suggested materials:

Varieties of cardboard, scissors, glue, sticky tape, crayons

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 11 Patterns

Time: 9 hours

Strand: Numbers and Algebra

Standard M 1.2

Indicator:

M 1.2 Gr.6/ 1 Show the thinking process and finding the answers of pattern problems.

Learning objectives:

- Complete geometric patterns and number patterns.
- Solve word problems involving patterns.

Competency:

- Thinking capacity
- Problem solving capacity

Start up:

- Assess students' prior knowledge about patterns by asking what they knew and what they want to know more about patterns.
- Ask students to write all their prior knowledge)Part K(on page 169 and have students share what they know about patterns. Then ask them to write some questions which they want to know)Part W(on page 169.

Teaching/ learning activities:

1^{st} – 5^{th} hours (Geometric patterns and number patterns)

1. Explain to students that when a set of object produces a repeating pattern, the pattern is known as the geometric pattern.
2. Use the examples on pages 170 and 172. Guide them on how to predict the next shape or object.
3. Let students know that when a set of numbers produces a repeating pattern, the pattern is known as number pattern.
4. Use the examples on pages 172 and 173. Guide them on how to predict the next number.
5. Ask students to try Practice on page 174. Discuss the answers with them.
6. Assign the students to do Exercise A to F on pages 142 to 144 of the workbook as their homework.

6^{th} – 8^{th} hours (Solving problems involving patterns)

1. Use the example on page 175 to guide students to solve word problems involving patterns.
2. Ask students to try Practice on page 176. Discuss the answers with them.
3. Assign the students to do Exercise G on page 145 of the workbook as their homework.

9^{th} hour (Conclusion)

1. Get students to tick what they have learned and understood on page 177 (Part L).
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.
3. Have them complete Mastery Practice in the workbook on pages 146 to 148.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 6
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 6

Assessment:

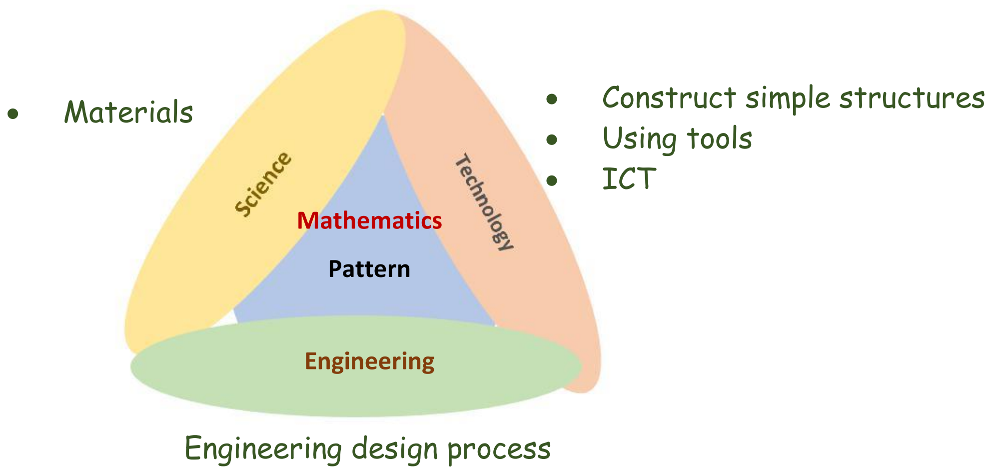
1. To assess cognitive behavior, test on page 177 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

STEM Activity: Christmas tree

Overview

A Christmas tree is a decorated tree, usually associated with the celebration of Christmas. Students are required to design and create a Christmas tree with toothpicks and gumdrops)gummy bear(as high as possible. They will analyze their Christmas tree that it is a triangular pyramid)a pyramid with a triangular base(. The numbers of the gumdrops or toothpicks in the first layer and the second layer are in a pattern sequence.

Subject integration



Activity Guide

Time: 3 hours

Start up:

1. Assign students to group of 3 to 4 students.

Lesson Development:

1. Assign students to read the situation on page 177. Then, lead students to discuss and identify the problem by answering these questions:
   (a) What are you required to do?
   (b) What will you have to do?
   (c) What do you need to know to get start?

(d) What shapes are the trees? Is it a triangular pyramid)a pyramid with a triangular base(?

2. Then engage students to explore and make connections between science, technology, engineering and math by using some of these following questions;
    (a) Which geometric shape is rigid?)Use the activity in Chapter 9 in Prathomsuksa 5(
    (b) What is a triangular pyramid? Can you find this shape in nature?
    (c) What is a regular tetrahedron?
    (d) How can we start to make a regular tetrahedron structure?
    (e) If we use 15 gumdrops and 30 toothpicks to form the triangles at the base, how many triangle shapes can we create? Can we design and create pyramids from that base?
    (f) What tools will we need?
3. Ask students to think about how to assess their project. Guide them to discuss in class and set their criteria by these following questions:
    (a) What are the achievement criteria?)A charismas tree(
    (b) How do you evaluate your success?)The height of the Christmas tree(
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 pyramid by using the criteria stated in no.3. Teacher may pose these following questions:
    (a) What works? What does not work?
    (b) How will you 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 students the following questions:
   (a) What did you learn from this activity?
   (b) Can you use those steps in your daily living?
   (c) What are the steps of engineering design process?

Suggested materials:

Gumdrops/gummy bear, toothpicks

Assessment:

Refer to Scoring Rubric for STEM Activities

Chapter 12 Pie charts

Time: 6 hours

Strand: Statistics and Probability

Standard M 3.1

Indicator:

M 3.1 Gr.6/1 Use data from pie charts to find the answers of word problems.

Learning objective:

- Read and interpret pie charts to solve word problems.

Competency:

- Communication capacity
- Thinking capacity

Start up:

1. Assess students' prior knowledge about pie charts by asking what they knew and what they want to know more about pie charts.
2. Ask them to write all their prior knowledge)Part K(on page 179 and have them share what they know about pie charts. Then ask them to write some questions which they want to know)Part W(on page 179.

Teaching/ learning activities:

1^{st} – 5^{th} hours (Reading pie charts)

1. Guide students on how to extract information from pie charts.
2. Use the examples on pages 180 and 181.
3. The sectors in a pie chart represent the quantities of different components. The data can be given as fractions. Guide them on how to extract information from them. Refer to page 182.
4. The data in a pie chart can be given in percentages too. Show them the connection between pie chart sectors and percentage. Percentages are used in a pie chart to compare the components in a set of data.
5. Use example on page 183 to explain more detail.
6. Ask students to try Practice on pages 184 to 186. Discuss the answers with them.
7. Have students work on Exercise A pages 150 to 154 of the workbook as their homework.

6^{th} hour (Conclusion)

1. Get students to tick what they have learned and understood on page 187 (Part L).
2. Review the vocabulary used by referring to key words in each subtopic in the chapter.
3. Have them complete Mastery Practice in the workbook on pages 155 to 157.

Learning materials:

- Primary Education Smart Plus Mathematics Textbook Prathomsuksa 6
- Primary Education Smart Plus Mathematics Workbook Prathomsuksa 6

Assessment:

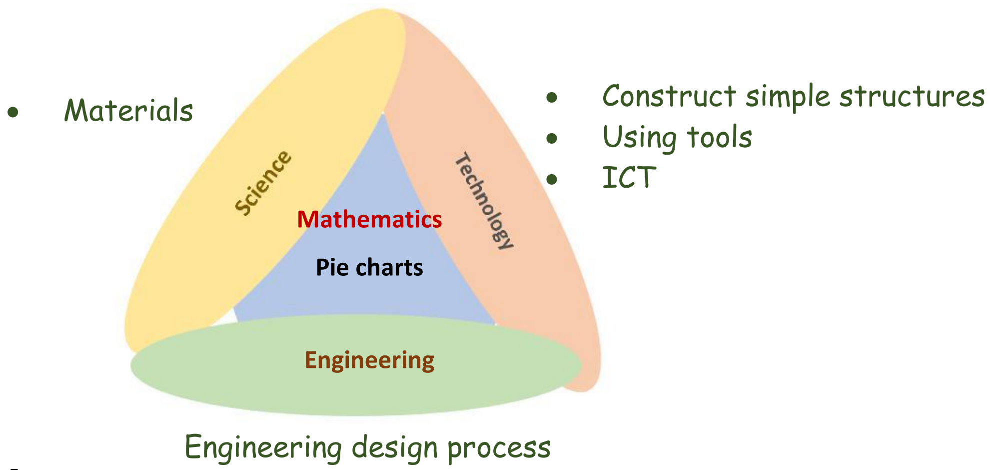
1. To assess cognitive behavior, test on page 187 (Part L column).
2. To assess affective behavior, refer to Scoring Rubric for Affective Domain.
3. To assess thinking process skills, refer to Analytic Scoring Scale and Process-based Scoring Rubrics.

STEM Activity: My Frisbee)Part 3(

Overview

After creating the package for Frisbee in the previous chapter, students are required to do a survey about the new packages of the Frisbee among your classmates. Which one do they prefer? Then, design and create an interesting 3-D presentation of their findings.

Subject integration



Activity Guide

Time: 3 hours

Start up:

1. Assign students the same group as the previous chapter.

Lesson Development:

1. Assign students to read the situation on page 187. Then, lead students to discuss and identify the problem by answering these questions:
   (a) How were your Frisbee and the package in the previous chapter? Was it fun? Was it a good package? Can it protect your Frisbee?
   (b) How do we know that the customers are satisfied with your Frisbee or its package?
   (c) What are you required to do?
   (d) What will you have to do?
   (e) What do you need to know to get start?

2. Then engage students to explore and make connections between science, technology, engineering and math by using some of these following questions;
   (a) Which type of statistics we should to consider to use? Pie chart, bar chart, or line graph?
   (b) What are the benefits of using pie charts, bar charts and line graphs?
   (c) What type of statistics is appropriate with your data?
   (d) How will you present your data?
   (e) How do you make the audience understand all your data easily?
   (f) What materials are appropriate to create the chart?
   (g) What materials should you consider in order to make it more interesting?
   (h) What tools will you need?
3. Ask students to think about how to assess their project. Guide them to discuss in class and set their criteria by these following questions:
   (a) What are the achievement criteria?)A pie chart, bar chart or line graph of survey(
   (b) How do you evaluate your success?)the understanding of the audience(
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.
   (a) 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:
   (b) What works? What does not work?
   (c) How will you make it better?
5. 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.(
6. Get each group to prepare a presentation of their work and explain their journey of creating it.)Teacher may suggest them a suitable type of presentation and/or assign them the topics for presentation such as team members, product, journey of their works, problems, how to test and improvement.(

Conclusion:

1. End the lesson by asking students the following questions:
   (a) What did you learn from this activity?
   (b) Can you use those steps in your daily living?

Suggested materials:

Variety of cardboard, yarn, string, crayons, straws, scissors

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