

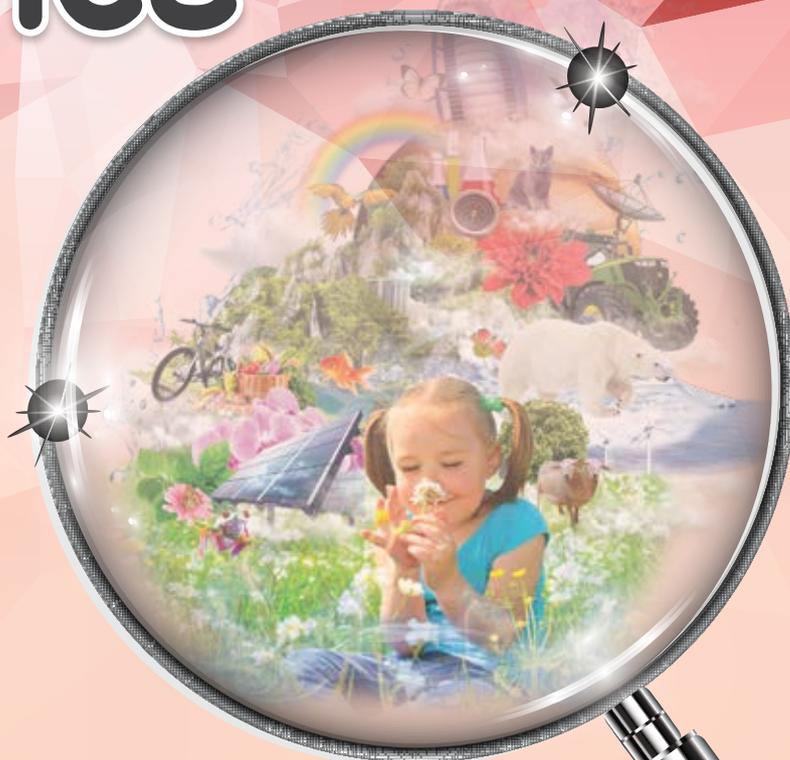
Teacher's Guide



SCIENCE

Primary
Education
Smart+
Prathomsuksa

2



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

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Preface

The learning standards of science based on the Basic Education Curriculum B.E. 2551 (revised Edition B.E. 2560) are divided into four main strands. They are:

Strand 1: Biology Science

Strand 2: Physical Science

Strand 3: Earth and Space Science

Strand 4: Technology

All the elements in this course including the contents, the teaching and learning activities, and the measurement and evaluation of the learning outcomes are very important to be coherent in order to lay a good strong foundation in the students in every level from Grade 1 to Grade 12.

Students not only need to know and understand the basic knowledge of science, but also to apply it in their daily lives and hopefully when they further their studies in the disciplines of science. The contents of each strand are relevant and suitable for each level, neither too easy nor too difficult. There are also links between the knowledge, the learning process and learning activities that encourage students to develop thinking skills which include analytical, creative and critical thinking skills. Besides that, students are encouraged to develop science process skills and also the 21st century skills. These skills allow students to be long-life learners and succeed in this information age. For example, by knowing how to carry out researches and construct their own knowledge with the use of inquiry strategies, students can solve their problems systematically. They can make great decisions based on the various kinds of information and empirical evidences gathered.

Goals

The new teaching and learning of science focuses on students themselves, allowing them to discover the knowledge mostly by themselves. With their fundamental knowledge and the results from their scientific investigations, students can construct their own principles, conceptual ideas and understandings systematically.

The teaching and learning of science has the following important goals:

1. To understand principles, theories and rules that are fundamental in science.
2. To understand the nature of science and the limitations of science.
3. To have important skills for study, research and technological development.
4. To realize the relationship between science, technology, humanity and the environment in which they affect and influence each other.
5. To apply knowledge and understanding in science and technology in order to benefit the society and life.
6. To develop the process of thinking and imagination, and the ability to manage and solve problems with excellent communication and decision-making skills.
7. To be a scientist who upholds values, moral and ethics issues when applying scientific knowledge and technology wisely.

General learning outcomes in each strand

This revised curriculum aims to provide the knowledge of science to students and focuses on the relation between the knowledge and the learning process. Students will develop important skills to carry out researches, construct the knowledge using the inquiry approach and solve a variety of problems. By having students participate in every stage of learning and doing various practical activities that suit each level, they will acquire the following general learning outcomes in each strand:

✧ **Biology Science**

Learning about life and living things, elements of living things, life processes, structures and functions of living things (how they live?), heredity, diversity of living things in the environment, the environment and the evolution of organisms.

✧ **Physical Science**

Learning about the nature of substances, changes in substances, motion, energy and waves.

✧ **Earth and Space Science**

Learning about the components of the universe, interactions within the Solar System, space technology, Earth system, geological changes and the processes of changes of the climate and their effects on organisms and the environment.

❖ Technology

- **Design and Technology**

Learning about the technology for living in the fast-changing society. Using knowledge and skills in science and mathematics creatively to solve problems and improve our life by applying the engineering processes. Choosing an appropriate technology with consideration for the impact on life, society and the environment.

- **Computer Science**

Learning about computational thinking, analytical thinking, systematic problem solving and the application of computer science, information technology and communication to solve the real life problems effectively.

Strands and Learning Standard

Strand 1: Biology Science

Standard 1.1: Understand the diversity of the ecosystem, the relationships between non-living things and living things, the relationships between organisms in the ecosystem, the energy transfer, the changes in the ecology, the meaning of population, the problems and impacts on the natural resources and environment, the guidelines for natural resource conservation and the environmental solutions including the applications of knowledge to benefit.

Standard 1.2: Understand the properties of organisms, the basic unit of life, the movement through cells, the relationships between structures and functions of different organ systems in animals and humans that work together, and the relationship between structures and functions of organ systems in plants that work together including the applications of knowledge to benefit.

Standard 1.3: Understand the processes and the importance of inheritance, the genetic materials, the genetic changes affecting organisms, biodiversity and the evolution of organisms including the applications of knowledge to benefit.

Strand 2: Physical Science

Standard 2.1: Understand the properties of matter, the component of matter, the relationships between the properties, structures and the energy bonds between particles, the principles and the nature of changes in the states of matter, the solution forming and the chemical reactions.

Standard 2.2: Understand the nature of forces in everyday life, the effects of forces on objects and the various kinds of movements of objects including the applications of the knowledge to benefit.

Standard 2.3: Understand the meaning of energy, the transition and transfer of energy, the interaction between matter and energy, energy in everyday life, the nature of waves, and the phenomena related to sound, light and electromagnetic waves including the applications of knowledge to benefit.

Strand 3: Earth and Space Science

Standard 3.1: Understand the components, the characteristics, the processes of forming and the evolution of the universe, the galaxy, the stars and the Solar System including the interactions within the objects in the Solar system that affects the organisms and the applications of knowledge to benefit.

Standard 3.2: Understand the components and relationships of the Earth's systems, the changes on the Earth's surface and inside the Earth, geohazards and the changes on the climate including the impacts on the organisms and environment.

Strand 4: Technology

Standard 4.1: Understand the key concepts of technology for living in a rapidly changing society, the applications of knowledge and skills in science and mathematics creatively to solve problems and improve our life with the engineering design processes and the selection of appropriate technology with consideration for the impact on life, society and the environment.

Standard 4.2: Understand and apply computational thinking in solving real life problems systematically, and use information technology and communication to learn, work, and solve problems effectively, knowingly and ethically.

Learners' Quality of Grade 3 students

- Understand the general characteristics of living things and life of living things around us.
- Understand the appearances, types and some properties of materials used in making objects and the change of material around us.
- Understand the pull and push of magnetic force and the effect of force on the change of movement of objects, electrical energy and electricity generation, sound generation and visualization.
- Understand the phenomena of the Sun, the Moon, the stars, sunrise and sunset, daytime and nighttime and direction, characteristics and the importance of air, formation of wind, advantages and disadvantages of wind, characteristics of stones, soil classification and utilization.
- Ask questions or impose problems on the subject to learn as assigned or from their own interest. Observe, survey, investigate by using simple tools. Collect data, record and explain survey results. Investigate by writing or drawing and communicate what you learn through storytelling or mime or gestures to help others understand.
- Solve simple problems using troubleshooting steps. Have basic skills in using information technology and communication, keep personal information secure.
- Show enthusiasm and interest in learning. Be creative about the subject as given or from their own interest. Participate in showing opinions and accepting others' opinions.

- Show responsibility by completing assigned tasks determinedly, considerably, economically, honestly until the tasks are accomplished and work with others happily.
- Realize the benefits of using knowledge and scientific processes to everyday life and learn more, carry out a project or piece of work as assigned or from their own interest.

Yearly Teaching Plan

Science Prathomsuksa 2 (Grade 2)

5 chapters

80 hours

Learning areas	Time (hours)
1. Plants <ul style="list-style-type: none">• Needs of plants• Care for plants• Life cycles of flowering plants	20
2. Living Things and Non-living Things <ul style="list-style-type: none">• Living things• Non-living things• Characteristics of living things and non-living things	10
3. Materials <ul style="list-style-type: none">• Physical properties of materials• Water absorbency• Mixing materials• Reusing used materials	24
4. Light <ul style="list-style-type: none">• What is light?• How does light travel?• Care for our eyes	10
5. Soil <ul style="list-style-type: none">• Components of soil• Types of soil• Uses of soil	16

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 Plants

Time: 20 hours

Strand 1: Biology Science

Standard Sc.1.2

Indicator

Sc.1.2 Gr.1/1 Identify plants that need light and water for growth based on empirical evidence.

Sc.1.2 Gr.1/2 Realize the need for plants to receive water and light for growth by taking care of plants to receive such things appropriately.

Sc.1.2 Gr.1/3 Create a model that describes the life cycle of flowering plants.

Introduction:

In this chapter, students will do experiments in order to identify plants' need based on empirical evidence. You will guide students to learn about what plants need to survive. You will also help students realize the importance of plants to people and make them care for the plants around them. In addition, students will create a model that describes the life cycles of flowering plants based in their observations and data collections.

Learning objectives:

Students will be able to:

- Conduct experiments that help them conclude that water and sunlight are essential for plants to live and grow.
- Example how to take care of plants to receive water and light for growth.
- Observe life cycle of plants and create a model that describes the life cycles of flowering plants.

Competency:

Thinking capacity, capacity for technological application

Concept:

- Plants need water and light for their growth and living processes. When plants do not receive what they need to live, they will not grow well and may die.
- When growing plants, we must know how to grow plants and how to take care of them.
- When flowering plants grow and have flowers, the flowers will reproduce and turn into fruits. Inside the fruits contain seeds. When seeds germinate, the seedlings inside the seed will grow and become new plants. A continuous process of plant life will repeat as a life cycle of flowering plants.

Start up:

1. To assess prior knowledge about plants, ask students what they knew and what they want to know about plants.
2. Let students write all their prior knowledge about plants in Part K column on page 1 and also write some questions which they want to know more in Part W column on page 1.

Teaching/Learning activities:

1st – 9th hours (Needs of plants)

1. Have students work on Let's Try activity on page 2 in the Textbook. Prepare two pots of plants and place them in the Sun. Show students two plants (one is wilting and another one is healthy). Ask students some questions (answers may vary):
 - (a) What difference that you can observe between these two plants?
(Leaves, healthy)

- (b) What causes this plant to wilt?
 - (c) What causes another plant to be healthy?
 - (d) What does the word “plant growth” mean?
 - (e) How can we conduct an experiment in order to prove your hypotheses?
 - (f) What are controlled variables?
 - (g) What do we have to observe?
 - (h) What parts of the plant absorb water?
 - (i) What will happen to a plant if without water?
 - (j) Do you think all plants need the same amount of water?
2. Explain that plants need the right amount of water for healthy growth. Refer to pages 3 and 4.
 3. Help students to carry out Let’s Try activity on page 5 in order to show that plants need sunlight and let them do the experiments. All students discuss and conclude that plants need sunlight to make food.
 4. Explain to students that plants need air. Plants also need nutrients to grow well. Refer to pages 6 and 7.
 5. Let students to do questions on pages 4 and 5 of the Workbook as their homework.

10th – 14th hours (Care for plants)

1. Let students go to school garden. Ask them to observe plants and then ask them some questions (answers may vary):
 - (a) How do gardeners take care of the plants?
 - (b) If you have to take care of these plants, what should you do?
2. Teacher may do some of these following activities:
 - (a) Assign each group of students to take care of some plants in school garden for two weeks.

- (b) Assign each group of students to choose their plants, then search for more information about how to take care of the plants.
 - (c) Assign each student to interview the gardeners about how to take care of their plants.
3. Guide students on how to take care of some fruit trees and vegetables in garden and potted plants. Refer to pages 8 and 9 in the Textbook.
 4. Have students to do the questions on page 6 of the Workbook as their homework.

15th – 19th hours (Life cycles of flowering plants)

1. Let students do Let's try activity to study the life cycle of a mung bean on page 10. Discuss with students:
 - (a) How to observe the changes in the mung bean every week for a month and then once every month for the next 3 months.
 - (b) How to take care of their plants.
 - (c) How to measure the height of the plant.
2. Let students do their experiment and discuss every week to check their observations and help them to solve the problems.
3. During the experiment, teacher can give some examples of other plants to let students understand what a plant life cycle is.
4. Discuss in class about their observations and ask them to create models of plant life cycle.
5. Teacher may ask them to present their models and explain more information about the life cycles of plants.
6. Discuss the life cycles of a green pea plant and a balsam plant. Refer to pages 13 and 14.
7. Have students to do the questions on pages 7 and 8 of the Workbook as their homework.

20th hour (Conclusion)

1. Let students to revise the lesson by answering the questions in Part L column on page 15.
2. Encourage them to watch a video by scanning the QR code on page 15.
3. Enhance students to think about questions that they want to know more about the plants in Part W column on page 16. Teacher may
 - (a) give them some examples of questions if students do not have any ideas.
 - (b) ask the whole class or each group to give some questions if their writing skills are not good enough.
4. Review the lesson by referring to the Mind Map on page 16.

Learning materials:

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

Assessment:

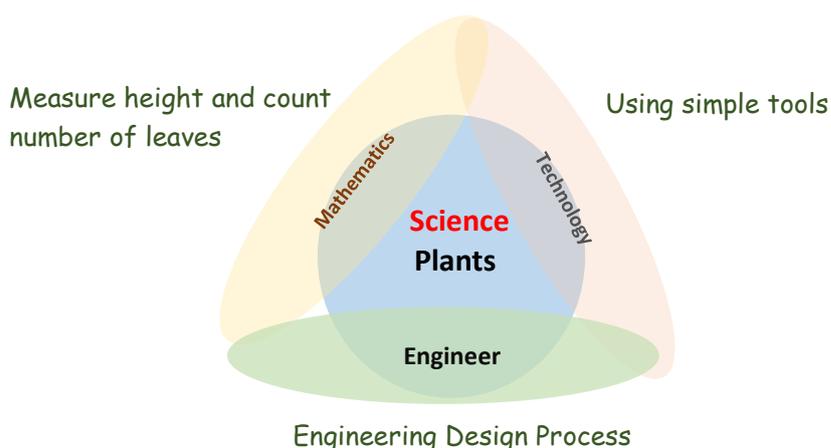
1. Assessing cognitive behavior; test on page 15 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

STEM Activity

Overview

According to the previous activities, students understand that plants need water, sunlight, air and nutrients to grow healthily. They also understand and give some ideas on how to take care of plants healthily. This lesson will extend their understanding. They will apply height measurement and counting number in mathematical concept, plant science concept, and use simple tools such as computer for searching more information, and engineering design process for designing a grass head that has the tallest grass in two weeks.

Subject integration



Time: 4 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Review their knowledge content of plants by using these following questions:
 - (a) What is your favorite plant?
 - (b) What are essential factors for growing your plant healthily?
 - (c) How do you take care of your plants?

- (d) If you have a chance to grow a plant, what plant will you choose?

Lesson development:

1. Let students read a situation on page 17. Then, the whole class discusses and identifies a problem by answering the following questions.
 - (a) What is a problem of this situation?
 - (b) What are our missions?
 - (c) What do you need to know to get started?
2. Enhance students to explore and make connections between science, technology, engineering and mathematics by posing the following questions.
 - (a) What are essential factors for your plant growth?
 - (b) How do we measure plant growth?
3. Ask students to think about how to assess their project. Discuss in class and set their criteria by using the following questions:
 - (a) What are success criteria? (Plant growth, etc.)
 - (b) How do we know that our mission is success?
4. Let students brainstorm and draw their designs. Then, let them follow their plans and create. (Teacher may ask each group to present some brief ideas before they start so that teacher can give some suggestions for their possible solutions or prevent trial and error.)
5. After they finish their mission, ask them to test their product by using the criteria in #3. Teacher may use the following questions:
 - (a) What works or what does not work?
 - (b) How will you modify your solution to make it better?
6. Let them improve their design. (Teacher can skip this step if you do not have enough time.)
7. Each group presents their product and presents their creative work, and explains their journey of creating.

Conclusion:

1. Let students present their work and engage their peers to ask some questions.
2. End the lesson by asking students if everyone came up with the same design, and why not? They should answer that they all have different ideas but same target, and this speaks to the importance and role of diversity in engineering and problem-solving.

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 2 Living Things and Non-living Things

Time: 10 hours

Strand 1: Biology Science

Standard Sc.1.3

Indicator

Sc.1.3 Gr.1/1 Compare the characteristics of living things and non-living things based on collected data.

Introduction:

Children might have difficulty characterizing objects as living things or non-living things. For example, they could describe anything that moves as alive. In science, a living thing is anything that is or has ever been alive (such as cat, bird and tree). A non-living thing is anything that is not now nor has ever been alive (such as car, rock or bread).

In this chapter, you will help students to compare the characteristics of living things and non-living things based on collected data. Students will identify and describe the characteristics of living things and non-living things. Students will begin to understand that living things have similar basic needs to survive. Living things need food, water and air to breathe. Students will also understand that living things move, eat, breathe, grow, reproduce, excrete, and respond to stimuli.

Learning objectives:

Students will be able to:

- Classify objects as living things or non-living things.
- Observe and identify characteristics of living things and non-living things.
- Compare characteristics of living things and non-living things.

- Give examples of living things and non-living things.
- Pose questions about living things or non-living things.

Competency:

- Communication capacity, thinking competency

Concept:

- Everything that surrounds us is either living or non-living.
- Living things need basic needs. They need food, water and air to breathe.
- Living things can move by themselves, eat food, excrete, breathe, grow, reproduce, and respond to stimuli while non-living things do not show such characteristics.
- Living things require food, breathing, growth, excretion, movement, response to stimuli and reproduction. The offspring will be similar to the parent but non-living things have no such things.

Start up:

1. To assess prior knowledge about living things and non-living things, ask students what they knew and what they want to know about living things and non-living things.
2. Let students write all their prior knowledge in Part K column on page 19 and also write some questions which they want to know in Part W column on page 19.

Teaching/Learning activities:

1st – 2nd hours (Living things)

1. Tell students that they will be studying living things and non-living things.
2. Then, teacher may do some engagement activities by:

- (a) presenting some pictures or real examples of objects such as bags.
 - (b) letting students walk outside the classroom such as school garden, schoolyard and let them identify objects as living or non-living things.
 - (c) letting students watch a video or a slideshow presentation of the different living things and non-living things.
- 3.** Prepare some videos or pictures of living things, then ask:
- (a) Are there any living things in these pictures? What are they?
 - (b) Can you give some more examples of living things?
 - (c) Why do you think those are living things?
- 4.** Let students play a game of 20 questions to name more living things.
(Teacher may use only 10 questions in order to spend less time.)
- 5.** Teacher asks students to group living things according to their observable characteristics (humans, plants and animals).
- 6.** Let students know more about living things. Refer to page 20 of the Textbook.

3rd – 4th hours (Non-living things)

- 1.** Prepare some videos or pictures of non-living things, then ask:
- (a) Are there any non-living things in these pictures? What are they?
 - (b) Can you give some more examples of non-living things?
 - (c) Why do you think those are non-living things?
- 2.** Let students play a game of 20 questions to name more non-living things.
(Teacher may use only 10 questions in order to spend less time.)
- 3.** Let students know more about non-living things. Refer to page 21 of the Textbook.
- 4.** Have students to do the questions on pages 13 and 14 of the Workbook as their homework.

5th – 9th hours (Characteristics of living things and non-living things)

1. Have students work on Let's Try activity on page 22 in the Textbook.
 - (a) Let students observe the things in the school garden.
 - (b) Ask each student to name one living thing or one non-living thing. Write all their contributions on paper, under the column headings "Living things" and "Non-living things".
 - (c) Have students reflect on the list of things they generated and think about all the characteristics that make things "alive". Have them brainstorm and answer to these questions:
 - What are some characteristics of living things?
 - What are some characteristics of non-living things?
 - What makes living things different from non-living things?
 - (d) Ask some guiding questions below.
 - What are some characteristics of living things?
 - What are some characteristics of non-living things?
 - What makes living things different from non-living things?
2. Explain to students that a living thing is anything that is or has ever been alive. Living things need food and water, breathe, grow, excrete, can move by themselves, reproduce, and respond to stimuli. A non-living thing is anything that is not now nor has ever been alive. Non-living things do not need food and water. They also cannot breathe, grow, excrete, move by themselves, reproduce, and respond to stimuli.
3. Let students know more about non-living things. Refer to page 21 of the Textbook.
4. Let students do Let's Try activity on page 32 to conclude that a snail is a living thing because it can respond to stimuli.
5. Extend their understanding by giving an example of something that is dead but still classified as living, such as a log, flower, and vegetable.
6. Extend their understanding by discussing the following questions about some characteristics of living things:

(a) Eat

- Do all living things eat?
- Do plants eat food? Plants do not eat but they need energy. Where do they get it?
- What do animals eat?

(b) Move

- Are all things that move “alive”?
- What types of non-living things move? (Cars and machines)
- What types of living things do not move? (Coral)
- Do all living things move?
- How is the movement of living things different from the movement of non-living things? (For example, cars need to be fed with petrol in order to move.)
- Do plants move?
- Why do living things move?

(c) Growth

- Living things such as humans and animals eat food in order to grow. Is growth necessary for living things?

7. Assign students to do Let’s Try activity on page 35. Find out why it is important for living things to reproduce and what would happen if living things do not reproduce. Then, present findings with examples in class.
8. Explain more about the characteristics of living things. Refer to pages 24 to 34 and pages 36 to 37.
9. Have students to do the questions on pages 15 to 18 of this subtopic in the Workbook as their homework.

10th hour (Conclusion)

1. Revise the lesson by asking students to do questions in Part L column on page 39.
2. Encourage them to watch a video by scanning the QR code on page 39.
3. Whole class discusses about what they want to know more about living things and non-living things in Part W column on page 40. Teacher may guide them if they do not have any ideas such as:
 - (a) give them some examples of questions if students do not have any ideas.
 - (b) ask the whole class or each group to give some questions if their writing skills are not good enough.
4. Review the lesson by referring to the Mind Map on page 40.

Learning materials:

- Videos or pictures of animals and plants
- Primary Education Smart Plus Textbook Science Prathomsuksa 2
- Primary Education Smart Plus Workbook Science Prathomsuksa 2

Assessment:

1. Assessing cognitive behavior; test on page 39 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

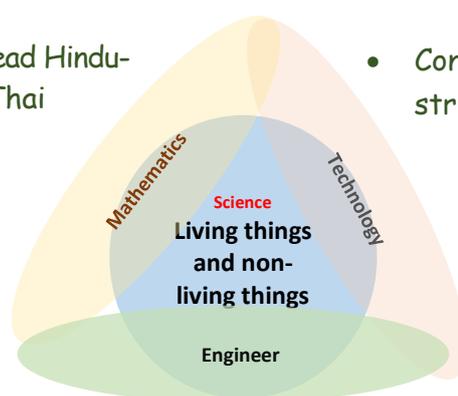
STEM Activity

Overview

This lesson will engage students to apply their knowledge of living things and non-living things. They will design and create display structures that represent both living things and non-living things for their presentation. Moreover, they will apply their art knowledge for this activity.

Subject integration

- Write and read Hindu-Arabic and Thai numerals



- Construct simple structures

Engineering Design Process

Time: 4 hours

Start up:

1. Divide students into groups of 3 or 4.

Lesson development:

1. Let students read a situational question on page 41. Then, the whole class discusses and identifies a problem by answering the following questions:
 - (a) What is a problem of this situation?
 - (b) What are our missions?

- (c) What do you need to know to get started?
2. Enhance students to explore and make connections between science, technology, engineering and mathematics by posing the following questions:
 - (a) What characteristics of structures should represent? (Characteristics of living things and non-living things)
 - (b) What is the meaning of “stand on its own”?
 - (c) What are our possible solutions for the structure that can stand on its own? (Play dough structures, hard paper structures, pipe cleaner structures, etc.) How does it look like?
 - (d) What is the size of the structure / how big is it?
 - (e) What materials do we need?
 3. Ask students to think about how to assess their project. Discuss in class and set their criteria by using the following questions:
 - (a) What are success criteria? (stand on its own at least 5 minutes, interesting figures, represent both of characteristics of living things and non-living things, etc.)
 4. Students brainstorm and draw their designs. Then, let them follow their plans and create. (Teacher may ask each group to present some brief ideas before they start so that teacher can give some suggestions for their possible solution or prevent trial and error.)
 5. After they finish their mission, ask them to test their product by using the criteria in #3. Teacher may use the following questions:
 - (a) What works or what does not work?
 - (b) How will you modify your solution to make it better?
 6. Let them improve their design. (Teacher can skip this step if you do not have enough time.)
 7. Each group prepares and presents their creative work and explains their journey of creating.

Conclusion:

1. End the lesson by asking students if everyone came up with the same design, and why not? They should answer that they all have different ideas but same target, and this speaks to the importance and role of diversity in engineering and problem-solving.

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 3 Materials

Time: 24 hours

Strand 2: Physical Science

Standard Sc.2.1

Indicator

Sc.2.1 Gr.1/1 Compare the water absorption properties of the materials using empirical evidence. Identify and apply the features of water absorption of materials into everyday objects.

Sc.2.1 Gr.1/2 Explain the observed properties of materials derived from mixed materials using empirical evidence.

Sc.2.1 Gr.1/3 Compare the observable properties of the materials in order to make an object for a specific purpose. Explain the reuse of recycled materials by using empirical evidence.

Sc.2.1 Gr.1/4 Realize the benefits of reusing recycled materials by reuse the recyclable materials.

Introduction:

Different objects are made of different materials such as wood, plastic, glass, cloth, metal, rubber and ceramic. Each material has its own characteristics such as water absorption properties.

In this chapter, you will guide students to learn about different types of materials. Students will also learn how to use materials to make an object for a particular purpose depends on their properties. Students will learn how to handle objects safely and reuse used materials.

Learning objectives:

Students will be able to:

- Explain the observed properties of materials derived from mixed materials using empirical evidence.
- Compare the water absorption properties of the materials using empirical evidence.
- Explore, collect data, and identify kinds of materials that are used to make things in everyday life.
- Compare the observable properties of the materials in order to make an object for a specific purpose.
- Explain the reuse of recycled materials by using empirical evidence.
- Explore and apply knowledge about properties of materials to everyday life.

Competency:

Thinking skills

Concept:

- Materials have different properties so they can be used for different purposes.
- Each material has different water absorption properties, therefore it is used to make different objects.
- Some materials can be mixed together to obtain the right properties for useful purpose as we need.
- Using materials to make an object for a particular purpose depends on their properties. Maybe used materials can be reused.

Start up:

- To assess prior knowledge about materials by asking what students knew and what they want to know.

- Write all their prior knowledge in Part K column on page 43 and have students share what they know about materials. Then, ask students write some questions which they want to know in Part W column on page 43.

Teaching/Learning activities:

1st – 8th hours (Physical properties of materials)

1. Carry out Let's Try activity on page 44. Students investigate the unique characteristic of materials: wood, rubber and metal.
2. Then, discuss and conclude that different materials have different properties.
 - (a) Strength
 - (b) Hardness
 - (c) Buoyancy
 - (d) Flexibility
3. Teacher gives more information about unique characteristic of each material – wood, rubber, metal, plastic and glass in terms of strength, hardness, buoyancy and flexibility. Refer to pages 45 and 46.
4. Teacher gives examples of objects, then ask them to explore about properties of those materials.
 - (a) What material is it made from?
 - (b) Why do we choose those materials?
5. Then, discuss and conclude that there are many kinds of materials that are used to make things in daily life.
6. Let students give some examples of objects that are made of metals. Then, ask them to explore about the physical properties of metals.
7. Let students give examples of objects which are made of wood, rubber, plastic and glass. Then, ask students:
 - (a) What materials can be used to make mugs or chairs? (plastic, glass and wood)

- (b) Why do we choose those materials?
8. Teacher gives more information about how to choose appropriate and safe materials for everyday items.
 9. Whole class discusses and concludes that materials have different properties so they can be used for different purposes and when choosing materials that will be safe and appropriate for toys and other objects.
 10. Have students to do the questions of this subtopic on pages 32 to 36 of the Workbook as their homework.

9th – 14th hours (Water absorbency)

1. Teacher explains the meaning of “water absorbency” and investigate the water absorbency properties of materials.
2. Let students do Let’s Try activity on pages 54 to 56.
3. Teacher discusses with students and concludes that different materials have different levels of absorbency. Therefore, we use materials with different levels of absorbency to make different objects for different uses.
4. Teacher gives more examples and more information of water absorbency properties and their usefulness.
5. Rubber, plastic, glass and metal do not absorb water. Examples:
 - (a) Rubber is used to make gloves and boots. They keep our hands and feet dry.
 - (b) Plastic is used to make umbrellas, raincoats and tents. They keep us dry.
 - (c) Metal and glass keep the water out. We can use it to make car body and car window.

Refer to pages 57 to 59 in the Textbook.

6. Teacher assigns students to find information from the internet or the books in the library. Then, present findings to classmates.

7. Have students to do the questions on pages 36 and 37 of the Workbook as their homework.

15th – 18th hours (Mixing materials)

1. Teacher asks students to think and make some examples of mixing different materials to make a new material with different properties. (Answers may vary.)
2. Let students do Let's Try activity on pages 60 and 61.
3. Teacher discusses with students and concludes that some materials can be mixed together to make a new material with different properties. The objects made from this new material can serve different useful purposes.
4. Teacher give more information of mixed materials. Refer to pages 62 to 65.
 - (a) Plaster and paper pulp can be mixed to make paper mache objects.
 - (b) Cement, sand, stones and water are mixed to make concrete.
 - (c) Thai desserts
5. Teacher discusses with students and concludes that we use materials derived from mixed materials to make objects because they have properties that are much better than the properties of the individual materials.
6. Teacher assigns students to do Let's Find Out activity on page 65.
 - (a) Ask students to search for a way to fold a newspaper into a box. Make one.
 - (b) Search for a way to make a paper mache box from glue and newspaper. Make one.
 - (c) Compare the properties of the two boxes.
7. Have students to do the questions on page 38 of the Workbook as their homework.

19th – 23th hours (Reusing used materials)

1. Ask students do Let's Try activity on page 66.
2. Teacher discusses with students and concludes that we can reduce waste by reusing the used materials.
3. Teacher gives more information on how to reuse the used materials.
 - (a) Plastic bottles
 - (b) Old tires
 - (c) Paper
4. Teacher discusses with students about the benefits of reusing the used materials. Reusing used materials can help to:
 - (a) save money.
 - (b) reduce the amount of waste sent to the landfills.
 - (c) reduce the amount of raw materials needed to make new things.
5. For more understanding, teacher can let students watch video clips of reuse and recycle materials from this link:
https://www.youtube.com/watch?v=6jQ7y_qQYUA
6. Teacher assigns students to do Let's Find Out activity on page 69. Ask students to search for information regarding the importance of reusing used materials in waste management. Teacher may suggest students to go online or visit the library. Prepare posters to create awareness among schoolmates. Then, paste on the school bulletin board.
7. Have students to do the questions on page 39 of the Workbook as their homework.

24th hour (Conclusion)

1. Revise the lesson by asking students to do questions in Part L column on page 70.
2. Encourage them to watch a video by scanning the QR code on page 70.

3. Whole class discusses what they want to know more about materials in Part W column on page 71. Teacher may guide students if they do not have any ideas.
4. Review the lesson by referring to the Mind Map on page 71.
5. Have students to do the questions on page 40 of the Workbook as their homework.

Learning materials:

- Some real objects that made from used materials.
- Video clips:
https://www.youtube.com/watch?v=6jQ7y_qQYUA
<https://www.youtube.com/watch?v=uRnFzZj4dVk>
<https://www.youtube.com/watch?v=xFPoIU5iiYQ>
<https://www.youtube.com/watch?v=FiipFvHtMDE>
- Primary Education Smart Plus Textbook Science Prathomsuksa 2
- Primary Education Smart Plus Workbook Science Prathomsuksa 2

Assessment:

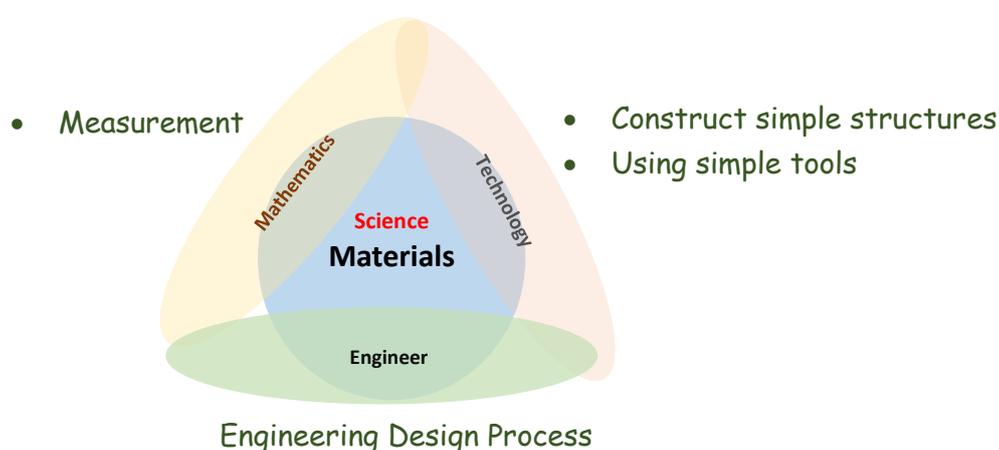
1. Assessing cognitive behavior; test on page 70 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

STEM Activity

Overview

In this chapter, students will use their knowledge of material properties to create their new toys (playhouse). This will help to prevent wastage and reduce the amount of raw materials needed to make new things.

Subject integration



Time: 5 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Review their knowledge content of materials by using the following questions:
 - (a) When we use materials for creating something, what do we have to consider?
 - (b) What are used materials?
 - (c) Why should we reuse used materials instead of new materials?
 - (d) When we want to make some objects, what do we have to consider?
(Type and characteristic of materials)

Lesson development:

1. Students read a situation on page 72. Then, whole class discusses and identifies a problem by answering the following questions:
 - (a) What is a problem of this situation?
 - (b) What do you need to know to get started?
 - (c) What are our missions?
2. Enhance students to explore and make connections between science, technology, engineering and mathematics by posing the following questions:
 - (a) What are the purposes of the playhouse?
 - (b) What appropriate age for playing with the playhouse?
 - (c) What materials are suitable for making the playhouse? Why?
 - (d) What characteristic of materials that can stand by its own? Can you give some examples of those materials?
 - (e) Does the size of a playhouse affect its time of standing?
3. Ask students to think about how to assess their project. Discuss in class and set their criteria by using the following questions:
 - (a) What are success criteria? (playhouse must be at least 30 cm tall)
4. Students brainstorm, design and create their playhouses. (Teacher may ask each group to present some brief ideas before they start so that teacher can give some suggestions for their possible solutions or prevent trial and error.)
5. After they finish their mission, ask them to test their product by using the criteria in #3. Teacher may use the following questions:
 - (a) What works or what does not work?
 - (b) How will you modify your solution to make it better?
6. Let them improve their design. (Teacher can skip this step if you do not have enough time.)
7. Each group prepares and presents their creative work and explains their journey of creating. Teacher should encourage others to ask or give some comments.

Conclusion:

1. End the lesson by asking students:

- (a) If everyone came up with the same design, and why not? They should answer that they all have different ideas but same target, and this speaks to the importance and role of diversity in engineering and problem-solving.
- (b) If we have limited budget for creating, which model of your classmate team will be considered as a good project?
- (c) If you are the owner of a factory, which design is good? Why?

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 4 Light

Time: 10 hours

Strand 2: Physical Science

Standard Sc.2.3

Indicator

Sc.2.3 Gr.1/1 Describe the movement direction of the light from the light source and explain the visibility of objects based on empirical evidence.

Sc.2.3 Gr.1/2 Realize the value of knowledge of vision by introducing hazards prevention from improper lighting.

Introduction:

Light is a form of energy that enables us to see things around us. Light travels in straight lines in all directions.

Staring at a very bright object, like the Sun, can cause eye damage. We must avoid looking at it. We can also use sunglasses to protect our eyes from the glaring sunlight.

Learning objectives:

Students will be able to:

- Conduct experiments and describe how light travels and what happens when light hits an object.
- List the way of prevention from improper lighting.

Competency:

Thinking capacity, capacity for applying life skills, capacity for technological application

Concept:

- Light travels in all directions from the light source in a straight line.
- When the light from the object reflects into our eyes, we will see the object. Seeing the light source, its light will come into our eyes directly.
- For some objects which are not light sources, they require the light from the light source then reflect light into our eyes.
- We must avoid looking at a very bright object. If a very bright light enters into our eyes, it can cause eye damage.

Start up:

1. To assess prior knowledge about light by asking what students knew and what they want to know about light.
2. Write all their prior knowledge in Part K column on page 74 and have students share what they know about light. Then, ask students to write some questions which they want to know in Part W column on page 74.
3. Talk about the Sun that is the most important source of light for living things.

Teaching/Learning activities:

1st – 2nd hours (What is light?)

1. Ask students to name things that give out light. They are known as luminous objects. What are things that do not give out light known as? Refer to pages 75 to 77.
2. Teacher gives more information about light resources such as artificial light sources which are made by humans. A lighted candle, a campfire and fireworks are artificial light sources.
3. Teacher posts some questions to make students realize that light is a form of energy.

- (a) What will happen if there is no light?
 - (b) Do plants and animals need light?
4. Teacher assigns students to do Let's Find Out activity on page 77. Explain why the moon is considered as a non-luminous object. Then discuss their findings in class.

3rd – 7th hours (How does light travel?)

1. Let students do Let's Try activity on page 78 to investigate how light travels. Light travels in straight lines in all directions. When the light enters our eyes, we can see the object.
2. Explain more information about how light travels. Refer to pages 79 and 80.
3. Teacher shows students picture of fireworks and explain that we can see the fireworks in the night sky anywhere we are, as long as we are not too far away from it and our view is not blocked.
4. Let students do Let's Try activity on page 81 to investigate how we see things.
5. Teacher discusses and concludes with students that we can see a luminous object because its light enters our eyes. In this sensory organ, the image of the object is sent to the brain. The brain interprets what we see.
6. Teacher asks some questions in order to let students think how we can see non-luminous objects such as a book.
7. Teacher lets students to the darkroom and ask whether they see anything (No, because there is no light). Then, turn on light and ask the same questions.
8. Teacher and students discuss and conclude that "To see non-luminous objects, we need light from a light source. When the light from a light source hits a non-luminous object, the light is reflected. We can see the object when the reflected light enters our eyes."

9. Teacher explains more information:
 - (a) We can see things in daytime because the light hits the objects around us and is reflected into our eyes.
 - (b) At night, electric bulbs and street lamps are the light sources. The light hits objects like buildings and roads. The light is reflected and enters our eyes. Therefore, we can see them.
10. Have students do the questions on pages 44 to 46 of the Workbook as their homework.

8th – 9th hours (Care for our eyes)

1. Teacher starts a conversation about how to take care of our eyes from improper lighting. Teacher may use some pictures to start discussion such as:
 - (a) Picture of using a cell phone in the dark
 - (b) Picture of playing computer game during the night
 - (c) Picture of reading a book while sitting in a car
 - (d) Picture of reading a book in the improper lighting
2. Let students watch the following video clip:
<https://www.youtube.com/watch?v=lW5Sra-xlqo>
3. Then discuss and ask students to list how to take care or prevent from improper lighting.
4. Let students do the questions on page 47 in the Workbook.

10th hour (Conclusion)

1. Wrap up class by using the following sample questions:
 - (a) How does light travel?
 - (b) What happens when light hits an object?
 - (c) How can we see object?

- (d) What should we do when we have to see something in improper lighting?
2. To test their understanding of this chapter, have students answer the questions in Part L on page 86.
 3. Encourage students to watch a video by scanning the QR code on page 86.
 4. Ask students what they want to know more about light in Part W column on page 86.
 5. Use Mind Map on page 87 to help students to understand the relationships between all the subtopics learned in this chapter.
 6. Ensure students understand the terms used in this chapter by referring to the Glossary.

Learning materials:

- Pictures of light resources
- Primary Education Smart Plus Textbook Science Prathomsuksa 2
- Primary Education Smart Plus Workbook Science Prathomsuksa 2

Assessment:

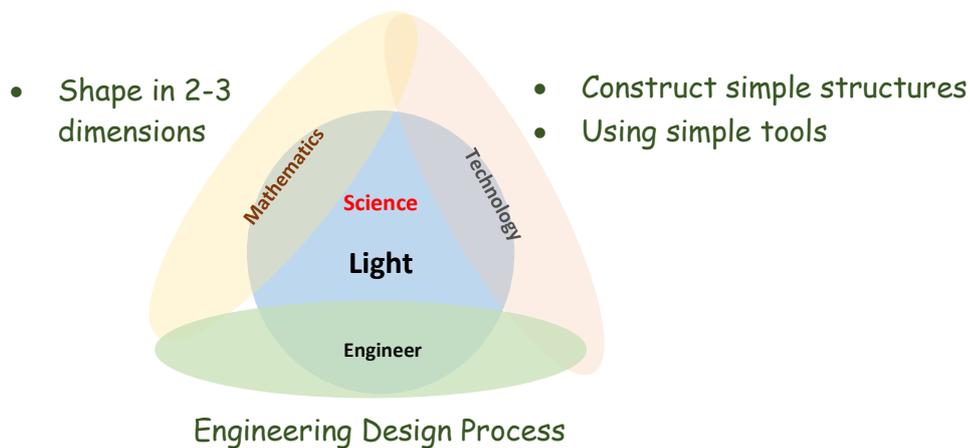
1. Assessing cognitive behavior; test on page 86 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

STEM Activity

Overview

This activity will engage students to use the engineering design process for designing and creating their Krathong. The activity also enhances them to make a real-life application of light. Also, arts and natural resources or green design will be added in the activity.

Subject integration



Time: 3 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Review their understanding about the engineering design process by using their previous STEM activity.
 - (a) What is your previous STEM activity?
 - (b) What did you create? How?
 - (c) Did each group come up with the same design? Why or why not?

Lesson development:

1. Students read a situation on page 88. Then, the whole class discusses and identifies a problem by answering the following questions:
 - (a) What does the situation talk about?
 - (b) What are our missions?
 - (c) What do you need to know to get started?
2. Enhance students to explore and make connections between science, technology, engineering and mathematics by posing the following questions:
 - (a) In general, what do you celebrate on this festival?
 - (b) What characteristic of materials which you should use in order to float?
 - (c) What are natural materials which can float?
 - (d) Should you use fresh leaves or dry leaves or other product of plants?
 - (e) Do you need to decorate your Krathong? If yes, what are they?
 - (f) How can you make everyone see your Krathong during night time?
3. Ask students to think about how to assess their product. Discuss in class and set their criteria by using the following questions:
 - (a) What are success criteria? (Krathong floats at least 10 minutes, etc.)
4. Let students search for more information about natural resources that can float. Let them brainstorm and draw their designs. Then, let them follow their plans and create. (Teacher may ask each group to present some brief ideas before they start so that teacher can give some suggestions for their possible solutions or prevent trial and error.)
5. After they finish their mission, ask them to test their product by using the criteria in #3. Teacher may use the following questions:
 - (a) What works or what does not work?
 - (b) How will you modify your solution to make it better?
6. Let them improve their design. (Teacher can skip this step if you do not have enough time.)

7. Each group prepares and presents their creative work and explains their journey of creating.

Conclusion:

1. Let them present their Krathong and share their ideas. Teacher may use the sample questions:
 - (a) When you compare your work with your friend's work, what are pros and cons of your ideas?
 - (b) What are the steps of your design?
 - (c) What are the benefits of this activity?
 - (d) Do all of you have the same ideas? Why or why not?

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 5 Soil

Time: 16 hours

Strand 3: Earth and Space Science

Standard Sc.3.2

Indicator

Sc.3.2 Gr.2/1 Identify soil components and classify soil types using soil texture and soil formation as criteria.

Sc.3.2 Gr.2/2 Explain the use of soil from collected data.

Introduction:

Soil is the material found on the surface of the Earth. Soil contains minerals, organic matter, air and water. Each component is important for supporting plant growth. Soil texture refers to the ‘feel’ of the soil. This is determined by the size and type of rock particles in the soil.

In this chapter, you will guide students to identify the components of soil and the physical properties of soil.

Learning objectives:

Students will be able to:

- Explore and conduct experiments to describe what soil is composed of.
- Conduct the experiments and explain some properties of soil.
- Explore and present the benefits of soil.

Competency:

Capacity for applying life skills, capacity for technological application

Concept:

- Each kind of soil has different characteristics and properties. Soil can be classified into three main categories: clay soil, loamy soil and sandy soil, each of which is appropriate for different kinds of plants.
- Soil can be of use in various ways.

Start up:

1. Engage students into the lesson by asking them:
 - (a) Who grow plants at home? What plants do you grow at home?
 - (b) What do you need to prepare when growing plants?
 - (c) Have you ever observe soil at your home and somewhere else? Are they different or the same?
 - (d) Do you think the soil from school and at your home is the same?
2. To assess prior knowledge about soil, ask students what they knew and what they want to know about soil.
3. Let students write all their prior knowledge in Part K column on page 90 and also write some questions which they want to know in Part W column on page 90.

Teaching/Learning activities:

1st – 4th hours (Components of soil)

1. Prepare different types of soil or ask students to prepare it from home. Ask students to explore components of soil.
 - (a) Can we observe soil by our five senses?
 - (b) What can we observe first when we look at soil? (Color, texture)
 - (c) What scientific equipment should we use to get more detail? (Magnifier)
2. Teacher discusses with students and concludes that soil consists of four main components, namely rock particles, organic matter, air and water.

3. Give more detail that it takes millions of years for soil to develop and covers the surface of the Earth layer by layer as we can see.
4. Teacher suggests students how to observe soil and then let students do Let's Try Activity on page 92. Soil is made up of layers of different soil particles.
5. Have students do the questions on page 51 of the Workbook as their homework.

5th – 11th hours (Types of soil)

1. Carry out Let's Try activity on page 94. Using questions to lead them to discuss to conclude that different types of soil have different physical properties. The samples of questions are:
 1. Does each type of soil have the same or different color/soil grain?
 2. Which soil has the finest soil grain?
2. Teacher explains additional information about three types of soil and their physical properties. Refer to pages 95 and 96.
3. Carry out Let's Try activity on page 97. Let students discuss and understand that water retention capacity for each type of soil is different.
4. Teacher provides more additional information about water retention of each type of soil referred on page 98.

12th – 15th hours (Uses of soil)

1. Carry out Let's Try activity on page 99. Engage them discuss until they can conclude that each type of soil is appropriate for different kinds of plants. (Teacher may do this activity from the beginning of lesson.)
2. Teacher explains more information about the uses of soil. Give examples of how we use soil. Refer to pages 101 to 103.

3. Carry out Let's Try activity on page 104. Ask them to search for additional information via the internet. Lead them to discuss and conclude that soil can be of use in various ways.

16th hour (Conclusion)

1. Revise the lesson by asking students to do questions in Part L column on page 105.
2. Encourage them to watch a video by scanning the QR code on page 105.
3. Enhance students to think about questions that they want to know more about soil in Part W column on page 106. Teacher may
 - (a) give them some examples of questions if students do not have any ideas.
 - (b) ask the whole class or each group to give some questions if their writing skills are not good enough.
4. Review the lesson by referring to the Mind Map on page 106.
5. Have students to do the questions on pages 52 to 54 of the Workbook as their homework.

Learning materials:

- Different types of soil
- Primary Education Smart Plus Textbook Science Prathomsuksa 2
- Primary Education Smart Plus Workbook Science Prathomsuksa 2

Assessment:

1. Assessing cognitive behavior; test on page 105 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

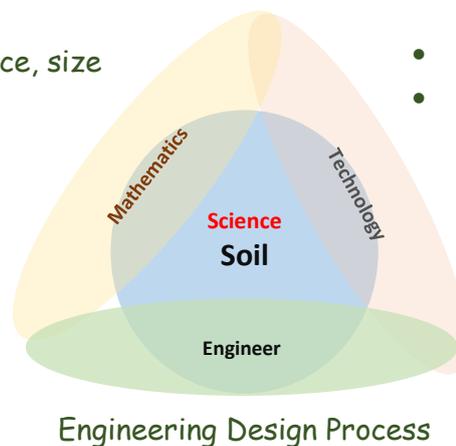
STEM Activity

Overview

This lesson will engage students to apply their knowledge of soil to design and create clay figurines. They will apply the concept of force. Force can change the shape of objects. Math concept should be integrated in the concept of how tall/big of your figurine. Teacher can make it more complicated by asking them to design and create a figurine that can be rolled like a ball and then stands on its own.

Subject integration

- Length, distance, size



- Construct simple structures
- Using simple tools

Time: 3 hours

Start up:

1. Pair up students, then review them the process of engineering design.
 - (a) What is an engineering design process?

- (b) Do we have same design when we use engineering design process? Why not?

Lesson development:

1. Students read a situation on page 107. Then, the whole class discusses and identifies a problem by answering the following questions:
 - (a) What is a problem of this situation?
 - (b) What are our missions?
 - (c) What do you need to know to get started?
 - (d) Do you have any idea for this problem?
2. Engage students to explore and make connections between science, technology, engineering and mathematics by posing the suggested questions:
 - (a) How tall is your figurine?
 - (b) What is an appropriate size of your figurine that it can stand when it dries? What type of soil should we choose to use?
 - (c) Can we make it more interesting by coloring?
 - (d) Can we search for additional information about local handmade of soil products?
 - (e) What can we put inside the figurine so that it can stand easily?
3. Ask students to think about how to assess their project. Discuss in class and set their criteria by using the following questions:
 - (a) What are success criteria? (Clay figure that can stand, etc.)
4. Let them brainstorm and draw their designs. Then, let them follow their plans and create. (Teacher may ask each group to present some brief ideas before they start so that teacher can give some suggestions for their possible solution or prevent trial and error.)
5. After they finish their mission, ask them test their product by using the criteria in #3. Teacher may use the following questions:
 - (a) What works or what does not work?

- (b) How will you modify your solution to make it better?
6. Let them improve their design. (Teacher can skip this step if you do not have enough time.)
 7. Each group prepares and presents their creative work and explains their journey of creating.

Conclusion

1. End the lesson by asking students if everyone came up with the same design, and why not? They should answer that they all have different ideas but same target, and this speaks to the importance and role of diversity in engineering and problem-solving.

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 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

Scoring Rubric for Scientific Thinking

Skill	Needs improvement (1)	Partially proficient (2)	Proficient (3)	Advanced (4)
State problem / question	Need assistant to state the problem or identify the information	Sometimes state the problem or identify the information correctly	Occasionally state the problem or identify the information correctly	Work alone and correctly state the problem and identify the information and the steps needed to arrive at a solution
Conclusion/Synthesis thinking ability	Conclusions drawn were lacking, incomplete, or confused and need help to write conclusion or answer questions	Sometimes ask for guidance to write or complete a conclusion	Occasionally answer questions and complete a conclusion in complete sentences	Always writes response to whether hypothesis was wrong or wrong and answer in complete sentences
Using scientific reasoning for explanation	No evidence of scientific reasoning was used	Some evidence of scientific reasoning was used	Effective scientific reasoning was used	Employed refined and complex reasoning and demonstrated understanding of cause and effect
Using scientific concepts and related content	Always relies on others in using scientific concepts	Minimal reference to relevant scientific concepts, principles, or big ideas	Provided evidence of understanding of relevant scientific concepts, principles, or big ideas	Provided evidence in depth and sophisticated understanding of relevant scientific concepts, principles, or big ideas

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 labeled drawing plan	All information and data are clear and organized. They are presented accurately. There is a clearly labeled 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