PELANGI

Teacher's Guide

SCIENCE

Primary Education Smart+

Prathomsuksa

4

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

Contents

Preface		2
General learning outcomes in each strand		4
Strands and Learning Standard		6
Learners' Quality of Grade 3 students		8
Yearly Teaching Plan		10
Chapter 1	Classification of Living Things	11
Chapter 2	Plants	17
Chapter 3	Animals	24
Chapter 4	Materials	31
Chapter 5	States of Matter	39
Chapter 6	Gravitational Force	47
Chapter 7	Light	55
Chapter 8	Solar System	62
Scoring Rubric for Affective Domain		71
Scoring Rubric for Scientific Thinking		72
Scoring Rubric for STEM Activities		73

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 6 students

- Understand the general characteristics of living things and life of living things around us.
- Understand structure, particular characteristics and adaptation of organisms including the relationship of organisms in the habitat. The functions of various parts of the plant and the function of the human digestive system.
- Understand the properties and classifications of materials, state and the changing state of matter, dissolution, chemical change, reversible and irreversible changes and a simple separation.
- Understand the characteristics of gravity, resultant force, friction force, electric force and the effects of various kinds of forces, the results of forces acting on an object, pressure, principle (of force acting) on the object, simple circuit and the basis knowledge of sound and light phenomena.
- Understand the phenomenon of rise and fall including the changing of the appearances of the moon's phases, the components of the Solar System, orbital period of the planets, the differences of planets and stars, the rise and fall of the star cluster, using star map, eclipse and the development and benefits of space technology.
- Understand the characteristics of the water source, the water cycle, the formation of cloud, mist, dew, frost, precipitation, rock formation, rock cycle, the use of rocks and minerals, fossils formation, the formation of wind, sea breezes, monsoons, features and impacts of natural disasters, geohazard and the causes and effects of greenhouse gases.
- Find information effectively and evaluate credibility, decide to select information based on logical reasoning to solve problems, use information

and communication technology to work together, understand your rights and duties, and respect other people's rights.

- Ask questions or impose problems about subject to learn as given or from their own interest, predict multiple answers, create a hypothesis corresponding to the question or problem that is investigated. Plan, survey and investigate by using appropriate tools and information technology in order to collect both quantitative and qualitative data.
- Analyze, conclude and summarize the relation of information derived from survey and investigation by using the proper model in order to communicate the results of the survey with references reasonably.
- Show the interest and determination to learn the subject, be creative in studying the subject of their own interests, show their own opinions, accept the reliable information with available references and listen to other people's opinions.
- Take responsibility with committed work determinedly, carefully, economically, honestly until the work is accomplished and work with others creatively.
- Realize the value of the knowledge of science and technology, apply knowledge and scientific process in living, admire, praise and respect the rights of the inventor and learn more, carry out a project or piece of work as assigned or from their own interest.
- Appreciate, gratitude, and concern, show the behavior of usage and care natural resources and environment worthily.

Yearly Teaching Plan

Science Prathomsuksa 4 (Grade 4)

8 chapters 80 hours

Learning areas	Time (hours)
1. Classification of Living Things • Plants • Animals • Other living things	6
2. Plants • Classification of plants • Parts of flowering plants and their functions	8
3. Animals • Classification of animals • Invertebrates • Vertebrates	10
4. Materials • Properties of materials • Uses of materials	12
5. States of Matter • What is matter? • Measuring matter • Three states of matter	12
6. Gravitational Force • What is gravitational force? • Mass and weight	10
7. Light • Light and objects	8
8. Solar System • The Sun • Phases of the Moon • The Solar System	14

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 Classification of Living Things

Time: 5 hours

Strand 1: **Biology Science**

Standard Sc.1.3

Indicator

Sc.1.3 Gr.4/1. Classify living things by comparing the similar and different features of living things into groups; plants, animals and not plants or animals.

Introduction:

Living things can be grouped by comparing their similar and different characteristics. Non-flowering plants are plants that do not produce flowers. Examples of non-flowering plants are mosses, ferns and conifers. Flowering plants are plants that have flowers. They have parts that have different functions.

Learning objectives:

Students will be able to:

- Observe characteristics of plants, animals and other living things.
- Differentiate between observed characteristics of plants and animals.
- Classify living things based on the similarities and differences in their characteristics.

Competency:

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

Concept:

- Plants are immobile and possess autotrophic nutrition. Animals are mobile and possess heterotrophic nutrition.
- Other living things include fungi, bacteria and algae. Fungi are decomposers.

Start up:

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

Teaching/Learning activities:

1st – 2nd hours (Plants)

1. Have students work on Let's Try activity on page 2 in the Textbook.
2. Students can explore some common plants. Refer to pages 3 and 4.

3rd – 4th hours (Animals)

1. Let students to carry out Let's Try activity on pages 5 and 6 in the Textbook.
2. Let students explore more common animals. Refer to pages 7 to 8.

5th hour (Other living things)

1. Have students work on Let's Try activity to identify the characteristics of other living things on page 9 in the Textbook.
2. Discuss the characteristics of other living things with your students. Refer to pages 10 and 11.
3. Have students to do the questions on pages 3 to 9 of the Workbook as their homework.

6th hour (Conclusion)

1. Revise the lesson by answering the questions in Part L column on page 12.
2. Encourage them to watch a video by scanning the QR code on page 12.
3. Enhance students to think about questions that they want to know more about classification of living things in Part W column on page 13. 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 13.

Learning materials:

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

Assessment:

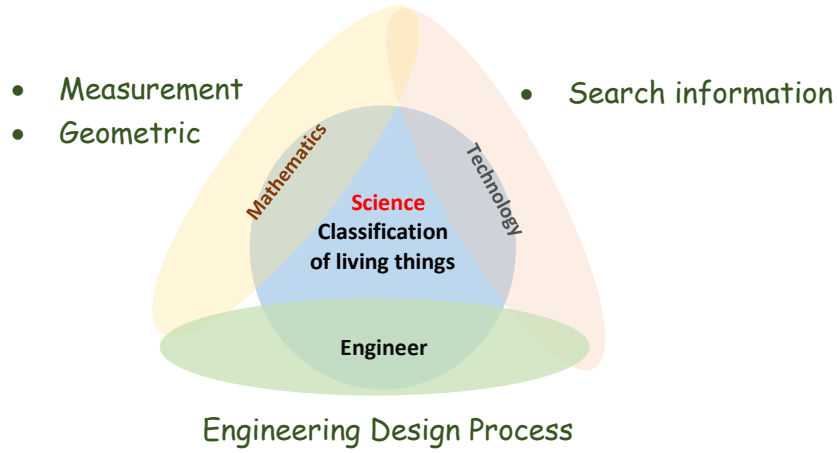
1. Assessing cognitive behavior; test on page 12 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

STEM Activity

Overview

This lesson will engage students to apply their knowledge of living things. They will design and create models that represent plants, animals and other living things for their presentation. Moreover, they will apply their art knowledge for this activity.

Subject integration



Time: 2 hours

Start up:

1. Divide students into groups of 3 or 4.

Lesson development:

1. Let students read a situation on page 14. 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 the characteristics of the models that represent each of the three groups of living things?
   (b) How does each model look like?
   (c) What is the size of the model? How big is it?
   (d) 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? (can represent characteristics of the group of living things that it is representing, etc.)
4. Let students brainstorm and draw their designs. Then, let them follow their plans and create.
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 student group presents their product 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, 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 Plants

Time: 8 hours

Strand 1: **Biology Science**

Standard Sc.1.2

Indicator

Sc.1.2 Gr.4/1. Describe the functions of root, stem, leaf and flower of flowering plants from collected data.

Standard Sc.1.3

Indicator

Sc.1.3 Gr.4/2. Classify plants into two groups; flowering plants and non-flowering plants using collected information.

Introduction:

We can classify plants into flowering plants and non-flowering plants. Non-flowering plants are plants that do not produce flowers. They produce spores or cones for reproduction. Flowering plants are plants that have flowers. The flowers produce fruits and seeds.

Flowering plants have parts that have different functions. Roots absorb water and minerals from the soil. Roots also provide support to the plant by anchoring the plant to the soil. There are different root systems. Some plants have taproot systems while some have fibrous roots. Stems transport water, minerals and food to other parts of the plants. The stem also provides support to the leaves and flowers. Leaves make food for the plant through photosynthesis. The main function of a flower is to reproduce. Each component of a flower has different functions.

In this chapter, students will learn about classification of plants based on flowering. They will also learn about parts of a plant and their functions.

Learning objectives:

Students will be able to:

- Classify plants into flowering plants and non-flowering plants based on flowering.
- Identify the parts of a flowering plant and their functions.
- Observe and collect data of flowering plants.

Competency:

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

Concept:

Parts of flowering plants have different functions. Plants can be classified into flowering plants and non-flowering plants.

Start up:

1. To assess prior knowledge about plants and their parts, ask students what they knew and what they want to know about plants.
2. Let students write all their prior knowledge in Part K column on page 16 and have students share what they know about plants and also write some questions which they want to know in Part W column on page 16.

Teaching/Learning activities:

1st – 3rd hours (Classification of plants)

1. Teacher asks students to observe differences between non-flowering plants and flowering plants. Teacher may use the following questions:
   (a) What are different characteristics between these plants?
   (b) What are the functions of flower?
   (c) How do non-flowering plants reproduce?
3. Explain more about non-flowering plants. Refer to page 17.
4. Have students work on Let's Try activity on page 18 in the Textbook. Students should conclude that ferns have spores for reproduction. Spores are located on the underside of the leaves. Ask students some questions:
   (a) Do ferns produce flowers?
   (b) Can you give another example of plant which produce spores?
5. Give more information about conifers and how they reproduce. Refer to page 19.
6. Explain know more about flowering plants. Refer to page 20. Let students to give some examples of flowering plants.
7. Have students to do the questions on page 13 of the Workbook as their homework.

4th – 7th hours (Parts of flowering plants and their functions)

1. Ask students to carry out Let's Try activity on pages 21 and 22. Students should conclude that flowering plants have parts that have different functions. Each part is important to help the plant to grow and live healthily.
2. Let students to discuss the functions of roots, stems, leaves and flowers. Refer to pages 22 to 31.
3. Carry out Let's Try activity to identify the components of a flower on page 29.
4. Have students to do the questions on pages 14 to 17 of the Workbook as their homework.

8th hour (Conclusion)

1. Revise the lesson by asking students to do questions in Part L column on page 32.
2. Encourage them to watch a video by scanning the QR code on page 32.
3. Whole class discusses about what they want to know more about plants in Part W column on page 32. Teacher may guide them if they do not have any ideas.
4. Review the lesson by referring to the Mind Map on page 33.
5. Have students to do the questions in Mastery Practice on pages 18 to 22 of the Workbook.

Learning materials:

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

Assessment:

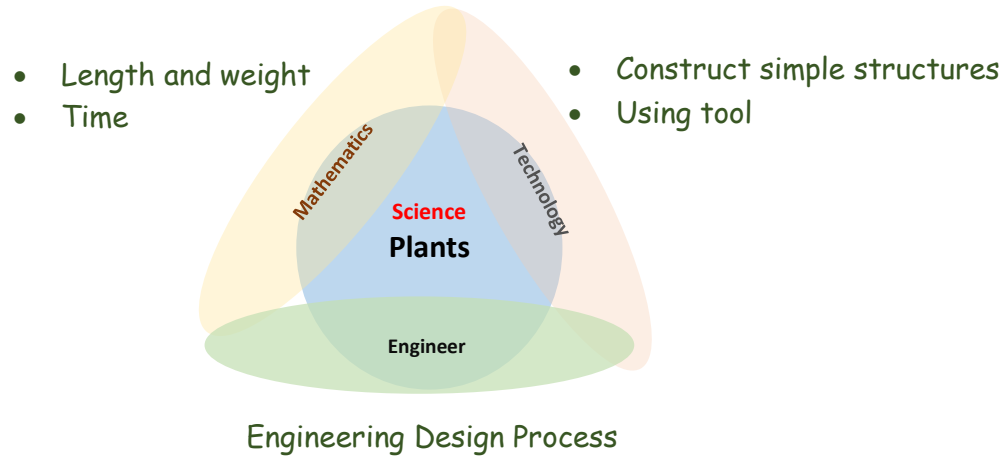
1. Assessing cognitive behavior; test on page 32 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

STEM Activity

Overview

Students will understand that plants have different parts and their functions. Pests are harmful to plants. Some pests like to eat the leaves, roots or stems of plants. This lesson will extend their understanding of plant parts and their functions. They will apply length and time in mathematical concept, plant science concept, and use computer as a tool to search for more information, and engineering design process for designing a method to protect their plant from pests.

Subject integration



Time: 3 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Review their knowledge of plants by using the 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. Students read a situation on page 34. 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 pests will harm your plant?
   (b) Can you search for more information about the pests such as how to control the pests?
   (c) 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 successful?
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 Animals

Time: 10 hours

Strand 1: **Biology Science**

Standard Sc.1.3

Indicator

Sc.1.3 Gr.4/3. Classify animals into 2 groups; animals with backbones and animals without backbones based on collected data.

Sc.1.3 Gr.4/4. Describe the observed key characteristics of groups of animals that have backbones; fish, amphibians, reptiles, birds and mammals and give examples of each group.

Introduction:

There are many different types of animals around us. Animals are classified into invertebrates and vertebrates based on the presence of the backbone.
Invertebrates are animals without backbones while vertebrates are animals with backbones. Examples of invertebrates are sponges, cnidarians, flatworms, roundworms, mollusks, annelids, arthropods and echinoderms. Vertebrates are classified into 5 groups – fish, amphibians, reptiles, birds and mammals.

In this chapter, you will guide students to learn how to classify animals into vertebrates and invertebrates.

Learning objectives:

Students will be able to:

- Classify animals into two groups; animals with backbones and animals without backbones based on the presence of the backbone.

- Describe the observed key characteristics of groups of animals that have backbones.
- Search for information and state the major groups of invertebrates and vertebrates.

Competency:

Thinking skill, technological application skill

Concept:

- Animals can be classified into vertebrates and invertebrates.
- Vertebrates can be divided into fish, amphibians, reptiles, birds and mammals.

Start up:

1. To assess prior knowledge about animals, ask students what they knew and what they want to know about animals.
2. Let students write all their prior knowledge in Part K column on page 36 and also write some questions which they want to know in Part W column on page 36.

Teaching/Learning activities:

1st – 2nd hours (Classification of animals)

1. Have students carry out Let's Try activity on page 37. Students should conclude that humans have a backbone.
2. Carry out Let's Try activity on page 38 to classify animals based on the presence of the backbone. Students should conclude that animals have backbones in their bodies. There are two groups of animals, namely

invertebrates and vertebrates. Invertebrates are animals without a backbone. Vertebrates are animals with a backbone in their bodies.

3. Explain more information about the classification of animals. Refer to page 39.

3rd – 6th hours (Invertebrates)

1. Invertebrates can be classified into eight smaller groups. Refer to pages 40 to 42 for the details.
2. Teacher may assign students to search for more information about each group of invertebrates.

7th – 9th hours (Vertebrates)

1. Carry out Let's Try activity to classify the vertebrates on pages 43 to 44. Students should conclude that vertebrates can be classified based on their characteristics including body covering, breathing organ, reproductive method, warm-blooded/cold-blooded, and care for the young.
2. Teacher gives more details of vertebrates and the five smaller groups referred to pages 45 to 49.
3. Have students do the questions on pages 26 and 29 of the Workbook as their homework.

10th hour (Conclusion)

1. Revise the lesson by asking students to do questions in Part L column on page 50.
2. Enhance students to think about questions that they want to know more about animals in Part W column on page 51. 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.

3. Use the Mind Map on page 51 to help students to understand the relationships between all the subtopics learnt in this chapter. Discuss all concepts in this chapter by using the following sample questions:
   (a) How can we classify animals into subgroup?
   (b) What are benefits of animal classification?
4. Ensure students understand the terms used in this chapter by referring to the Glossary.
5. Have students to do the questions in Mastery Practice on pages 30 to 33 of the Workbook as their homework.

Learning materials:

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

Assessment:

1. Assessing cognitive behavior; test on page 50 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

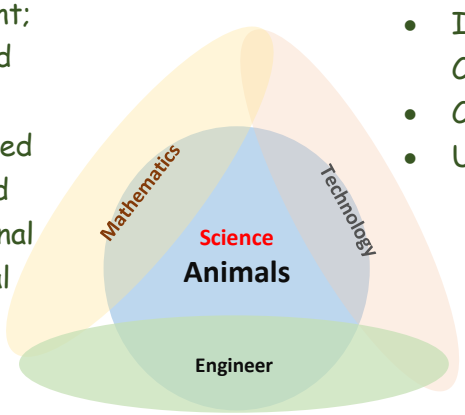
STEM Activity

Overview

In this activity, students will design and create a model of a vertebrate through the engineering design process. They have to think about an environment in which it could live. In addition, the animal should be made of clay and able to stand on its own. They will be asked to prove that the animal belongs to a certain group by its obvious characteristics.

Subject integration

- Understanding the basics of measurement; ability to measure and estimate the size of objects to be measured
- Ability to explain and analyse two-dimensional and three-dimensional geometric figures



- Information and Communication Technology
- Construct simple structures
- Using tool

Engineering Design Process

Time: 3 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Review their understanding of the engineering design process by using the suggested questions.
   (a) What is STEM education?

(b) What is the engineering design process that you use in the previous STEM activity?

Lesson development:

1. Students read a situation on page 52. Then, teacher asks and leads to discuss in order to identify a problem. Teacher may use the sample questions:
   (a) What are our missions?
   (b) What do you need to know to get started?
   (c) What scientific and mathematical concepts do we need to know before getting started?
2. Enhance students to explore and make connections between science, technology, engineering and mathematics by posing the suggested questions:
   (a) What are subgroups of vertebrates?
   (b) What are the basic needs of animals?
   (c) Do animals choose their habitats depend on their needs? How?
   (d) How do we search for more information about vertebrates?
   (e) What are the characteristics of the model of a vertebrate that can stand on its own?
3. Ask students to think about how to assess their project. Discuss in class and set their criteria with the following questions:
   (a) What are success criteria? (the model that can stand on its own at least 10 minutes, etc.)
   (b) How do we assess our work? (measuring time, clear and correct explanation)
4. Let students search for more information about vertebrates if they need. 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 to test their device by designing some experiments and use 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?
   (c) What criteria that you meet or do not meet?
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 students present their devices and share their ideas. Teacher may use the following sample questions:
   (a) How does your prototype look like?
   (b) What criteria that your group meet or do not meet? How did you know?
   (c) What are the steps of your design?
   (d) Do all of you have the same ideas? Why or why not?

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 4 Materials

Time: 12 hours

Strand 2: **Physical Science**

Standard Sc.2.1

Indicator

Sc.2.1 Gr.4/1. Compare the physical properties of substance; hardness, elasticity, heat conductivity and electrical conductivity using empirical evidence.

From experiment, indicate the physical properties of substance and apply the knowledge into daily life via the product design process.

Sc.2.1 Gr.4/2. Share opinions with others and reasonably debate the physical properties of substance from experiment.

Introduction:

The objects in our world are made of many different materials, each having different properties. The properties of materials include hardness, elasticity, heat conductivity and electrical conductivity.

In this chapter, you will guide students to learn different types of materials and their properties and uses.

Learning objectives:

Students will be able to:

- State different types of materials.
- Test and identify the properties of materials including hardness, elasticity, electrical conductivity and heat conductivity. Classify the materials based on the observed properties.
- Compare the physical properties of materials.

- State the uses of materials in our daily life and give examples.
- Using empirical evidence to indicate the physical properties of materials.

Competency:

Thinking capacity, technological application skill

Concept:

- Hardness, elasticity, heat conductivity and electrical conductivity are properties of materials. Different kinds of materials have some different properties.
- In our daily life, different materials are chosen to make objects based on their properties.

Start up:

1. To assess prior knowledge about materials by asking what students knew and what they want to know about materials.
2. Write all their prior knowledge in Part K column on page 54 and have students share what they know about materials. Then, ask students to write some questions which they want to know in Part W column on page 54.
3. Talk about the properties and uses of materials that students have ever studied from other grades. Ask them to look at the picture on page 54, and then ask some questions:
   (a) What is the material used to make the kitchen utensils?
   (b) What are properties of this material?
   (c) Can we use other materials such as rubber?

Teaching/Learning activities:

1st – 4th hours (Properties of materials)

1. Assign students to carry out Let's Try activity on pages 55 and 56 to study the hardness of materials. Students should conclude that the hardness of a material is the ability of the material to withstand scratches. Different materials have different hardness.
2. Explain more information about the hardness of materials on page 56.
3. Let students carry out Let's Try activity on pages 57 and 58. Students should conclude that the elasticity of a material is the ability of the material to return to its original shape and size after being stretched. Different materials have different elasticity.
4. Explain more information of the elasticity of materials. Refer to page 58. Teacher may ask students to tell some benefits of elasticity of materials.
5. Have students carry out Let's Try activity to find out heat conductivity of materials on pages 59 and 60. Students should conclude that the heat conductivity of a material is the ability of the material to allow heat to pass through it. Heat conductors are materials that allow heat to pass through them.
6. Explain more information about the heat conductivity of materials. Teacher may ask students to give some characteristics of materials which have good heat conductivity.
7. Carry out Let's Try activity to find out the electrical conductivity of materials on pages 61 and 62. Students should conclude that the electrical conductivity of a material is the ability of the material to allow electricity to pass through it. Electrical conductors are materials that conduct electricity.
8. Explain more information about the electrical conductivity of a material. Teacher may ask students
   (a) What materials can conduct electricity?
   (b) Are all metals electrical conductors?

5th – 11th hours (Uses of materials)

1. Have students carry out Let's Try activity on page 63. Students observe the objects given and identify the materials of the objects. Think of the uses of the objects and explain the properties of the materials.
2. Teacher explains more information about the uses of materials. Guide students to understand each property and how we apply them in our daily life. Refer to pages 64 and 65.
3. Ask students to give reasons why our pans are made of metal. What happens if they are made of rubber? Tell students that certain materials are used for certain things because of their suitable properties.
4. Ask further question in Let's Find Out on page 65. Teacher may use the sample questions:
   (a) What are the pros and cons of using the materials?
   (b) Can we find other materials instead of this material?
5. Have students do the questions on pages 35 to 37 of the Workbook as their homework.

12th hour (Conclusion)

1. Revise the lesson by answering the questions in Part L column on page 66.
2. Encourage students to watch a video by scanning the QR code on page 66.
3. Ask students what they want to know more about materials in Part W column on page 67.
4. Use Mind Map on page 67 to help students to understand the relationships between all the subtopics learnt in this chapter. Discuss all concepts in this chapter by using the following sample questions:
   (a) What are the properties of materials?

(b) How do we test the properties of materials such as hardness, elasticity, electrical conductivity and heat conductivity?

(c) Why do we have to learn this chapter?

5. Have students do the questions in Mastery Practice on pages 38 to 42 of the Workbook as their homework.

Learning materials:

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

Assessment:

1. Assessing cognitive behavior; test on page 66 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

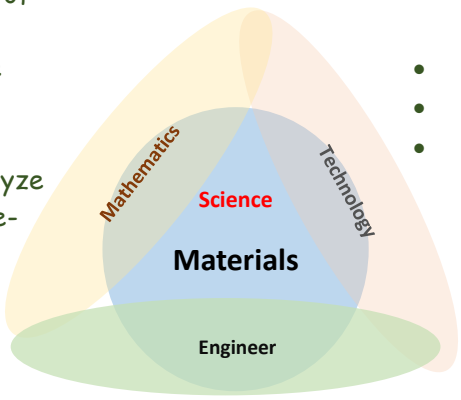
STEM Activity

Overview

This activity will engage students to look for any other materials for solving weather problem in their daily life. They will be challenged to search for information regarding the radiant barrier, and then design a house that stays coolest even when it is under the hot Sun.

Subject integration

- Understanding the basics of measurement; ability to measure and estimate the size of objects to be measured
- Ability to explain and analyze two-dimensional and three-dimensional geometric figures



Engineering Design Process

- Understanding of technology and technological processes
- Construct simple structures
- Using tool
- Information and Communication Technology

Time: 5 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Review their understanding of materials and their properties by using the following questions:
   (a) What are the properties of materials?
   (b) What are the purposes of heat insulator and heat conductor?
   (c) Do we need heat insulator for our home?

Lesson development:

1. Students read a situation on page 68. Then, the whole class discusses and identifies a problem by answering the following questions:
   (a) What is a problem of this situation?
   (b) Does this problem affect us?
   (c) What are our missions?
   (d) 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 materials should we use?
   (b) What material is a heat insulator?
   (c) Which part of house that we should use heat insulator?
   (d) How can we test our product?
   (e) How can we report our experiment results? What type of chart can be used?
3. Ask students to think about how to assess their product. Discuss in class and set their criteria with the following question:
   (a) What are success criteria? (temperature decrease, etc.)
4. Let students search for more information about materials to make heat insulators. 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 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 design and share their ideas. Teacher may use the sample questions:
   (a) What are pros and cons of your design?
   (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?
   (e) Does your prototype work well?
2. Discuss with the students about the engineering process.

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 5 States of Matter

Time: 12 hours

Strand 2: **Physical Science**

Standard Sc.2.1

Indicator

Sc.2.1 Gr.4/3. Compare the properties of the 3 states of matter. From observed information; mass occupies space, shape, and volume of matter.

Sc.2.1 Gr.4/4. Use measuring tools to measure mass and volume of the matter in three states.

Introduction:

Everything around us is made of matter. Matter is anything that has mass and takes up space. Mass is the amount of matter in an object. The mass of an object can be measured using a lever balance and an electronic balance. Volume is the amount of space taken up by an object. The volume of a liquid can be measured with a measuring cylinder or a syringe.

Matter can exist in the form of solid, liquid or gas. The three states of matter have different properties. A solid has a fixed shape and a fixed volume. A liquid has no fixed shape and takes the shape of its container. A gas has no fixed shape. The shape of a gas depends on the shape of its container. The particles of a substance are arranged differently when they are in different states of matter.

In this chapter, you will guide students to learn about the matter. They will also learn about how to use measuring tools to measure mass and volume of the matter in three states. Students will learn about the three states of matter and their properties.

Learning objectives:

Students will be able to:

- State that matter occupies space and has mass.
- Use measuring tools to measure mass and volume of the matter in three states.
- Describe the three states of matter.
- Describe the arrangement of particles in the three states of matter.

Competency:

Communication skill, thinking skill, problem-solving capacity, capacity for technological application

Concept:

Matter is anything that has mass and occupies space. There are three states of matter - solid, liquid and gas.

Start up:

1. To assess prior knowledge about matter by asking what students knew and what they want to know about matter.
2. Write all their prior knowledge about states of matter in Part K column on page 70 and have students share what they know about states of matter. Then, ask students write some questions which they want to know in Part W column on page 70.

Teaching/Learning activities:

1st – 3rd hours (What is matter?)

1. Have students work on Let's Try activity on pages 71 and 72 in the Textbook. They should conclude that matter is anything that has mass and takes up space.

2. Explain more information about matter. Teacher gives more examples of mass. Teacher should ask students to give more examples of matter. Give the reasons referred to Let's Think activity on page 73.

4th – 7th hours (Measuring matter)

1. Explain that mass is the amount of matter in an object. The mass of an object can be measured using a lever balance and an electronic balance. The mass of an object is measured in grams (g) or kilograms (kg). Refer to pages 74 and 75.
2. Teacher asks students some questions referred to Let's Think on page 75.
   (a) Is mass the same as weight? Why? Why not?
   (b) Can our body mass change when we measure on the Earth and the Moon? Why? Why not?
   (c) Can our body weight change when we measure on the Earth and the Moon? Why? Why not?

   Explain that mass is different from weight. Weight is the gravitational force that acts on an object. Mass is the amount of matter in an object. Thus, the mass of an object stays the same wherever it is, but its weight can change.
3. Carry out Let's Try activity on pages 75 and 76 to measure the masses of objects by using an electronic balance. Students should conclude that they can measure the mass of matter by using an electronic balance. They also can choose appropriate tools to measure mass.
4. Explain that volume is the amount of space taken up by an object. The volume of an object is measured in cubic centimetres (cm^3), millilitres (ml) or litres (l). The volume of a liquid can be measured with a measuring cylinder. We can also measure the volume of an irregular-shaped solid using the measuring cylinder. Refer to pages 77 and 78.

5. Assign students do Let's Try activity on page 79. They should conclude that they can measure the volume of matter using the measuring cylinder.

8th – 11th hours (Three states of matter)

1. Assign students to do Let's Try activity on page 80. Students should conclude that we can classify the matter based on their states of matter. They are solid, liquid and gas.
2. Ask students to give some examples of each state of matter. They should also explain the reasons.
3. Ask students to do Let's Try activity on pages 81 and 82 to know the properties of solids, liquids and gases. Students understand a solid has a fixed shape. Liquids and gases do not have fixed shapes and take the shape of their containers. Students should conclude that both solids and liquids have fixed volume. Unlike solids and liquids, a gas has no fixed volume. Refer to pages 82 and 83.
4. Give some questions so that students will understand more. Examples:
   (a) Ask students to squeeze a pencil and conclude that a solid has a fixed volume.
   (b) Ask students to give more examples of each state of matter. They should explain reasons too.
5. Using the arrangement of particles in a solid, liquid and gas, explain the reasons for their shape and volume. Refer to page 84.
6. Have students do the questions on pages 54 to 57 of the Workbook as their homework.

12th hour (Conclusion)

1. Review what they have learned by doing the questions in Part L column on page 85.
2. Encourage them to watch a video by scanning the QR code on page 85.
3. Enhance students to think about questions that they want to know more about states of matter in Part W column on page 86.
4. Use the Mind Map on page 86 to help students to understand the relationships between all the subtopics learnt in this chapter. Discuss all concepts in this chapter by using the following sample questions:
   (a) What are the properties of a solid, liquid and gas?
   (b) What are different properties of the three states of matter?
   (c) What is the state of powder? Why?
5. Have students do the questions in Mastery Practice on pages 58 to 61 of the Workbook as their homework.

Learning materials:

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

Assessment:

1. Assessing cognitive behavior; test on page 85 (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

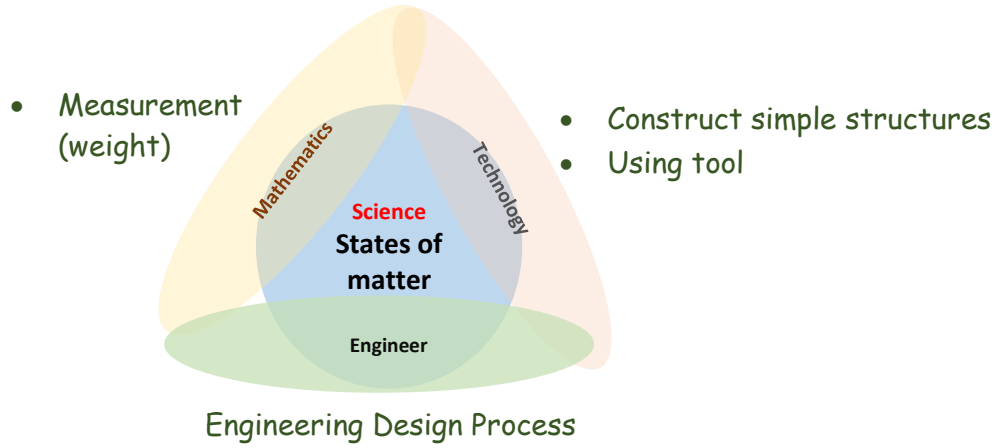
Overview

Students have known about the properties of air such as:

- It has no odor or taste.
- It has mass and volume.
- It takes up space.

This activity will encourage students to design and create way to measure the mass of the air in a balloon.

Subject integration



Time: 3 hours

Start up:

1. Divide students into groups of 3 or 4.

Lesson development:

1. Students read a situation on page 87. 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) How do we know that air has weight?
2. Enhance students to explore and make connections between science, technology, engineering and mathematics by posing the following questions:
   (a) What kind of weighing scale is used to weigh air?
   (b) How do we measure weight? What tools can we use to measure weight?
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? (way to weigh air, 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 students 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 each group presents their works and their journey of work. Teacher should encourage peers to ask or give some comments.

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 6 Gravitational Force

Time: 10 hours

Strand 2: Physical Science

Standard Sc.2.2

Indicator

Sc.2.2 Gr.4/1. Identify the effects of gravitational force acting on objects based on empirical evidence.

Sc.2.2 Gr.4/2. Use spring scales to weigh objects.

Sc.2.2 Gr.4/3. Describe how mass affects the changes in motion of the objects by using empirical evidence.

Introduction:

Gravitational force is a non-contact force exerted by the Earth pulling everything to its center resulting in the weight of an object. Mass is defined as something that represents the amount of matter that affects the changes in motion of objects. The more massive an object is, the more it resists changes in its motion. Spring scale is used to measure the mass of an object. The more mass an object has, the more weight it has.

Learning objectives:

Students will be able to:

- Conduct the experiments and explain the effects of gravitational force acting on objects.
- Use spring scales to weigh objects.
- Conduct the experiments and explain how mass affects the changes in motion of the objects.

Competency:

Communication skill, thinking skill, problem-solving skill, technology application skill

Concept:

- Gravitational force is a force exerted by the Earth pulling everything to its centre resulting in the weight of an object.
- The weight of an object can be measured by using a spring scale. The unit of weight is the Newton (N). The more mass an object has, the more weight it has.
- Mass is defined as something that represents the amount of matter that affects the changes in motion of the objects. The more massive an object is, the more it resists changes in its motion.

Start up:

1. Lead to the lesson by dropping a pencil on the floor or throwing the pencil up, then ask:
   (a) Why does the pencil drop on the floor? (answers may vary)
   (b) What type of force that pulls the pencil down toward the floor?
2. To assess prior knowledge about gravitational force, ask students what they knew and what they want to know about gravitational force.
3. Let students write all their prior knowledge on their textbooks on page 89 (Part K) and also write some questions which they want to know on page 89 (Part W).

Teaching/Learning activities:

1st – 4th hours (What is gravitational force?)

1. Have students work on Let's Try activity on page 90 to explain why all objects that go up come down.

2. Explain about gravitational force. Our Earth has gravitational force. This force holds everything around us close to the ground by pulling each of them toward the center of the Earth. Give some examples on how gravitational force affects our daily lives. May ask students to give some evidence that explain effect of gravitational force.
3. Tell the story of Sir Isaac Newton who discovered the gravitational force. Refer to Let's Know More on page 92.
4. Let students to observe the differences between going up and down the stairs. And then discuss why it is easier to go down the stairs than to go up. Refer to page 93.

5th – 9th hours (Mass and weight)

1. Lead to the lesson by asking students:
   (a) What is mass? (Answers may vary)
   (b) How does the amount of matter of an object affect the changes in motion of the object?
2. Ask students to observe when they push or pull two objects of different weight. Teacher may use the following questions.
   (a) What happens when you push a heavy table?
   (b) Is it easier to push a light weight table?
   (c) Do you have to give more force to push a heavy object?
3. Explain that the mass of an object is the amount of matter in the object. The more matter an object has, the greater mass it has. The greater mass an object has, the harder it is to move. Refer to page 94.
4. Whole class discusses why a car changes its direction easier and quicker than a truck. Refer to Let's Think on page 94.

5. Explain that the weight of an object measures how much gravitational force is acting on it. A spring balance and a compression balance can be used to measure weight. Its unit is Newton (N).
6. Carry out Let's Try activity on pages 95 and 96 to explain the mass of an object affects its weight.
7. Explain relations of mass, weight and gravitational force. The more mass an object has, the more weight it has or the more gravitational force is acting on it.
8. Ask students to think about our weight and mass when we stay on the Earth and the Moon. They should come up that our mass does not change. Weight changes because of gravitational force, the Moon's gravitational force is weaker than the Earth's. The Moon's gravitational force acting on the person is lesser. Therefore, our weight on the Moon is lesser compared to their weight on Earth.
9. Let students to do the questions on pages 63 and 64 of the Workbook as their homework.

10th hour (Conclusion)

1. Revise the lesson by asking students to do questions in Part L column on page 98.
2. Encourage them to watch a video by scanning the QR code on page 98.
3. Enhance students to think about questions that they want to know more about gravitational force in Part W column on page 98. 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. Use the Mind Map on page 99 to help students to understand the relationships between all the subtopics learnt in this chapter. Discuss all concepts in this chapter by using the following sample questions:
   (a) What is mass?
   (b) What is weight?
   (c) What are relations among mass, weight and gravitational force?
   (d) Why is our weight on the Moon lesser when compared to the weight on the Earth?
5. Let students to do the questions in Mastery Practice on pages 65 and 68 of the Workbook.

Learning materials:

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

Assessment:

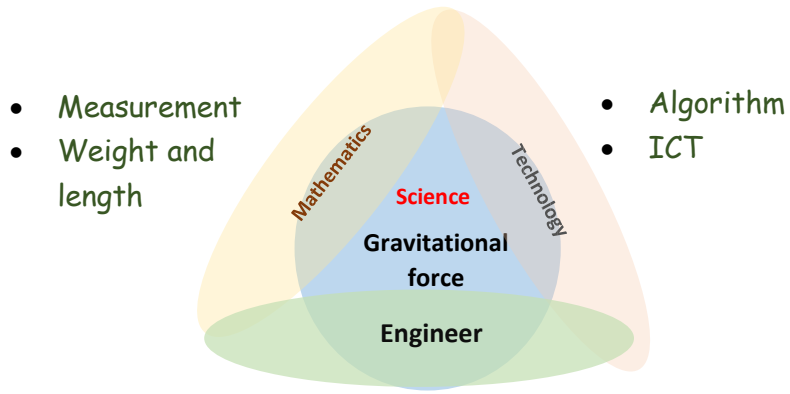
1. Assessing cognitive behavior; test on page 98 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

STEM Activity

Overview

A pendulum is a weight suspended from a point so that it can swing freely due to the gravitational force. The pendulum moves as a swing. The swing is moving back and forth due to the force of gravity on the swing. Students will complete a pendulum painting that must be at least 30 cm tall. The painting must be at least 30 cm in length and width.

Subject integration



Engineering Design Process

Time: 3 hours

Start up:

1. Divide students into groups of 3 or 4.

Lesson development:

1. Let students read a situation on page 100. 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 reviewing with the class how the pendulum works and posing the following questions:
   (a) How does the pendulum work?
   (b) What is the relationship between the length of a pendulum and its movement?
3. Teacher sets up different pendulum systems (different lengths of string). Students observe the relationship between the length of a string and its movement.
4. Teacher may demonstrate pendulum painting.
5. Students practice to use pendulums with different length of strings.
6. 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? (length of pendulum, at least 30 cm tall, etc.)
7. Let students brainstorm and draw their designs. Students create their own individual painting representing the different lengths of pendulum. 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.)
8. After they finish their mission, ask them to test their product by using the criteria in #6. 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?

9. Let them improve their design. (Teacher can skip this step if you do not have enough time.)
10. Each group presents their creative work and explains their journey of creating.

Conclusion:

1. End the lesson by asking each group presents their works and their journey of work. Teacher should encourage peers to ask or give some comments.

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 7 Light

Time: 8 hours

Strand 1: **Physical Science**

Standard Sc.2.3

Indicator

Sc.2.3 Gr.4/1. Classify objects based on seeing through: transparent, translucent and opaque by using empirical evidence.

Introduction:

Light enables us to see things around us. When light hits a transparent object, the light passes right through it. Translucent objects allow only some light to pass through them. Opaque objects do not allow light to pass through them at all. Opaque objects create dark shadows.

In this chapter, you will guide students to learn about how light help us see things. They will also find out what happens when light hits transparent, translucent and opaque objects.

Learning objectives:

Students will be able to:

1. Conduct experiment and describe what happens when light hits different objects.
2. Classify objects based on seeing through: transparent, translucent and opaque by using empirical evidence.

Competency:

Thinking capacity, capacity for technological application

Concept:

Light enables us to see things around us. Objects can be classified into three types (transparent objects, translucent objects and opaque objects) based on visual characteristics from sources of light.

Start up:

1. To assess prior knowledge about light by asking what students knew and what they want to know.
2. Write all their prior knowledge in Part K column on page 102 and have students share what they know about light. Then, ask students write some questions which they want to know in Part W column on page 102.
3. Talk about students prior experience of light and objects such as:
   (a) Have you ever seen shadow play? What science behind this play?
   (b) What happens when we shine light through glass, brick or window?
   (c) Why do we choose cloth to make curtain?

Teaching/Learning activities:

1st – 7th hours (Light and objects)

1. Ask students to do Let's Try activity on page 103. Students should conclude that light cannot pass through every object.
2. Explain that some objects allow light to pass through them. Some allow a little light to pass through them. Some do not allow at all. What are these objects known as? Ask students to give some examples of the respective objects. Refer to pages 104 and 105.

3. Ask and explain to students by showing some examples of how we use transparent, translucent and opaque objects in our daily life.
4. Let students to do Let's Try activity on page 106. Discuss and conclude that the location of a light source relative to the object casting shadows determines the size of the shadows. Teacher may use the sample questions:
   (a) Does distance between light source and object affect the size of shadow.
   (b) Will the shadow be much bigger than the object itself when we move the light closer to the object?
   (c) Can we save energy when we use translucent roof or wall?
   (d) Have you ever known Polaroid sunglass? Is it a transparent, translucent and opaque object?
5. Have students to do the questions on pages 71 and 73 of the Workbook as their homework.

8th hour (Conclusion)

1. Wrap up the class by using the following sample questions:
   (a) What happens when light hits different objects?
   (b) What are translucent, transparent and opaque objects?
   (c) What should we do if we want to make a bigger shadow?
   (d) Can translucent object make shadow? Why?
2. To test their understanding of this chapter, have students do questions in Part L column on page 107.
3. Encourage them to watch a video by scanning the QR code on page 107.
4. Whole class discusses what they want to know more about light in Part W column on page 108.
5. Use the Mind Map on page 108 to help students to understand the relationships between all the subtopics learnt in this chapter.

6. Ensure students understand the terms used in this chapter by referring to the Glossary.
7. Have students to do the questions in Mastery Practice on pages 74 to 77 of the Workbook as their homework.

Learning materials:

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

Assessment:

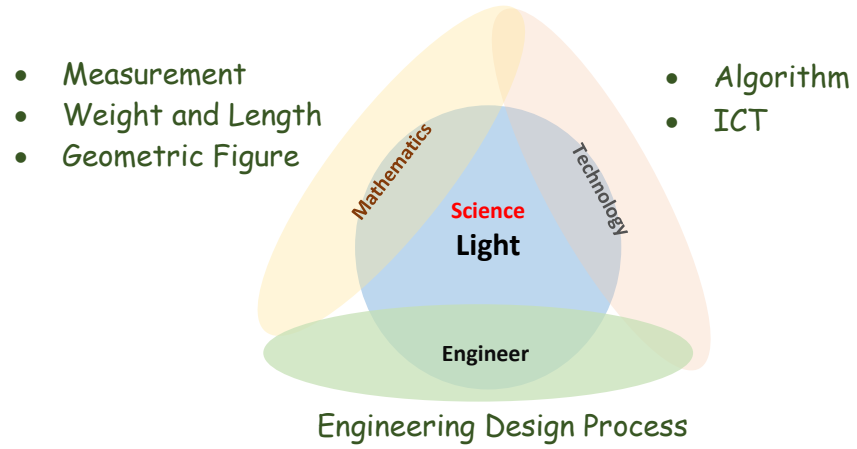
1. Assessing cognitive behavior; test on page 107 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

STEM Activity

Overview

This lesson will extend students' concept of light and three types of objects (transparent object, translucent object and opaque object). This activity is not only integrated science, technology, engineer and mathematics but also integrate arts. Students will search for their local culture, and then integrate with their science concept to create their folk shadow puppets.

Subject integration



Time: 3 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Review their knowledge content of light and three types of objects.
   (a) What are advantages of three types of objects?
   (b) What happens when light cannot go through an opaque object?

Lesson development:

1. Students read a situation on page 109. 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 sample questions:
   (a) What is scientific concept of shadow puppet?
   (b) What are characteristics of a material that is suitable to create a shadow puppet?
   (c) What size and shape of the shadow puppet should be?
   (d) What are the factors that affect on shadow puppet? (Size, shape, distance between light source and puppet, etc.)
   (e) Can we make shadow puppet with translucent object? How can we make some parts of puppet shadow move?
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? (Shadow puppet satisfaction survey, 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 the students:
   (a) Do you have the same or different ideas? Why or why not?
   (b) Should we copy ideas from friends or from other sources? Why or why not?

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 8 Solar System

Time: 14 hours

Strand 3: **Earth and Space Science**

Standard Sc.3.1

Indicator

Sc.3.1 Gr.4/1. Explain a diagram of the (motion) sunrise and sunset location using empirical evidence.

Sc.3.1 Gr.4/2. Make a model to explain the phenomena of the changing of Moon phases and forecast the appearance of the Moon.

Sc.3.1 Gr.4/3. Make a model presenting the components of the Solar System and use a model to explain the comparison of each planet's orbit.

Introduction:

There are eight planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune) in our Solar System going around the Sun. All planets move around the Sun in an orbit. Some planets have natural satellites orbiting them. Other bodies in the Solar System include asteroids, meteoroids and comets.

In this chapter, you will guide students about the Sun, characteristics of planets, and other bodies in the Solar System.

Learning objectives:

Students will be able to:

- Draw and explain a diagram of the (motion) sunrise and sunset location.
- Search for the information and make a model to explain the phenomena of the changing of Moon phases.

- Search for the information and describe the Sun and the planets in the Solar System.
- Create a model presenting the components of the Solar System and use a model to explain the comparison of each planet's orbit.
- Describe the natural satellites, asteroids, meteoroids, meteors, meteorites and comets.

Competency:

Thinking capacity, capacity for technological application

Concept:

- The Moon is the Earth's natural satellite. It orbits around the Earth and also spins on its own axis.
- The Earth spins around itself from the West to the East anti-clockwise direction, if we see the Earth from North pole. As a result, we have always seen the Moon rises in the East and sets in the West in the same pattern.
- The Moon is a sphere shape but the Moon's appearance in the sky is different in each day.
- The Solar System has the Sun as a center including 8 planets and natural satellites.
- There are also dwarf planets, asteroids, comets and other small objects orbiting around the Sun.

Start up:

1. To assess prior knowledge about the Solar System by asking what students knew and what they want to know.

2. Write all their prior knowledge in Part K column on page 111 and have students share what they know about the Solar System. Then, ask students write some questions which they want to know in Part W column on page 111.
3. Talk about the Sun and the Solar System that students have ever known. By using the following sample questions: (Answers may vary)
   (a) What can you see in the sky during the day? What can you see in the sky at night?
   (b) Why can we see objects during the day?
   (c) What is the most important energy source of living things? Why?
   (d) Does the Moon change its shape every night? Why?

Teaching/Learning activities:

1st – 3rd hours (The Sun)

1. Show students a diagram of the Solar System and then discuss:
   (a) The planets in the Solar System
   (b) How do the planets stay in orbit around the Sun?
2. Carry out Let's Try activity on page 113. Ask and discuss by using the following sample questions before and after the activity:
   (a) Can you estimate the size of the Sun, if we compare our Earth as a 1-baht coin?
   (b) Why do we see the Sun appear to be the same size as the Moon?
   (c) If an apple represents the Earth, how many apples represent the Sun?
3. Explain more about the Sun. Refer to page 114.
4. Enhance students to think about safety precautions when we observe the Sun and advantages of the Sun to living things. Refer to Let's Think on page 114.
5. Carry out Let's Try activity on pages 115 and 116 to understand and conclude the Sun seems to move from the East to the West.

6. Carry out Let's Try activity on page 117 to understand and conclude what causes the Sun to rise and set in the same directions every day.
7. Explain more about the rotation of the Earth which causes the Sun which appears to rise and set. Refer to page 118.

4th – 8th hours (Phases of the Moon)

1. Discuss about the Moon:
   (a) What can you see in the sky during the night?
   (b) Does the Moon change its shape every night?
   (c) Why does the Moon change its shape every night?
2. Carry out Let's Try activity on pages 119 and 120 to identify the phases of the Moon.
3. Explain more about the phases of the Moon and lunar calendar. Refer to pages 120 to 124.
4. Assign students to search for more information about the phases of the Moon and the festivals celebrated in Thailand. Refer to Let's Find Out on page 124.

9th – 13th hours (The Solar System)

1. Show students a picture of our Solar System. Ask them to count the number of big objects in it. Tell them that the biggest object in the Solar System is our Sun. Emphasize that the Sun is a star, burning ball of hot gas.
2. Explain that there are 8 planets in the Solar System. Explain a planet does not give out light and heat but a star does.
3. Get students to memorize the sequence of the arrangement of the planets starting from the one nearest to the Sun. State the main characteristics of each planet. Refer to pages 125 to 131.
4. Explain more scientific knowledge about why there were 9 planets in our Solar System before 2006. Teacher should emphasize nature of science as

well that scientific knowledge can be changed when we have more and better technology to study. Refer to Let's Know More on page 130.

5. Assign students Let's Try activity to create a model of solar system. Refer to pages 131 and 132.
6. State that asteroids are rocks that located between the orbits of Mars and Jupiter. This area is known as the asteroid belt.
7. Explain the differences between meteoroids, meteors and meteorites. They are actually referred to the same objects but at different locations. Give further information of asteroid hit the Earth 65 million years ago. Refer to pages 133 to 134.
8. Have students to do the questions on pages 83 and 87 of the Workbook as their homework.

14th hour (Conclusion)

1. To test their understanding of this chapter, have students do questions in Part L column on page 135.
2. Encourage them to watch a video by scanning the QR code on page 135.
3. Whole class discusses what they want to know more about the Solar System in Part W column on page 136.
4. Use the Mind Map on page 136 to help students to understand the relationships between all the subtopics learnt in this chapter. Discuss all concept in this chapter by using these following sample questions:
   (a) What are the objects in our Solar System?
   (b) What are the characteristics of the objects in the Solar System?
   (c) Why do we have to study the Sun, the planets and other bodies in the Solar System?
   (d) Why does the Moon change its shape when viewed from the Earth?

(e) What is a lunar calendar?

5. Ensure students understand the terms used in this chapter by referring to the Glossary.
6. Have students to do the questions in Mastery Practice on pages 88 to 92 of the Workbook as their homework.

Learning materials:

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

Assessment:

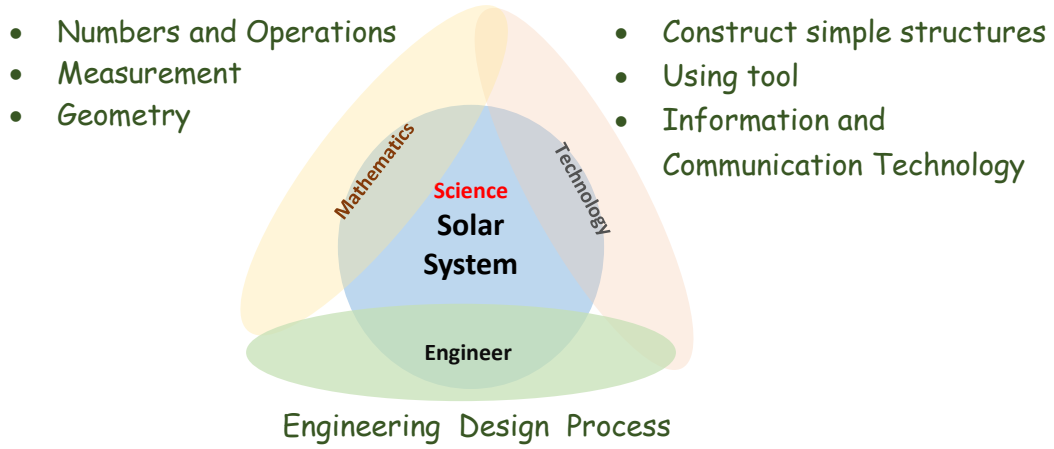
1. Assessing cognitive behavior; test on page 135 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

STEM Activity

Overview

This lesson will let students to understand more about our solar system. They will search for additional information about the solar system via internet. They will create a model of the Solar System by using different sizes of beans which represent the size of the planets.

Subject integration



Time: 3 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Review their knowledge content of the Solar System by using the following sample questions:
   (a) What is the Solar System?
   (b) What are the planets in our Solar System?

Lesson development:

1. Students read a situation on page 137. 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 sample questions:
   (a) How do scientists study our Solar System?
   (b) How can we get more additional information about the planets in our Solar System?
   (c) How can we use engineering design process to create a scale model of the Solar System?
   (d) What tools should we use?
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? (The solar system model which is represented by using beans, correct size of beans, easy to understand, correct distance, 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) Do we use the size of beans correctly?
   (c) 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 the students:
   (a) Do we get a good model? Why or why not? Why should we have to do to improve our model?
   (b) Does every group use same beans as your model? Why or why not? Do we have the same or different model? Why or why not?

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