PELANGI

Teacher's Guide

SCIENCE

Primary Education Smart+

Prathomsuksa

6

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

Contents

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 life 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 6 (Grade 6)

9 chapters 80 hours

Learning areas	Time (hours)
1. Food, Nutrition and Digestion • Food and nutrition • Digestive system	10
2. Separation Techniques • Separating a mixture of solids • Separation by magnets • Separating insoluble solids from liquids	11
3. Static Electricity • Static electricity	7
4. Electric Circuits • Simple electric circuits • Series and parallel circuits	12
5. Light • Umbra and penumbra	5
6. Eclipses and Space Technology • Solar eclipse and lunar eclipse • Space technology	9
7. Rocks • Types of rocks and rock cycle • Uses of rocks and ores • Fossils	10
8. Wind and Monsoons • Wind • Monsoons	8
9. Natural Disasters and Greenhouse Effect • Natural disasters • Greenhouse effect	8

Note: The hours needed for each subtopic can be changed when necessary. The above allocated hours are just a suggestion. The total number of 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 Food, Nutrition and Digestion

Time: 10 hours

Strand 1: Biology Science

Standard Sc.1.2

Indicator

Sc.1.2 Gr.6/1 Identify the nutrients and tell the benefits of each food type from your dish.

Sc.1.2 Gr.6/2 Tell the guidelines how to choose food in order to have all of nutrients in the right proportion based on gender and age including safe for health.

Sc.1.2 Gr.6/3 Realize the importance of nutrients by choosing foods that have all of nutrients in the right proportion based on gender and age including safe for health.

Sc.1.2 Gr.6/4 Build a model of digestive system and describe the function of the digestive organs as well as explain digestion and nutrient absorption.

Sc.1.2 Gr.6/5 Realize the importance of the digestive system by telling the way to keep the organs in the digestive system to function normally.

Introduction:

Food provides nutrients to our body. Nutrients are the substances needed by our body for good health. There are six types of nutrients, namely carbohydrates, proteins, fats, vitamins, minerals and water. A balanced diet is a diet that contains the right amounts of all nutrients needed by the body.

The digestive system helps to digest food, breaking the food into simpler substances for the body to absorb.

In this chapter, you will guide to learn about the nutrients needed by our body for good health and tell the benefits of each food type. Students will also learn about the importance of nutrients and tell the guidelines on how to choose food that have all of nutrients in the right proportion. They will understand and realize the importance of the digestive system.

Learning objectives:

Students will be able to:

- Describe the six types of nutrients.
- State the factors affecting our needs for energy.
- Describe a balanced diet.
- Describe how the digestive system works.
- Build a model of digestive system and describe the function of the digestive organs as well as explain digestion and nutrient absorption.
- State the ways to keep the systems healthy.

Competency:

Thinking capacity, problem solving capacity, applying life capacity,

Concept:

- There are six types of nutrients in foods: carbohydrates, proteins, fats, minerals, vitamins and water.
- Different foods contain different amounts of the nutrients we need. We should eat a variety of foods, not just one type of food all the time.
- Each nutrient has different benefits for the body. Carbohydrates, proteins and fats are nutrients that provide energy to the body. Minerals, vitamins and water are nutrients that do not provide energy, but help the body to function normally.

- Having good health needs to eat a balanced diet and get enough energy to meet the body requirement. Moreover, consuming all of nutrients in the right proportions based on gender and age, as well as the types of food and the amount of food additives must take into account for health and safety.
- The digestive system consists of various organs, e.g. the mouth, esophagus, stomach, small intestines, large intestines, rectum, liver and pancreas, which work together in digestion and nutrient absorption.
- The organs in the digestive system are important, so we should take care of ourselves and keep the organs to function normally.

Start up:

1. Assess students' prior knowledge by asking what they knew (Part K) and what they want to know (Part W) on page 1.
2. Lead to Let's Try activity on page 2 by asking some questions. Teacher may use the following questions:
   (a) What are the nutrients in food?
   (b) How do we choose food that is suitable for our gender and age and is safe for our health?
   (c) How does our digestive system work?

Teaching/Learning activities:

1st – 5th hours (Food and nutrition)

1. Lead students to discuss about food or meal that they have before class. Ask students to list the sources of our food. We all need food to survive. What kind of food do we eat? Where do the food we eat come from?
2. Ask students for the reasons why we need to eat.
3. What are nutrients? The six types of nutrients we need are carbohydrates, protein, fats, vitamins, minerals and water.

4. What are carbohydrates? What do they provide us with? What are the foods that contain mainly carbohydrates? Refer to page 2.
5. What are proteins? What do proteins provide us with? What are the foods that contain mainly proteins? Refer to page 3. Explain more about proteins. Refer to Let's Know More on page 3.
6. What are fats? What do fats provide us with? What are the foods that contain mainly fats? Refer to page 4.
7. What are vitamins? What happens if we are lack of vitamins? Which food contains a lot of vitamins? Refer to page 4.
8. What are minerals? What happens if we are lack of minerals? Which food contains a lot of minerals? Refer to page 5.
9. Water is important for us. How does water help us to stay healthy? Refer to page 5.
10. Explain more information about the importance of water to us. Teacher may assign students to search for information about food such as vegetables and fruits which have more water. Refer to Let's Know More on page 5.
11. Assign students to check their food whether it contain all the six nutrients. Carry out Let's Try activity on page 6. Then, explain more why we should eat a variety of food. Refer to Let's Know More on page 6.
12. Different foods contain different combinations of nutrients. Therefore, it is important for us to know the nutrient we eat.
13. Lead to discuss about what kind of food children should avoid such as junk food and sweet food. Teacher may let students read nutrition facts on some snack packages and then discuss why we should avoid or eat less. Refer to page 7.
14. Explain what food additives are and how they affect our health. Refer to page 8.

15. Explain different foods contain different energy values and each person needs a different amount of energy. Refer to page 9.
16. Carry out Let's Try activity on pages 10 and 11 to check if they take enough energy as required.
17. Explain what a balanced diet is and how the food guide pyramid can help us to have a balanced diet. Emphasize the food that we should eat more, and the food we should eat less. Refer to pages 11 and 12.
18. Explain that the doctors use BMI to assess our growth. Refer to page 13.
19. Teacher ask students about BMI chart for boys, then ask them to calculate their BMI and analyze their BMI. Refer to Let's Find Out on page 14.

6th – 9th hours (Digestive system)

1. Guide students to understand the functions of our digestive system.
2. Using the diagram on page 15, guide students to identify the important parts of the human digestive system. Explain the pathway of the food in our system and the function of each part of the digestive system. What happens to the food when it reaches the stomach, small intestine and large intestine? Refer to pages 15 and 16.
3. Ask students to search for more information about the digestive system and make a model of the digestive system. Let them present their model in class and explain how their model works. Refer to Let's Find Out on page 17.
4. Lead them to know that the organs in the digestive system are important, so we should take care of ourselves and keep the organs to function properly. Ask them to give examples of good habits of taking care of our digestive system. Refer to page 17.
5. Have students to do the questions on pages 9 to 13 of the Workbook as their homework.

10th hour (Conclusion)

1. End the lesson by using the following sample questions:
   (a) What are the functions of the digestive system? How does it work?
   (b) What should we do to keep our body healthy?
   (c) What details should we know before eating or buying some snack?
   (d) List some healthy eating behaviors for teenages.
2. To test their understanding of this chapter, have students fill in the blanks in Part L column on page 18.
3. Encourage them to watch a video by scanning the QR code on page 18.
4. Guide the whole class to discuss what they want to know more about food, nutrition and digestion in Part W column on page 19.
5. Use the Mind Map on page 19 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.
7. Have students to do the questions in Mastery Practice on pages 14 to 18 of the Workbook as their homework.

Learning materials:

- Primary Education Smart Plus Science Textbook Prathomsuksa 6
- Primary Education Smart Plus Science Workbook Prathomsuksa 6
- Digestive system poster
- Food pyramid poster

Assessment:

1. Assessing cognitive behavior; test on page 18 (Part L)
2. Assessing affective behavior; (refer to Scoring Rubric for Affective Domain)
3. Assessing thinking process; (refer to Scoring Rubric for Scientific Thinking)

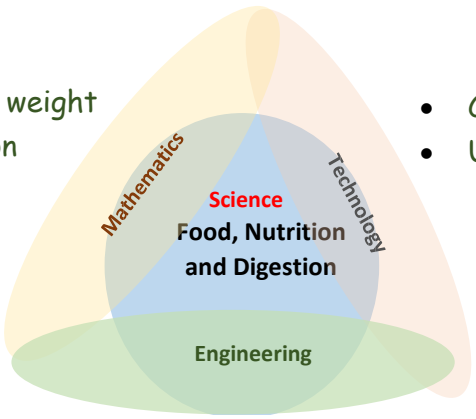
STEM Activity

Overview

Most children do not like to eat fruits and vegetables. However, fruits and vegetables contain many nutrients that are good for our health. They are rich in vitamins, minerals, water and fiber which help in food digestion and also for body to function properly. In this chapter, students will prepare their mixed fruit and vegetable salad. They will apply their nutrition knowledge.

Subjects Integration

- Measurement weight
- Data collection
- Calculation



- Construct simple structures
- Using simple tools

Engineering design process

Time: 4 hours

Start up:

1. Divide students into team of 3 or 4.
2. Review their understanding about engineering design process by using the suggested questions:
   (a) In our daily life, can we use the engineering design process for solving problem? How?
   (b) Give an example of using the engineering design process for solving problem.

Lesson development:

1. Students read the situation on page 20. Then, the whole class discusses and identifies the problem by answering the following questions:
   (a) What is the 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 much fruit or vegetable do kids have to eat for a day?
   (b) Are fruit and vegetable good for health? What are they?
   (c) Have you ever eaten any food made from fruits or vegetables?
   (d) Why do kids not like eating vegetables? Is it the color, the texture or the taste?
   (e) Is there any taste can replace or mask bitter taste?
   (f) Can we find anything to mask the bitterness of vegetables?
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 the success criteria?
   (b) How can we know that kids like our food?
   (c) What is a reliable measurement that shows our success? (collect survey data, the need for smartification of food)
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 test their product by using the criteria in #3. Teacher may use these 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. Each group presents their ideas and results. Teacher should encourage peers to ask or give some comments.
2. End the lesson by asking the students:

(a) Can we use the engineering design process for solving problems in our daily life?

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 2 Separation Techniques

Time: 11 hours

Strand 2: Physical Science

Standard Sc.2.1

Indicator

Sc.2.1 Gr.6/1 Explain and compare the separation techniques by removing, gliding, and magnetic separation, pouring, filtering, and precipitating by using empirical evidence. And identify the method of solving everyday problems involving separation.

Introduction:

The substances in a mixture usually can be separated. Some separation techniques are sifting, magnet attraction, decantation, filtration and precipitation. In this chapter, you will guide students to learn about how mixtures can be separated using different methods.

Learning objectives:

Students will be able to:

- State the separation techniques such as handpicking, sifting, and magnet attraction, decantation, filtration and precipitation.
- Compare various separation techniques.
- Choose an appropriate separation technique to separate a mixture.
- Solve everyday problems involving separation.

Competency:

Problem solving capacity, applying life skills

Concept:

- A mixture consists of two or more different substances mixed together, such as oil mixed with water, rice and sand.
- Depending on the properties of the substances in the mixture, we can choose the most appropriate separation technique to separate them from the mixture.
- If we want to separate solids from other solids of different sizes, we can use the handpicking or sifting method.
- Mixtures containing substances that get attracted to magnets can be separated using a magnet.
- If we want to separate insoluble solids from liquids, pouring, we can use decantation, filtration or precipitation.

Start up:

1. To assess the students' prior knowledge, ask them what they knew (Part K) and what they want to know (Part W) on page 22.
2. Talk about separation techniques. Teacher may use the following questions:
   (a) Have you ever tried to separate a mixture of oil and water? Can you do that? How?
   (b) How do we separate salt from sugar?

Teaching/Learning activities:

1st – 4th hours (Separating a mixture of solids)

1. Explain that a mixture is made up of two or more different substances mixed together. The substances in a mixture can be gases, liquids or solids. Ask students to give examples of such mixtures.
2. Mixtures have more than one substance in them. There are a few separation techniques that we can use to separate them. Separating the substances from

a mixture allows us to obtain the pure substances so that we can use them separately. Refer to page 23.

3. How do we know which techniques to use? We have to understand the basic principle behind each technique and properties of the substances in the mixture. Carry out Let's Try activity on page 24. Students should conclude that we can separate some substances from their mixtures by handpicking. This works well with solid substances that have noticeable differences in sizes, shapes or colors.
4. Teacher asks them to give more examples of mixtures which can be separated using the handpicking method.
5. Carry out Let's Try activity on page 25. They should conclude that sifting is a technique used to separate solids of different sizes. A sieve has a net that retains the bigger solids, while allowing the smaller solids to go through. Read more details about sifting on page 26.

5th – 6th hours (Separation by magnets)

1. Explain that magnet attraction is used to separate substances that are attracted to magnets.
2. Ask students to Let's Try on page 27. They should conclude that magnet attraction is useful for separating substances that are attracted to magnets from substances that are not attracted to magnets.
3. Explain how people use properties of magnets in everyday applications, for example using an electromagnet to separate magnetic objects from non-magnetic objects in recycling centers. Refer to page 28.

7th – 10th hours (Separating insoluble solids from liquids)

1. Engage students to think about how to separate insoluble solids from liquids. What are decantation, filtration and precipitation?

2. Carry out Let's Try activity on page 29.
3. Teacher explains that the simplest technique to separate a liquid from an insoluble solid is decantation. The solid is allowed to settle to the bottom of the container before the liquid is carefully poured off the top. Refer to page 30.
4. Carry out Let's Try activity on pages 30 and 31 to separate water and sand.
5. Teacher explains that filtration is used to separate insoluble solids from a liquid in a mixture using a filter. Refer to pages 31 and 32.
6. Carry out Let's Try activity on page 33 to separate proteins from milk.
7. Teacher gives more information about precipitation. Precipitation involves the conversion of a substance that dissolves in a liquid into a solid by adding other substance. Then, the solid that is insoluble in the liquid is removed from the liquid by filtration. Refer to page 33.
8. Have students to do the questions on pages 22 to 24 of the Workbook as their homework.

11th hour (Conclusion)

1. Wrap up the class by using the following sample questions:
   (a) What are conditions of using separation techniques such as magnet attraction, sifting, filtration and precipitation?
   (b) What can we get from each technique?
   (c) What are the pros and cons of each technique?
2. To test their understanding of this chapter, have students fill in the blanks in Part L column on page 34.
3. Encourage them to watch a video by scanning the QR code on page 34.
4. Guide whole class to discuss what they want to know more about separation techniques in Part W column on page 35.

5. Use the Mind Map on page 35 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.
7. Have students to do the questions in Mastery Practice on pages 25 to 28 of the Workbook as their homework.

Learning materials:

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

Assessment:

1. Assessing cognitive behavior; test on page 34 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

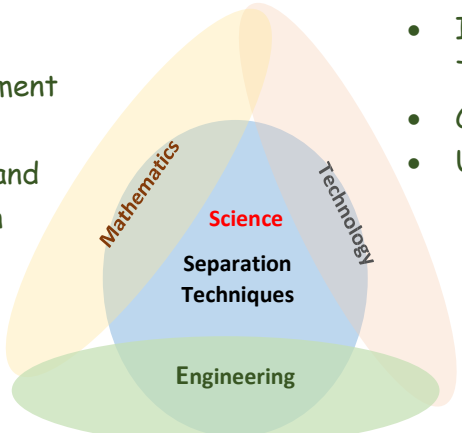
STEM Activity

Overview

Oil does not mix with water. That explains why oil spills on the ocean float on the surface. The water will sink and the oil floats on water. A liquid that is less dense than water will float on the water. A liquid that has a greater density will sink. It means that oil float on the surface because water is more dense than oil. In this activity, students will understand more about the density of two substances which cause a big problem in Thailand such as environmental problem. They will design and create a system to contain and then remove the oil from a tray of oil and water mixture. Then, they will test and share their ideas in class.

Subject integration

- Measurement time
- Number and operation



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

Engineering design process

Time: 5 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Review their understanding about the engineering design process by using the suggested questions:

(a) What is the engineering design process?

(b) What are the purposes of the engineering design process?

(c) Who uses the engineering design process?

3. Review their understanding about the properties of materials such as water absorption.

Lesson development:

1. Students read the situation on page 97. Then, teacher asks and leads the whole class to discuss in order to identify the problem. Teacher may use these sample questions:

   (a) What is the problem of this situation?

   (b) What are our missions?

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

   (d) What scientific knowledge is applied in this activity?

2. Enhance students to explore and make connections between science, technology, engineering and mathematics by posing the following sample questions:

   (a) What materials can float on the water? Why?

   (b) What will happen if there is oil float on the water?

   (c) What materials can absorb oil the best?

   (d) How do we know whether that material absorbs oil well?

   (e) What is a good organic oil absorbent?

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 the success criteria? (absorb oil in limited time, etc.)

4. Let students search for more information about absorbents. 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 device 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. Each group presents their devices and ideas. Teacher may use the sample questions:
   (a) What are the steps of your device?
   (b) What are the benefits of this activity?
   (c) Do all of you have the same ideas? Why or why not?
   (d) Do we need to work in team? Why or why not?

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 3 Static Electricity

Time: 7 hours

Strand 2: Physical Science

Standard Sc.2.2

Indicator

Sc.2.2 Gr.6/1 Explain the causes and effects of electric force which occurs from the polishing material using empirical evidence.

Introduction:

Static electricity is the buildup of electrical charges on the surface of an object. It's called “static” because the charges remain in one area rather than moving or “flowing” to another area.

There are two types of electrical charges on an object, namely the positive charge and the negative charge.

Learning objectives:

Students will be able to:

- Explain the causes and effects of electric force which occurs from the polishing material.
- Give examples of statistic electricity in daily life.

Competency:

Applying life skills, technological application skill

Concept:

- When two objects, that have been polished, are close together may pull or push each other. It causes electric force, which is distance force, occurring between two charged objects.
- There are two types of charges which are positive electrical charges and negative electrical charges. Objects with the same charge will push or repel each other while objects with opposite charges will pull or attract each other.

Start up:

1. To assess the students' prior knowledge, ask them what they knew (Part K) and what they want to know (Part W) on page 38.

Teaching/Learning activities:

1st – 6th hours (Static electricity)

1. Carry out Let's Try activity on page 39 to find out what happens when objects are rubbed together.
2. Whole class discusses and explains that when we rubbed things together, there will be an electric force. Certain objects when rubbed can attract other objects because of static electricity.
3. Teacher explains more information about static electricity. There are two types of charges, namely the positive charge and the negative charge. Refer to pages 40 to 42.
4. Teacher gives more examples of static electricity in daily life. Refer to page 42.
5. Explain about static electricity can build up in clouds. Refer to Let's Know More on page 42.
6. Have students to do the questions pages 31 to 33 of the Workbook as their homework.

7th hour (Conclusion)

1. To test their understanding of this chapter, have students fill in the blanks in Part L column on page 43.
2. Encourage them to watch a video by scanning the QR code on page 43.
3. Guide the whole class to discuss what they want to know more about static electricity in Part W column on page 44.
4. Use the Mind Map on page 44 to help students to understand the relationships between all the subtopics learned in this chapter.
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 34 to 37 of the Workbook as their homework.

Learning materials:

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

Assessment:

1. Assessing cognitive behavior; test on page 43 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

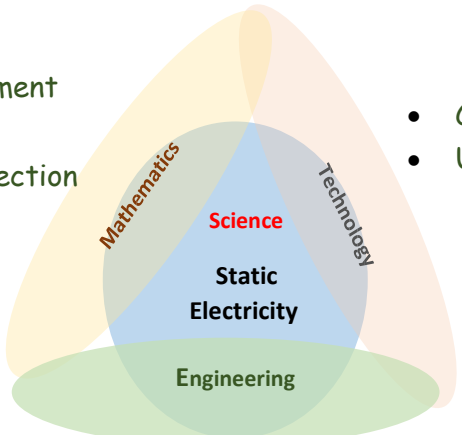
STEM Activity

Overview

Static electricity is the buildup of electrical charges on an object when it is rubbed with another object. There is a non-contact force between two electrically charged objects. Students are required to create a static flyer, an object that can 'fly' due to static electricity.

Subject integration

- Measurement time
- Data collection



- Construct simple device
- Using simple tools

Engineering design process

Time: 4 hours

Start up:

1. Review about the engineering design process and technology by asking some of these sample questions:
   (a) In our daily life, can we use the engineering design process for solving problem? How?
   (b) Give an example of using the engineering design process for solving problem.
2. Divide students into groups of 3 or 4.

Lesson development:

1. Students read a situation on page 45. Then, whole class discusses and identifies the problem by answering the following questions:
   (a) What is the 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 these following questions:
   (a) What happens when we rub two objects?
   (b) Can we make a lightweight object move by using static electricity?
   (c) According to Let's Try activity on page 39. What happened to the balloons? Why?
   (d) If we make something over the balloon, what will happen to that object?
   (e) What characteristic of that object if we want it fly for a long time?
3. Ask students to think about how to assess their project. Discuss in class and set their criteria by these following questions:
   (a) What are the success criteria?
   (b) What is a reliable measurement that shows our success? (Duration of fly in the air, etc.)
4. Students brainstorm and draw their designs including label materials. 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 trail and errors.)
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 their creative work and explains their journey of creating.

Conclusion:

1. Each group presents their ideas and work. Teacher should encourage peers to ask or give some comments.
2. End the lesson by asking students:
   (a) Can we use the engineering design process for solving problems in our daily life?

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 4 Electric Circuits

Time: 12 hours

Strand 2: Physical Science

Standard Sc.2.3

Indicator

Sc.2.3 Gr.6/1 Identify components and describe the functions of each component of a simple electric circuit from empirical evidence.

Sc.2.3 Gr.6/2 Draw a diagram of and build a simple electric circuit.

Sc.2.3 Gr.6/3 Design an experiment and experiment in an appropriate method to explain how to build a series electric circuit and its results.

Sc.2.3 Gr.6/4 Realize the benefits of the knowledge of series electric circuit by telling the benefits and applications in everyday life.

Sc.2.3 Gr.6/5 Design an experiment and experiment in an appropriate method to explain how to build series and parallel circuits with light bulbs.

Sc.2.3 Gr.6/6 Realize the benefits of the knowledge of series and parallel electric circuits with light bulbs by telling the benefits, limitations and applications in everyday life.

Introduction:

An electric circuit is the path along which the electric current flows. It is made up of a source of electricity, connecting wires and other components such as a switch and a bulb. The components of an electric circuit can be arranged in a series circuit or parallel circuit.

Learning objectives:

Students will be able to:

- Identify a simple electric circuit and the components of a circuit.
- Draw and set up simple open circuits and closed circuits.
- Compare and contrast between a series circuit and a parallel circuit.
- Set up series circuits and parallel circuits.
- State the uses of electric circuits.
- Tell the benefits, limitations and applications in everyday life of series and parallel electric circuits with light bulbs.

Competency:

Thinking capacity, problem solving capacity, applying life capacity, technological application capacity

Concept:

- A simple electric circuit is made up of a power source, connecting wires and other components such as a switch and a bulb. Power sources such as dry cells or batteries which supply electric power. Connecting wires are conductors that connect power sources to other components.
- When multiple cells are connected end to end by the opposite terminals connecting to each other, a series electrical circuit, it makes electric power suitable for electrical appliances. The series electrical circuit can be used in daily life such as an electrical circuit in flashlight.
- In a series circuit, when one bulb is removed, the other bulbs do not light up. The circuit becomes incomplete.
- In a parallel circuit, conversely, when one bulb is removed, the other bulbs will still light up. The electric current can still flow through the other branches in the circuit.

Start up:

1. To assess prior knowledge of students, ask what they knew (Part K) and what they want to know (Part W) on page 47.

Teaching/Learning activities:

1st – 6th hours (Simple electric circuits)

1. Carry out Let's Try activity on page 48 to make a torch lights up by using batteries. Students should conclude that batteries supply electricity for the torch to work. When electricity flows through the bulb, it lights up. The path along which the electric current flows is called the electric circuit.
2. Show students some bulbs, batteries, connecting wires and switches. Ask four students about the symbols of the bulbs, batteries, connecting wires and switches. Refer to page 49.
3. Carry out Let's Try activity on page 50 by using the bulbs, connecting wires and switches, building a few complete circuits. Ensure the bulbs light up. Draw the diagrams for the circuits.
4. Explain more about a complete circuit (or a closed circuit) and an incomplete circuit (or an open circuit). Refer to page 51.
5. Explain about Thomas Edison who invented the light bulb. Refer to Let's Know More on page 51.
6. Carry out Let's Try activity on page 52 to explain that we can make a bulb lights up brighter and dimmer.
7. Teacher explains more information that a bulb in a circuit lights up brighter when more electricity flows through it. This can be done by adding more batteries to the circuit. Whereas a bulb in a circuit becomes dimmer if more bulbs are added to the same circuit. Refer to page 53.
8. Explain about conductors and insulators, and give some examples. Refer to Let's Know More on page 53.

7th – 11th hours (Series and parallel circuits)

1. Build and explain series circuits and parallel circuits. Refer to Let's Try activity on page 54.
2. Explain to students about series circuits and parallel circuits and different effects of both types of electric circuits. Refer to pages 55 to 57.
3. Ensure to explain how to write series and parallel circuits diagrams.
4. Ensure that students understand about two types of circuits by asking students to do Let's Think on page 58.
5. Give examples of using parallel circuits in the house. Explain why parallel circuits are used in the electrical wiring of our houses.
6. Have students to do the questions on pages 42 to 48 of the Workbook as their homework.

12th hour (Conclusion)

1. Wrap up the class by using the following sample questions:
   (a) What are the components of an electric circuit?
   (b) What are closed circuits and open circuits? What are their differences?
   (c) What is the difference between series circuits and parallel circuits?
   (d) What type of circuit we use in our house? Why?
2. To test their understanding of this chapter, have students fill in the blanks in Part L column on page 59.
3. Encourage them to watch a video by scanning the QR code on page 59.
4. Guide the whole class to discuss what they want to know more about electric circuits in Part W column on page 60.
5. Use the Mind Map on page 60 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.

7. Have students to do the questions in Mastery Practice on pages 49 to 53 of the Workbook as their homework.

Learning materials:

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

Assessment:

1. Assessing cognitive behavior; test on page 59 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

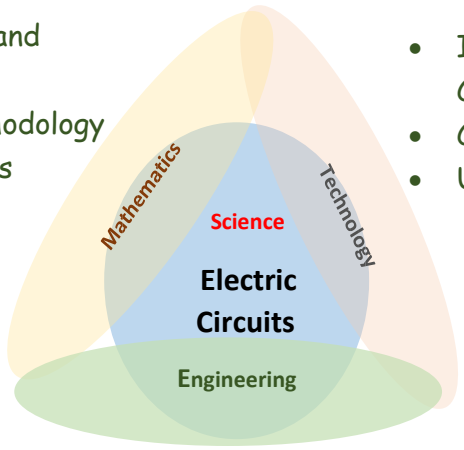
STEM Activity

Overview

A closed circuit is a complete path that allows electricity to flow. The components of the circuit are a source of electricity, connecting wires and other components such as a switch and a bulb. We always use electricity in our daily life. In this activity, students are required to design and create a better buzz wire circuit game and set the new rules for the game.

Subject integration

- Understanding and ability to apply statistical methodology for data analysis
- Mathematical reasoning



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

Engineering design process

Time: 5 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Review their understanding of the components of an electric circuit and the function of a battery, switches and wires.

Lesson development:

1. Students read the situation on page 61. Then, whole class discusses and identifies the problem by answering these questions:
   (a) What is the 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 these suggested questions:
   (a) What scientific knowledge is applied in this activity?
   (b) What are the essential components of an electric circuit?
   (c) What is the difficulty of playing the game?
   (d) Is the size of the loop making the game more exciting?
   (e) How do we get more information about a buzz wire circuit game?
   (f) Do we need to create a closed circuit?
   (g) What are insulators and conductors?
   (h) What materials can be used as conductors?
   (i) What may happen when the wires touch each other?
   (j) How can we report our experimental results? What type of chart is used?
3. Ask students to think about how to assess their project. Discuss in class and set their criteria with the following question:
   (a) What are the success criteria? (a buzz wire game with a new rule, etc.)
   (b) How do you assess your success? (a satisfaction survey)
4. Students brainstorm and draw their designs including label materials. Then, let them follow their plans and create. A diagram of the circuit can be drawn out to give students a better understanding and visual of what the circuit consists of and how it will work.

5. After they have finished their mission, ask them to test their device 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 their presentation.

Note:

You may get more information about the buzz wire circuit game via this link:

- http://www.miniscience.com/projects/BUZZWIRE/index.html

Conclusion:

1. Let them present and share their ideas. Teacher should peers to ask or give some comments.
2. End the lesson by asking the students:
   (a) Do your classmate like your game? Which is the most favorite part? (size, curve, rule, shape?)
   (b) What are the steps of your design?
   (c) Do all of you have the same ideas? Why or why not?

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 5 Light

Time: 5 hours

Strand 2: Physical Science

Standard Sc.2.3

Indicator

Sc.2.3 Gr.6/7 Explain umbra and penumbra from empirical evidence.

Sc.2.3 Gr.6/8 Write a diagram of light rays showing the formation of umbra and penumbra.

Introduction:

Light is a form of energy that enables us to see things around us. Light travels in straight lines in all directions. When light is blocked by an opaque object, a shadow is formed. The size of a shadow changes according to the distance between the object and the light source.

The darkest part of a shadow where the light is completely blocked by an object is called the umbra. The edges of a shadow receive some light from the light source. Therefore, the edges of the shadow appear lighter than its center. That part of the shadow is called the penumbra.

Learning objectives:

Students will be able to:

- Collect data and explain umbra and penumbra.
- Write a diagram of light rays showing the formation of umbra and penumbra.

Competency:

Communication skill, applying life skills

Concept:

- When an opaque object is placed to block the light rays, the shadow will appear on the screen behind the object and its shadow will shape similar to that object.
- Penumbra is the partly lighted area casting on the screen. Umbra is the area where the light is completely blocked. There is no light on the screen at all.

Start up:

1. Assess students' prior knowledge by asking what they knew (Part K) and what they want to know (Part W) on page 63.

Teaching/Learning activities:

1st – 4th hours (Umbra and penumbra)

1. Let students do Let's Try activity on page 64 to find out how a shadow is formed. Discuss and conclude that when light is blocked by an opaque object, it cannot pass through the object. Therefore, the area behind the object receives little or no light. The dark area behind the object is called the shadow.
2. Explain the location of a light source relative to the size of a shadow.
3. Teacher may use the sample questions:
   (a) Does distance between the light source and the object affect shadow size?
   (b) Will a light that is far away from an object cast a shadow similar in size to the object?
   (c) Will the shadow be enlarged or much bigger than the object itself when we move the light closer to the object?

4. Explain to students more about umbra and penumbra on pages 67 and 68.
5. Have students to do the questions on pages 65 to 67 of the Workbook as their homework.

5th hour (Conclusion)

1. Wrap up the class by using the following sample questions:
   (a) What happens when light hits an opaque object?
   (b) What are umbra and penumbra?
   (c) Does distance between the light source and the object affect shadow size?
   (d) Will the shadow be much smaller than the object itself when we move the light farther away from the object?
2. To test their understanding of this chapter, have students fill in the blanks in Part L column on page 69.
3. Encourage them to watch a video by scanning the QR code on page 69.
4. Guide the whole class to discuss what they want to know more about light in Part W column on page 70.
5. Use the Mind Map on page 70 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.
7. Have students to do the questions in Mastery Practice on pages 68 to 71 of the Workbook as their homework.

Learning materials:

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

Assessment:

1. Assessing cognitive behavior; test on page 69 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

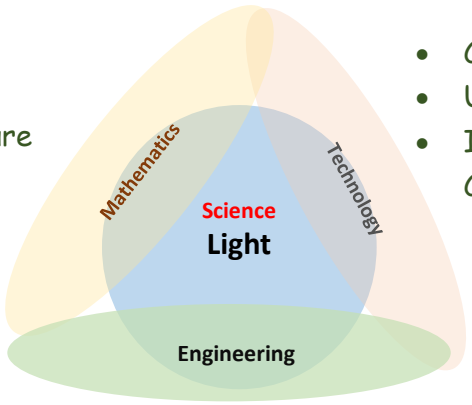
STEM Activity

Overview

This lesson will extend students' concept of light and the formation of shadow. An area of darkness formed by an opaque object obstructing light is called a shadow. In this activity, students are required to create a shadow of a tower by using toy bricks.

Subject integration

- Measurement
- Geometric figure



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

Engineering Design Process

Time: 3 hours

Start up:

1. Divide students into teams of 3 or 4.
2. Review their knowledge content on light.
   (a) How does light travel?
   (b) What happens when light cannot go through an opaque object?

Lesson development:

1. Students read the situation on page 71. Then, whole class discusses and identifies the problem by answering these questions:

(a) What is the problem of this situation?

(b) What are our missions?

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

2. Engage students to explore and make connections between science, technology, engineering and mathematics by posing these suggested questions:

   (a) What size and shape of the tower shadow should be?

   (b) What factors affect the shadow of the tower? (size, shape, distance between light source and tower, etc.)

   (c) How can we make the shadow of the object the tallest?

   (d) What is the height of your tower and the length of its shadow?

   (e) Can we make the tower with translucent material?

3. Ask students to think about how to assess their project. Discuss in class and set their criteria with the following question:

   (a) What are the success criteria? (length of shadow, etc.)

4. Students brainstorm and draw their designs including label materials. 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. Each group presents their ideas and results. Teacher should encourage peers to ask or give some comments.
2. End the lesson by asking the students:
   (a) What are the steps of your design?
   (b) Do you have same or different ideas? Why or why not?
   (c) Should we copy ideas from friends or from other sources? Why or why not?
   (d) What are the advantages of think, create, and do by yourself?
   (e) What should we do if our product is not satisfied?

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 6 Eclipses and Space Technology

Time: 9 hours

Strand 3: Earth and Space Science

Standard Sc.3.1

Indicator

Sc.3.1 Gr.6/1 Create a model that describes the happening of solar eclipse and lunar eclipse and compare the phenomena of solar and lunar eclipses.

Sc.3.1 Gr.6/2 Explain space technology development and give examples of the use of space technology in everyday life based on collected data.

Introduction:

There are some natural phenomena including solar eclipse and lunar eclipse. A solar eclipse occurs when the Moon passes in a direct line between the Earth and the Sun. A lunar eclipse happens when the Earth comes in between the Sun and the Moon.

Astronomy is the study of objects in the space like planets, stars, the Moon and the Sun. The invention of telescope, satellite, space probes, rocket, and space shuttles helps man in the study of astronomy.

Learning objectives:

Students will be able to:

- Explain and compare characteristics of stars and planets based on the model.
- Create a model that describes the happening of solar eclipse and lunar eclipse.
- Compare the phenomena of solar and lunar eclipses.

- Search for information to describe space technology development.
- Collect data and give examples of the use of space technology in everyday life.

Competency:

Thinking capacity, technological application capacity

Concept:

- When the Earth and the Moon orbit aligned with the Sun at the right distance, the Moon moves over the Sun and its shadow casts on Earth. The observers who are in the shadow area will see the Sun goes dark resulting in solar eclipse phenomenon. There are three types of solar eclipse which are total solar eclipse, a partial solar eclipse and an annular solar eclipse.
- If the Moon and the Earth orbit aligned with the Sun and the Moon moves through the Earth's shadow, blocking the Sun's light, so the Moon goes dark resulting in lunar eclipse phenomenon. There are total lunar eclipse and a partial lunar eclipse.
- Space technology begins with human needs to explore celestial objects with the naked eye, telescope and develop space transportation to explore space with rockets and spaceship. It has been continually developed until now. Currently, some space technologies have been applied in daily life.

Start up:

1. To assess prior knowledge by asking what students knew (Part K) and what they want to know (Part W) on page 73.
2. Talk about students' prior experience of such as:
   (a) What is the most important energy source for living things?
   (b) What are some of the natural phenomena that occur on Earth because of the Sun?

Teaching/Learning activities:

1st – 5th hours (Solar eclipse and lunar eclipse)

1. Carry out Let's Try activity on page 74 to understand type of shadow formed by the Moon.
2. Carry out Let's Try activity on page 75 to understand how solar eclipse and lunar eclipse occur.
3. Then, explain more about how solar eclipse and lunar eclipse occur. Refer to pages 76 to 79.
4. Explain more about effects of reflection and refraction of the sunlight through the Earth's atmosphere. Refer to Let's Know More on page 79.
5. Ask students to compare and contrast solar eclipse and lunar eclipse. Then make a multimedia presentation. Refer to Let's Find Out activity on page 79.

6th – 8th hours (Space technology)

1. Explain and discuss space technology. Explain about what astronomy, rocket, satellite, space probe and space shuttles are. Refer to pages 80 to 82.
2. Explain that space technology has been continually developed until now. Currently, some space technologies have been applied in daily life. Refer to pages 82 to 84.
3. Assign each group to find out more about the products and processes that have been derived from space technologies. Present and share their findings in class.
4. Have students to do the questions on pages 75 to 77 of the Workbook as their homework.

9th hour (Conclusion)

1. Wrap up the class by using the following sample questions:
   (a) What are the phases of the Moon?
   (b) How do the solar eclipse and lunar eclipse occur?
   (c) Do we have any advances in space exploration? How?

2. To test their understanding of this chapter, have students fill in the blanks in Part L column on page 85.
3. Encourage them to watch a video by scanning the QR code on page 85.
4. Guide the whole class to discuss what they want to know more about eclipses and space technology in Part W column on page 86.
5. Use the Mind Map on page 86 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.
7. Have students to do the questions in Mastery Practice on pages 78 to 82 of the Workbook as their homework.

Learning materials:

- Primary Education Smart Plus Science Textbook Prathomsuksa 6
- Primary Education Smart Plus Science Workbook Prathomsuksa 6
- Poster of solar eclipse and lunar eclipse

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).

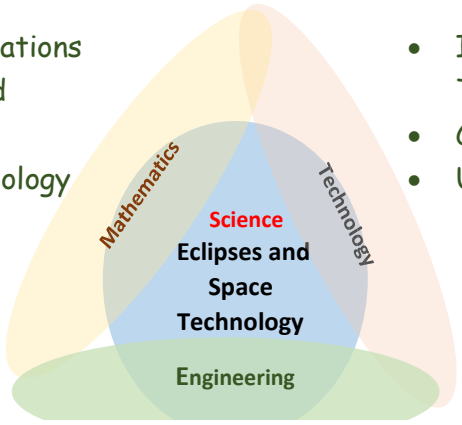
STEM Activity

Overview

Have you ever wondered what it would be like to live on Mars, Venus or Mercury? In this activity, students will search for information about the living conditions on each planet in our Solar System. Then pick a planet (except Earth) and create their future house on that planet.

Subject integration

- Numbers and operations
- Understanding and ability to apply statistical methodology for data analysis



Engineering design process

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

Time: 5 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Review their understanding of the engineering design process.
3. Ask them how to search for more astronomical advance. They should tell that how to decide that which website is reliable information.

Lesson development:

1. Students read the situation on page 87. Then, whole class discusses and identifies a problem by answering the following questions:
   (a) What is the problem of this situation?
   (b) What are our missions?
   (c) What do you need to know to get started?
2. Let them explore and make connections between science, technology, engineering and mathematics by posing these suggested questions:
   (a) What are the planets in the solar system?
   (b) What characteristics of the planets in the solar system?
   (c) What are the living conditions of human being?
   (d) What planets should you choose for your work? Why?
   (e) How do you get more reliable information about the astronomical advance?
   (f) What tools and materials do you need?
   (g) How can human being survive on the planet that you choose?
   (h) What are the components of the house? How many rooms are there in the house? How many floors are there in the house?
   (i) How can we report our experimental results? What type of chart is used?
3. Ask students to think about how to assess their project. Discuss in class and set their criteria with the following question:
   (a) What are the success criteria? (a house, etc.)
4. Students brainstorm and draw their designs including label materials. 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 group prepares their presentation.

Conclusion:

1. Let students present their works and share their ideas.
2. Wrap up the lesson by asking the students:
   (a) What are the steps of your device?
   (b) Do all of you have the same ideas? Why or why not?
   (c) Is teamwork important for your success?
   (d) What are key factors to success in work?
   (e) What subjects do you apply when you design and create your works?

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 7 Rocks

Time: 10 hours

Strand 3: Earth and Space Science

Standard Sc.3.2

Indicator

Sc.3.2 Gr.6/1 Compare the formation processes of igneous rocks, sedimentary rocks and metamorphic rocks, and explain the rock cycle from the model.

Sc.3.2 Gr.6/2 Describe and give examples of daily use of rocks and ores from collected data.

Sc.3.2 Gr.6/3 Create a model that explain the formation process of fossils and predict the past environment of fossils.

Introduction:

Rocks can be divided into three main groups, based on the ways they are formed. They are igneous, sedimentary, and metamorphic rocks. Each type has their own characteristics.

The rock cycle is a continuous process by which rocks are formed, changed from one form to another, broken down and then formed again.

Learning objectives:

Students will be able to:

- Describe different types of rocks.
- State examples of rocks.
- Compare the formation processes of each type of rocks.
- Compare and contrast the types of rocks and their transformation.
- Describe the rock cycle from a model.

- Give examples of daily use of rocks.
- Create a model that explain the formation process of fossils and predict the past environment of fossils.

Competency:

Communication capacity, thinking capacity, technological application capacity

Concept:

- Stone is a naturally occurring solid substance consisting of one or more minerals. There are three types of rocks, according to the formation processes: igneous rock, sedimentary rocks and metamorphic rocks.
- The three types of natural stones have changed from one type to another or the same type with the constant and continuous pattern of changes like cycle.
- Each type of rocks and minerals has different characteristics and properties. People make use of minerals in their daily lives in different ways, such as making cosmetics, toothpaste, jewelry, medical equipment and using rocks in various construction works.
- Fossils are formed by deposition or accumulation of living organisms in the past, so the structure of the remains or traces of life appeared in the rocks. In Thailand, various fossils such as plants, corals, shellfish, fish, turtles, dinosaurs and animal footprints are found.
- Fossils can be used as evidence to explain the environment of that area in the past. For example, if you find fossils of freshwater mussels, the environment may have been a freshwater source. And if plant fossils are found, the surroundings in that area may have been the forest. In addition, fossils can also be used to indicate the age of the rocks and provide data for the study of the evolution of life.

Start up:

1. To assess prior knowledge by asking what students knew (Part K) and what they want to know (Part W) on page 89.

Teaching/Learning activities:

1st – 4th hours (Types of rocks and rock cycle)

1. Explain about three types of rocks. Rocks can be categorized by how they are formed – igneous rocks, sedimentary rocks and metamorphic rocks.
2. Refer to pages 90 and 91 for the formation of igneous rocks and their characteristics. Conclude that igneous rocks are formed from the cooling of molten magma. They also study some examples of igneous rocks including granite, obsidian, basalt and pumice.
3. Carry out Let's Try activity on page 92 to understand how sedimentary rocks are formed.
4. Refer to pages 93 to 95 for the formation of sedimentary rocks and their characteristics. There are obvious layers in these rocks. Give some examples of sedimentary rocks.
5. Explain metamorphic rocks and how they are formed. Emphasize that metamorphic rocks are formed due to very high pressure and heat. Under these great conditions, rocks change into metamorphic rocks without melting. Refer to pages 96 and 97.
6. Know about geology and geologist. Refer to Let's Know More on page 96.
7. Ask students to make comparisons among the three types of rocks. Then share in class. Refer to Let's Find Out on page 97.
8. Carry out Let's Try Activity on page 98 to understand the rock cycle.
9. For more details about the rock cycle, refer to page 99.

5th – 6th hours (Uses of rocks and ores)

1. Rocks play an important part in our everyday lives. Rocks are used in many ways, depending on the characteristics of the rocks. Explain to students about the uses of rocks and minerals, and their ores. Give some examples of minerals from rocks which are used in cosmetics, jewelry, medicine and construction works. Refer to pages 100 to 103.
2. Assign them to find out other uses of rocks and minerals, then make a poster to present in class.

7th – 9th hours (Fossils)

1. Explain why the rocks usually have fossils. Fossils are the naturally preserved remains or trace of a living thing of a past geologic age.
2. Ask them to think about the formation of sedimentary rocks, why we usually found fossils.
3. Fossils are usually found in sedimentary rocks especially in limestone, sandstones and shales. Igneous and metamorphic rocks rarely contain fossils. Explain why.
4. Carry out Let's Try activity on page 106 to make our own fossils and to understand how fossils are made.
5. Explain that fossils can provide us with a lot of information. Fossils can be used as evidence to explain about the past environment of the area where the fossils are found. Give them some examples. Refer to pages 107 and 108.
6. Have students to do the questions on pages 87 to 91 of the Workbook as their homework.

10th hours (Conclusion)

1. Wrap up the class by using the following sample questions:
   (a) What are the three types of rock? How are they formed?

(b) State examples of rocks.

(c) What is the rock cycle?

2. To test their understanding of this chapter, have students fill in the blanks in Part L column on page 109.
3. Encourage them to watch a video by scanning the QR code on page 109.
4. Let the whole class discuss what they want to know more about rocks in Part W column on page 110.
5. Use the Mind Map on page 110 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.
7. Have students to do the questions in Mastery Practice on pages 92 to 96 of the Workbook as their homework.

Learning materials:

- Primary Education Smart Plus Science Textbook Prathomsuksa 6
- Primary Education Smart Plus Science Workbook Prathomsuksa 6
- Examples of rocks
- Rock cycle poster
- Video clip about rocks such as https://www.911metallurgist.com/blog/classes-of-rocks

Assessment:

1. Assessing cognitive behavior; test on page 109 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

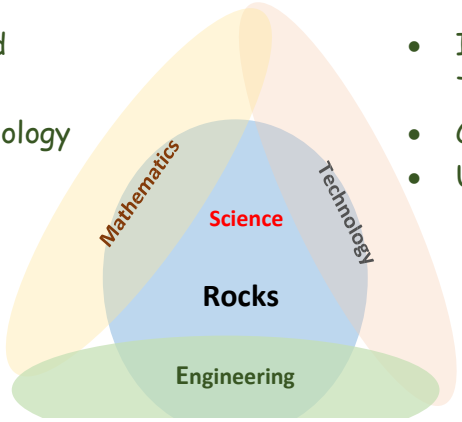
STEM Activity

Overview

Rocks are the most common material on Earth. We can group rocks in three major types based on how they are formed: igneous, sedimentary and metamorphic rocks. Each group contains a collection of rock types that differ from each other on the basis of the size, shape, and arrangement of mineral grains. Geologists use the rock cycle to explain how the three types of rock are related to each other. They also describe how Earth processes change a rock from one type to another through geologic time. In this activity, students will search for more information about rocks. Then, they will design a project that shows their knowledge of the rock cycle and the three types of rocks.

Subject integration

- Understanding and ability to apply statistical methodology for data analysis



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

Engineering design process

Time: 4 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Recall them about the engineering design process. Refer to previous activity.

3. Review their understanding of rocks and the rock cycle.

Lesson development:

1. Students read the situation on page 111. Then, guide the whole class to discuss and identify the problem by answering to these questions:
   (a) What is the problem of this situation?
   (b) What 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 these following questions:
   (a) What is your target group or what age group that will study your rock project?
   (b) What is the rock cycle?
   (c) How is each type of rock formed?
   (d) Can you list some examples of each type of rock?
   (e) How can we collect some examples of rocks?
   (f) What are the characteristics of igneous rocks, sedimentary rocks, and metamorphic rocks?
   (g) What is the meaning of 3-dimensional?
   (h) Are there many types of presentations? What are they?
   (i) What details should you include in your project? (Name of rock, characteristic, example, age, etc.)
   (j) What website can you get more information about rocks?
   (k) What tools do you need? How do you use those tools?
3. Ask students to think about how to assess their project. Discuss in class and set their criteria by these following questions:
   (a) What are the success criteria? (Rock project include knowledge of the rock cycle and the three types of rocks, etc.)

(b) How do they test their project? (Ask the target group to rate their work? Is it easy to understand? Neat, colorful, 3-D?)

4. Students brainstorm and draw their designs including label materials. Then, let them follow their plans and create.
5. After they finish their mission, ask them test their product by using the criteria in #3. Teacher may use these 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 their presentation.

Conclusion:

1. Each group presents their projects and share their ideas.
2. End the lesson by asking students:
   (a) What are the steps of your device?
   (b) What are the benefits of this activity?
   (c) Do all of you have the same ideas? Why or why not?
   (d) What are key words for success in your work?

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 8 Wind and Monsoons

Time: 8 hours

Strand 3: Earth and Space Science

Standard Sc.3.2

Indicator

Sc.3.2 Gr.6/4 Compare the formation of wind, sea breeze, and monsoons, as well as explain the effects on organisms and the environment from the model.

Sc.3.2 Gr.6/5 Explain the effects of monsoons on the causes of the seasons in Thailand based on collected data.

Introduction:

Wind is the moving air. When air is heated, the warm air will rise. When air is cooled, the cold air will sink. In Thailand, students experience three different seasons in a year. They will learn what causes the three different seasons? What is the season that we are having now?

Learning objectives:

Students will be able to:

- State and explain the formation of wind, sea breeze, and monsoons.
- Compare the formation of wind, sea breeze, and monsoons.
- Explain the effects on organisms and the environment from the model.
- Collect data and explain the effects of monsoons on the causes of the seasons in Thailand.

Competency:

Problem solving capacity, applying life capacity, technological application capacity

Concept:

- Land breezes, sea breezes, and monsoons are formed when the temperature of the land and the water is different. As a result, the temperature of the air above the land and the water surface is different causing the movement of air from the low temperature to high temperature.
- Land breezes and sea breezes are local winds found in coastal areas. Land breezes occur at night resulting in the wind blows from the land to the sea. Sea breezes occur during the day caused the wind blows from the sea to the land.
- Monsoon is a seasonal wind occurring in the tropical area of the world. Thailand was affected by the northeast monsoon in mid-October to February, resulting in a winter season. The result of the Southwest Monsoon in mid-May to mid-October caused a rainy season. The mid-February to mid-May period is a period of monsoon's changes. Thailand is near the equator, apparently the Sun is almost upright and upright at noon in Thailand. Therefore, Thailand fully gets the heat from the Sun and the weather is so hot caused a summer season.

Start up:

1. Talk about the weather during a week, and then ask some questions:

(a) How was the weather last week?

(b) How is the weather this week?

(c) Was the weather this week the same or different from the weather last week? How? Why?

(d) Do other countries such as UK, USA, or China have the same weather as our country? How? Why?

2. To assess prior knowledge by asking what students knew (Part K) and what they want to know (Part W) on page 113.

Teaching/Learning activities:

1st – 4th hours (Wind)

1. Wind is the moving air. Why does air move? Carry out Let's Try activity on page 114 to find out how warm air and cool air move.
2. Explain how wind is produced. Use the text on pages 115 and 116.
3. Have students work on Let's Think on page 117 to find out why air conditioners are not placed on the floor. Teacher may assign students to ask school technician or search for more information via the internet. Then, share their answers in class and discuss.
4. What are sea breeze and land breeze? How are they formed? Refer to pages 117 to 119 to guide students to understand both breezes.
5. Carry out Let's Try activity on page 117 to understand which gets heated up faster and which cools faster.
6. Explain to students about the sea breeze and land breeze. Teacher may ask them:
   (a) What occupation should understand and apply their knowledge of land breeze and sea breeze to their daily living?
   (b) How do they apply?
   (c) When should we play or swim in the sea, early morning or evening? Why?
7. Assign students to compare the sea breeze and land breeze. Make a poster and present findings in class.

5th – 7th hours (Monsoons)

1. In Thailand, students experience three different seasons in a year. They will learn what causes the three different seasons. What is the season that we are having now? Explain about monsoons.
2. Carry out Let's Try activity on page 121 to understand how the Northeast Monsoon occurs.

3. Explain more about the Northeast Monsoon. Teacher may ask them:
   (a) When does the Northeast Monsoon occur in Thailand?
   (b) What are the causes of the Northeast Monsoon?
   (c) What are the effects of the Northeast Monsoon?

   Refer to page 122.
4. Carry out Let's Try activity on page 123 to understand how the Southwest Monsoon occurs.
5. Explain more about the Southwest Monsoon. Teacher may ask them:
   (a) When does the Southwest Monsoon occur in Thailand?
   (b) What are the causes of the Southwest Monsoon?
   (c) What are the effects of the Southwest Monsoon?
   (d) What differences between the Southwest Monsoon and the Northeast Monsoon?
6. Assign them to discuss and plan to do a survey among their classmates. What season do they like most? Why? What are the activities that they can do during the three seasons in Thailand? Then present their findings in class.
7. Have students to do the questions on pages 101 to 103 of the Workbook as their homework.

8th hours (Conclusion)

1. To test their understanding of this chapter, have students fill in the blanks in Part L column on page 127.
2. Encourage them to watch a video by scanning the QR code on page 127.
3. Let the whole class discuss what they want to know more about wind and monsoons in Part W column on page 128.
4. Use the Mind Map on page 128 to help students to understand the relationships between all the subtopics learned in this chapter.

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 104 to 108 of the Workbook as their homework.

Learning materials:

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

Assessment:

1. Assessing cognitive behavior; test on page 127 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

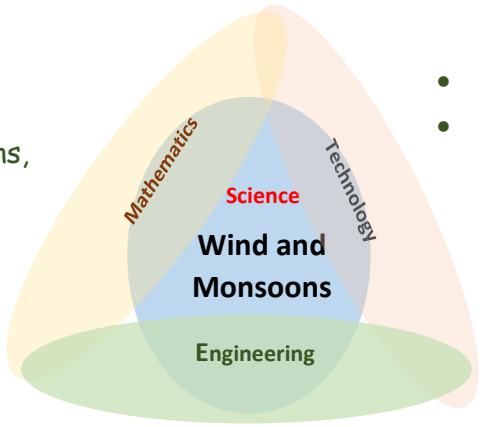
STEM Activity

Overview

With proper knowledge of the wind direction, people throughout the centuries were able to predict the weather based on experience and knowledge of surrounding climates. In this activity, students will apply their knowledge of wind and eco-design features to design and create their wind vane (also called a weather vane) that features their local culture. After they finish, their wind vane should be able to measure wind direction.

Subject integration

- Understanding and ability to apply statistical methodology for data analysis
- Understanding results of operations of numbers, relationships of operations, and application of operations for problem-solving
- Ability to explain and analyse two-dimensional and three-dimensional



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

Engineering design process

Time: 5 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Review their prior knowledge from the previous activity about the engineering design process. Teacher may use these suggested questions:

(a) What did you design and create in the last chapter?

(b) How is it? Are you satisfied with your work? Why? Or why not?

(c) What are the steps for designing and creating your product?

Lesson development:

1. Students read the situation on page 129. Lead them by using these sample questions:
   (a) What are our missions?
   (b) What do you need to know to get started?
   (c) How do we get more information about the wind vane?
2. Enhance students to explore and make connections between science, technology, engineering and mathematics by posing these following questions:
   (a) What is a wind vane?
   (b) How does a wind vane work?
   (c) What is the purpose of a wind vane besides measuring wind direction?
   (d) How do we use the wind vane?
   (e) What are the parts of wind vane affected by the wind?
   (f) What science concept is connected to wind vane?
   (g) Does the size of the wind vane affect its quality?
   (h) What tools and materials should be selected for creating a wind vane?
   (i) What is eco-design?
3. Ask students to think about how to assess their project. Discuss in class and set their criteria by these following questions:
   (a) What are the success criteria? (wind vane that can rotate and measure wind direction, etc.)
4. Provide them a computer tool to search for additional information about their local culture, weather vane and eco-design. Let them brainstorm and

draw their designs including label materials. Then, let them follow their plans and create. (Teacher should walk around, observe, ask and discuss with them for further suggestions.

5. After they finish their mission, ask them test their wind vane by designing some experiments and test by using their 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. Ask them to present their products and share their ideas. Teacher may use these sample questions:
   (a) What did you design and create? What is its name?
   (b) Why do you design your wind vane different from others?
   (c) What are the steps of your design?
   (d) Do we need to test our prototype? How?
   (e) Do all of you have the same ideas? Why or why not?

Assessment:

Refer to Scoring Rubric for STEM Activities.

Chapter 9 Natural Disasters and Greenhouse Effect

Time: 8 hours

Strand 3: Earth and Space Science

Standard Sc.3.2

Indicator

Sc.3.2 Gr.6/6 Describe the characteristics and the effects of flood, erosion, landslide, earthquake and tsunami.

Sc.3.2 Gr.6/7 Realize the impacts of natural disasters and geohazards by presenting the guidelines to monitor and protect yourself from natural disasters and local geohazards that may happen.

Sc.3.2 Gr.6/8 Create a model to explain the greenhouse effect and the effects of the greenhouse effect on living organisms.

Sc.3.2 Gr.6/9 Realize the impacts of greenhouse effect phenomena by presenting the practices to reduce the activities that cause greenhouse gases.

Introduction:

Floods, erosion, landslides, earthquakes and tsunamis are the natural events that negatively affect the lives of humans and the environment. Some of the natural disasters are due to geohazards. Geohazards are events caused by geological processes that have devastating effects on lives and properties.

The greenhouse effect is the process of trapping heat by the atmosphere to keep the Earth warm. Strengthening of the greenhouse effect through human activities is known as the enhanced greenhouse effect.

Learning objectives:

Students will be able to:

- Describe the characteristics and the effects of flood, erosion, landslide, earthquake and tsunami.
- Realize the impacts of natural disasters and geohazards.
- Present guidelines for monitoring and protecting yourself from natural disasters and local geohazards that may happen.
- Create a model to explain the greenhouse effect and the effects of the greenhouse effect on living organisms.
- Realize the impacts of greenhouse effect.
- Present the practices to reduce the activities that cause greenhouse gases.

Competency:

Problem solving capacity, applying life capacity, technological application capacity

Concept:

- Flooding, coastal erosion, landslides, earthquakes and tsunamis have different impacts on life and the environment.
- People should learn how to keep themselves safe from geohazards, such as always listening to the news, preparing survival bag that always ready to use and following the instructions of parents and officers strictly during the natural disasters and geohazards occur.
- The greenhouse effect is caused by greenhouse gases in the Earth's atmosphere trapping heat and partially releasing heat to the Earth's surface makes the Earth's climate suitable for living.

- If the greenhouse effect is more severe, it will affect global climate change. Therefore, human beings should reduce the activities that cause greenhouse gases.

Start up:

1. To assess prior knowledge by asking what students knew (Part K) and what they want to know (Part W) on page 131.
2. Let them watch video clips about natural disasters or environmental problems such as at:
   - https://www.youtube.com/watch?v=D7FC4J2OlKI
     (Monsoon natural disaster in Thailand Bangkok / Flooding Thailand)
   - https://www.unicef.org/emergencies/Thailand_66391.html
     (Children affected by Thailand's worst flooding speak out about their experiences)
   - https://reliefweb.int/report/thailand/iom-trains-thai-camp-managers-cope-future-natural-disasters
     (IOM Trains Thai Camp Managers to Cope with Future Natural Disasters)
3. Then, let students discuss:
   (a) What do they watch?
   (b) What are the problems and their causes?
   (c) What will we do when we face the disaster?

Teaching/Learning activities:

1st – 4th hours (Natural disasters)

1. Carry out Let's Try activity on page 132 to understand that how floods occur.
2. Explain about floods and their effects. How do we keep ourselves safe before, during and after a flood? Refer to pages 133 to 135.

3. Assign each group to search for more information about flooding in Thailand in 2011 via the internet in school. Ask them to discuss and analyze, then make a multimedia presentation to show their findings. Refer to Let's Find Out on page 135.
4. Erosion is the wearing down and removal of rocks and soil materials by natural processes, mainly by running water, glaciers, wind and waves. Explain the process, effects, and ways to prevent erosion. Refer to pages 136 to 141.
5. Teacher may let them watch video clips to understand more about erosion process such as:
   https://study.com/academy/lesson/erosion-definition-causes-effects.html
   (Erosion: Definition, causes & effects)
   https://www.youtube.com/watch?v=QV2HOfcCJaM
   (Types of erosion (coast & river) - diagram and explanation)
6. A landslide is the movement of rocks or soil materials down a slope. Explain the process and effects of landslides. How do we keep ourselves safe before, during, and after a landslide? Refer to pages 142 and 143.
7. Explain about earthquakes. How does it occur and what unit measure of an earthquake? Refer to page 144.
8. Carry out Let's Try activity on page 145 to understand what happens to the people and buildings during an earthquake.
9. Explain how earthquake affect humans and the environment. How do we keep ourselves safe before, during, and after an earthquake? Refer to pages 146 to 149.
10. Teacher may ask students to search for more information about earthquakes in Thailand. What are their effects? Explain to them about the strongest earthquake in Thailand in May 2014. Refer to Let's Know More on page 149.

11. To understand what causes a tsunami, carry out Let's Try activity on page 149.
12. Explain the process, effects, and how we keep ourselves safe before, during, and after a tsunami. Refer to pages 150 to 152.

5th – 7th hours (Greenhouse effect)

1. Carry out Let's Try activity on page 153 to understand what the greenhouse effect is. They should understand that heat cannot pass through the glass and hence it is trapped in the greenhouse. This will affect all living things and the environment.
2. Explain more about how the greenhouse effect occurs, activities that release more greenhouse gases, and its impacts on the living things on Earth. Refer to pages 155 to 158.
3. Lead to discuss in class how we can reduce the impact of the severe greenhouse effect. Ask them to brainstorm and present the practices to reduce the activities that cause greenhouse gases.
4. Assign each group to conduct a survey in their community to find out awareness on the impacts of the severe greenhouse effect. Ask them to create a greenhouse model to explain the greenhouse effect and a poster to raise the awareness of the importance of reducing greenhouse gases and the ways to do so. Refer to Let's Find Out on page 160. Teacher should arrange an exhibition for showing their products.
5. Have students to do the questions on pages 115 to 118 of the Workbook as their homework.

8th hours (Conclusion)

1. Wrap up the class by using the following sample questions:
   (a) What are characteristics and the effects of flood, erosion, landslide, earthquake and tsunami?

(b) What are the impacts of natural disasters and geohazards?

(c) What are the guidelines to monitor and protect yourself from natural disasters and local geohazards that may happen?

(d) What are the impacts of the greenhouse effect phenomena?

(e) How can you reduce the activities that cause greenhouse gases?

2. To test their understanding of this chapter, have students fill in the blanks in Part L column on page 161.
3. Encourage them to watch a video by scanning the QR code on page 161.
4. Let the whole class discuss what they want to know more about natural disasters and greenhouse effect in Part W column on page 162.
5. Use the Mind Map on page 162 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.
7. Have students to do the questions in Mastery Practice on pages 119 to 123 of the Workbook as their homework.

Learning materials:

- Primary Education Smart Plus Science Textbook Prathomsuksa 6
- Primary Education Smart Plus Science Workbook Prathomsuksa 6
- Viedo clips of natural disasters and greenhouse effect

Assessment:

1. Assessing cognitive behavior; test on page 161 (Part L).
2. Assessing affective behavior (refer to Scoring Rubric for Affective Domain).
3. Assessing thinking process (refer to Scoring Rubric for Scientific Thinking).

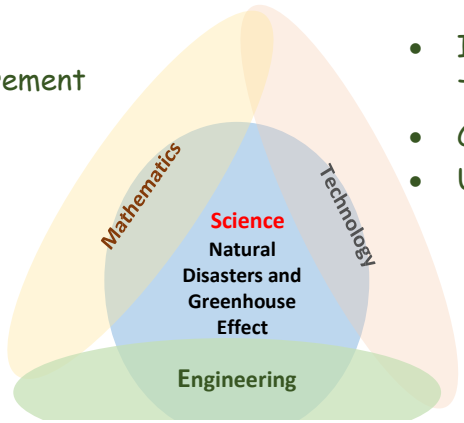
STEM Activity

Overview

Through this activity, students are introduced to work in teams to develop a dam. They will understand the function and engineering of dams and how they have many uses and solve many problems in the world. They will search for information about different types of dams and materials. Students will build a dam in a water trough, and then test it and share their experiences with the class.

Subject integration

- Measurement



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

Engineering design process

Time: 5 hours

Start up:

1. Divide students into groups of 3 or 4.
2. Discuss with students that how engineers solve problems and how a dam can create an energy source.

Lesson development:

1. Students read the situation on page 163. Then, guide the whole class to discuss and identify the problem by answering to these questions:

(d) What is the problem of this situation?

(e) What are our missions?

(f) 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 these following questions:

(a) Why do engineers build a dam?

(b) Can humans use the dam to reduce flood?

(c) What scientific knowledge do engineers apply when they have to build dams? (Water pressure, force?)

(d) Is there any force under water?

(e) In general, how do humans stop the water?

(f) Is there any force in a water trough?

(g) What materials do you need?

(h) Can you search for information about dams? What are their properties and characteristics?

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

(a) What are the success criteria? (A dam in a water trough, etc.)

4. Let students search for more information about dams. Let them brainstorm and draw their designs including label materials. 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 test their device by designing some experiments by using the criteria in #3. Teacher may use these 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 devices and share their ideas. Teacher may use the following sample questions:
   (a) What are the steps of your device?
   (b) Do all of you have the same ideas? Why or why not?
   (c) What are scientific and mathematical knowledge used in this activity?
   (d) Are your team member important to you in this activity? 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