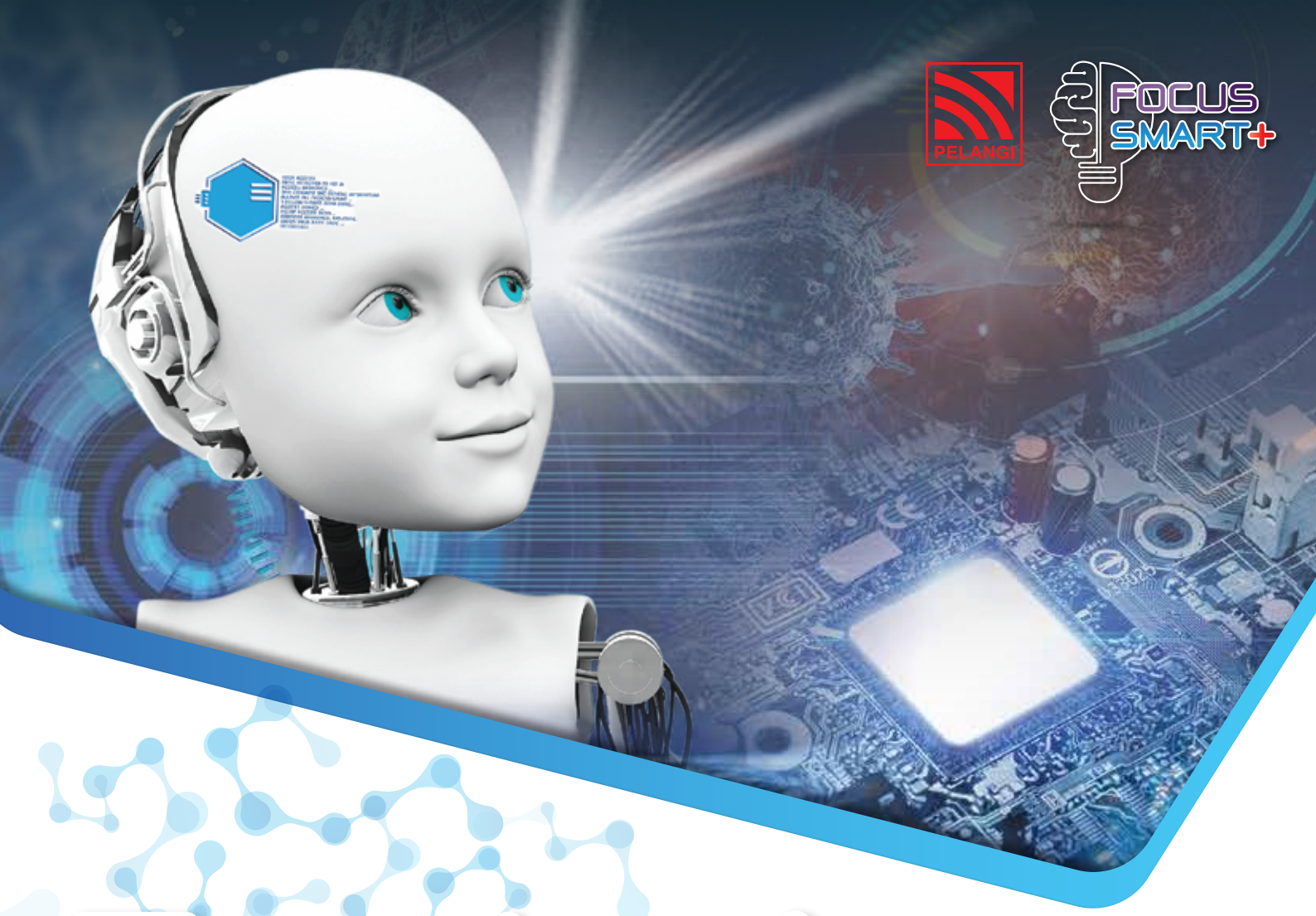


PELANGI

FOCUS SMART+

Teacher's Guide SCIENCE

Mathayom 2

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

asean

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: Biological Science

Strand 2: Physical Science

Strand 3: Earth and Space Science

Strand 4: Technology

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

Students not only need to know and understand the basic knowledge of science, but also to apply it in their daily lives and hopefully when they further their studies in the disciplines of science. The contents of each strand are relevant and suitable for each level, neither too easy nor too difficult. There are also links between the knowledge, the learning process and learning activities that encourage students to develop thinking skills which include analytical, creative and critical thinking skills. Besides that, students are encouraged to develop science process skills and also the 21st century skills. These skills allow students to be lifelong 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:

❖ Biological 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 Science and Space

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 Standards

Strand 1: Biological 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 for Grade 9 Students

- Understand the features and the main elements of cells of organisms, the relationships among the functions of the body systems in humans, plant's life, genetic transmission, the changes in genes or chromosomes and the examples of diseases caused by genetic changes, the benefits and impacts of Genetically Modified Organisms, biodiversity, the interactions between the components of the ecosystem, and the energy transfer in living organisms.

- Understand the components and properties of elements, solvents, pure substances and mixtures, the principles of separation, the changes in substances according to changes of states of matter, solution formation, the chemical reactions, physical properties of matter and the uses of polymers, ceramics and composites.

- Understand motion, resultant force and the effects of the resultant force acting on objects, the moment of a force, forces in daily life, field forces, the relationship of energy, kinetic energy, gravitational potential energy, the law of conservation of energy, energy transfer, heat balance, the relation of electrical quantities and home electrical circuits, electrical energy, and the fundamentals of electronic circuits.

- Understand the properties of waves and the characteristics of different waves, light, reflection and refraction of light and visual equipment.

- Understand the planets around the sun, seasons, the movement and appearance of the sun, lunar phases, the rise and fall of the moon, tides, the benefits of space technology and the development of the space exploration program.

- Understand the characteristics of the atmosphere, the components of weather and factors affecting the weather, the causes and effects of thunderstorms and tropical cyclones, weather forecast, the world climate changes, fossil fuel formation, the utilization renewable energy, the internal structure of the Earth, geological changes on the crust, soil layers, soil formation, surface water, groundwater, the causes and effects of natural disasters and geohazards.

- Understand the key concepts of technology such as technology system and technology change, the relationship between technology and science and mathematics, the analysis, comparison and decision making in selecting and using technologies with consideration for the impacts on life, society and environment. Apply knowledge, skills and resources to design and create solutions for everyday problems or career by using engineering design processes and choosing materials, equipment and tools properly, appropriately and safe, including being aware of the intellectual property rights.

- Take the primary data into the computer system, analyze, evaluate and present the data and information for the purpose to solve problems. Use computational thinking skills to solve real-life problems and write a simple program to help solve problems with the sense of social responsibility.

- Ask questions or identify problems associated with the evidences. Predict many answers and create a hypothesis that can lead to an investigation with controlled variables. Design and investigate using appropriate

materials and tools. Use proper tools and information technology to collect both quantitative and qualitative data accurately and safely.

- Analyze and assess the correspondence of the collected data from evidence by using the knowledge and principles of science to interpret, conclude and communicate ideas and knowledge from various investigations or using information technology to facilitate the understanding of the information.

- Show interests, commitment, responsibility, prudence and honesty in the subject being studied. Be creative to study on your own interests by using the right and reliable tools and methods. Further study from various sources of knowledge, show your opinions, listen to other people's comments and accept the changes of knowledge discovered when there are more data and the new testimonies or another argument.

- Realize the values of science and technology knowledge used in daily life. Apply knowledge, technology and scientific processes in life. Praise and respect the rights of the inventors. Understand both positive and negative impacts of scientific development on the environment and other elements. Study more and conduct more projects or create pieces of work according to your own interests.

- Appreciate, concern, care and maintain the balance of ecosystems and biodiversity.

Yearly Teaching Plan

Science **Grade 8 (Mathayom 2)**

9 chapters **120 hours**

Learning areas	Time (hours)
1. Human Body Systems • Respiratory System • Excretory System • Circulatory System • Nervous System • STEM Activity	**19**
2. Human Reproduction • Male Reproductive System • Female Reproductive System • Puberty • Menstrual Cycle • Fertilization and Pregnancy • Importance of Pre-natal Care • Importance of Research in Human Reproduction	**15**
3. Mixtures • Separating Mixtures • Solutions • STEM Activity	**11**
4. Forces • Resultant Force on the Same Plane (Net Force) • Liquid Pressure and Buoyancy • Friction • Moment of Force • Natural Fields • STEM Activity	**27**

5. Motion • Scalar and Vector Quantities • Distance and Displacement • Speed and Velocity • STEM Activity	**10**
6. Work and Energy • Work and Power • Simple Machines • Energy • STEM Activity	**11**
7. Earth • Layers of the Earth • Slow Processes that Change the Surface of the Earth • Sources of Energy • STEM Activity	**11**
8. Soil • Soil • Soil Formation • Soil Uses and Soil Improvement • STEM Activity	**10**
9. Water • Surface Water and Groundwater • Hazards due to Surface Water and Groundwater	**6**

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

Chapter 1 – Human Body Systems (19 hours)

Learning Standards and Learning Areas

Learning Standards	Learning Areas
Standard Sc. 1.2 1. Identify the organs and describe the function of the organs involving in the respiratory system. 2. Explain the mechanisms of inhalation and exhalation using models including describing the process of gas exchange. 3. Realize the importance of respiratory system by suggesting the guidelines to take care of the respiratory organs to function normally.	• Respiratory system
4. Identify the organs and describe the functions of the organs in the excretory system for the elimination of waste products in kidneys. 5. Realize the importance of the excretory system for the elimination of waste products in kidneys by suggesting the guidelines for their practice to facilitate the excretory system to function normally.	• Excretory system
6. Describe the structures and functions of the heart, blood vessels and blood. 7. Explain the process of circulatory system using a model. 8. Design and conduct an experiment to compare the normal heart rate and the heat rate after doing activities.	• Circulatory system

9. Realize the importance of the circulatory system by suggesting the guidelines how to take care of the organs in circulatory system to work normally.	
10. Identify and describe the functions of organs in CNS that control and coordinate in the human body. 11. Realize the importance of central nervous system by introducing how to take care of and prevent the brain and spinal cords from injuries.	• Nervous system

Learning Objectives

Students will be taught to:

1. Identify the structures or organs in human respiratory system.
2. Understand the adaptation of alveoli for efficient gas exchange.
3. Understand the mechanism of human breathing and gas exchange.
4. Understand the importance and how to take care of our respiratory system.
5. Identify our main organs in human excretory system.
6. Identify the waste products excreted by the excretory organs.
7. Identify the structures or organs in human circulatory system.
8. Understand the importance and how to take care of our excretory system.
9. Identify the path of blood flow.
10. Understand heart rate.
11. Understand the importance and how to take care of our circulatory system.
12. Identify the structures of organs in our nervous system.
13. Understand the pathway of transmission of information.
14. Understand the importance and how to take care of our nervous system.

Learning Outcomes

Students will be able to:

1. List the structures or organs in the respiratory system and their functions.
2. State how the alveoli adapt to exchange gases efficiently.
3. Explain the mechanism of human breathing and gas exchange.
4. Explain the importance of human respiratory system.
5. List ways to care for human respiratory system.
6. List the main organs in human excretory system.
7. List the waste products excreted by the excretory organs.
8. State the importance and the ways to care for our excretory system.
9. State the structures or organs in human circulatory system.
10. State the path of blood flow.
11. Measure our heart rate.
12. State the importance and the ways to care for our circulatory system.
13. List the structures of organs in our nervous system.
14. State the pathway of transmission of information.
15. State the importance and the ways to care for our nervous system.

Teaching and Learning Activities

1st – 6th hours (Respiratory system)

1. Ask students to take a deep breath and slowly breathe out. Ask them why we need to breathe. What happens when we breathe in and out? Explain the terms such as inhalation, exhalation and external respiration.
2. Show students a diagram of our respiratory system. Identify the structures or organs in it and their functions.
3. Watch the video by scanning the QR code below.

4. Explain how alveoli adapt to allow efficient gas exchange.
5. Guide students to compare and contrast between inhalation and exhalation, and also between inhaled air and exhaled air.
6. Ask students to do Question 1 on page 3 of the workbook as their homework.
7. Explain how oxygen travels from the alveoli into blood vessels and from the blood vessels into body cells.
8. Ask students to do Question 2 on page 3 of the workbook as their homework.
9. Guide students on the harmful substances and diseases that affect our respiratory system.
10. Guide students on ways to care for our respiratory system.
11. Ask students to do Question 3 on page 3 of the workbook as their homework.
12. Have students try Test Yourself 1.1 and discuss the answers with them.

7th – 8th hours (Excretory system)

1. Explain the terms metabolism and excretion. Explain also why defecation is not excretion.
2. Explain the importance of excretion.
3. Also explain the three main organs of excretion such as the skin, lungs and kidneys.
4. Have students try Test Yourself 1.2 and discuss the answers with them.

9th – 14th hours (Circulatory system)

1. Explain what our circulatory system does and the four basic characteristics.
2. Explain the pulmonary circulation and systemic circulation. Watch the video by scanning the QR code on the next page.

3. Explain the components of blood.
4. Show students a model of human heart and identify the parts and their functions. Guide students to realize the function of the heart.
5. Compare and contrast the three types of blood vessels.
6. Ask students to do Question 1 on page 5 of the workbook as their homework.
7. Explain how the blood gets oxygenated and deoxygenated and how they travel.
8. Ask students to do Question 2 on page 5 of the workbook as their homework.
9. Guide students on how to measure their own heart rate and to compare their heart rates at rest and after exercising.
10. Ask students to do Question 3 on page 6 of the workbook as their homework.
11. Have students try Test Yourself 1.3 and discuss the answers with them.

15^{th} – 18^{th} hours (Nervous system)

1. Explain the functions of our nervous system.
2. Show the diagram of our nervous system and identify its components.
3. Show the diagram of our brain and describe its components and their roles.
4. Ask students to do Question 1 on page 6 of the workbook as their homework.
5. Show a diagram of a neuron. Describe its components and their functions.
6. Guide students to understand the three types of neuron, namely sensory neuron, interneuron and motor neuron, and their differences.

7. Ask students to do Questions 2 and 3 on pages 6 and 7 of the workbook as their homework.
8. Guide students to realize how information is transmitted via our nervous system when our sensory organ detects a stimulus.
9. Ask students to do Question 4 on page 7 of the workbook as their homework.
10. Guide students to realize the importance of our nervous system and ways to take care of it.
11. Ask students to do Question 5 on page 8 of the workbook as their homework.
12. Have students try Test Yourself 1.4 and discuss the answers with them.

19th hour (Conclusion)

1. Use Conceptual Map on page 23 to help students to understand the relationship of all the subtopics learnt in this chapter.
2. Revise the lesson using Basic Recall on page 24.
3. Randomly select 5 objective questions in QR Quiz and 2 subjective questions from the Mastery Practice in the Textbook and have students solve them in the class. Have students work on the rest of the questions at home.
4. Ask students to do the Map It Out and the Enrichment Exercises in the workbook to test their understanding of this chapter as their homework.

Emphasized Skills:

1. Observing
2. Classifying
3. Making inferences
4. Making hypothesis
5. Predicting

Learning Materials:

- Focus Smart Plus Textbook Science M2
- Focus Smart Plus Workbook Science M2

STEM Activity: Artificial lungs

Group size: 3 to 4 persons
Suggested time: 4 - 5 hours

Overview:
This activity will make students understand more about our breathing mechanisms.

Procedure:

1. Review their knowledge of human respiratory system and get students answer these questions:
   a. What do our lungs do?
   b. What are our lungs made up of?
   c. How do the lungs function?

2. Let students read a situation on page 25 and identify the problem. Tell them to describe their mission and set their goal.

3. Ask students to do some research on the word *breathing process*. Then, encourage them to explore and integrate their knowledge of Science, Technology, Engineering and Mathematics by asking them these questions:
   a. What does 'breathing process' mean?
   b. How are you going to apply that understanding in your project?
   c. How does the chest cavity affect the breathing process?
   d. How does the diaphragm affect breathing process?

4. Brainstorm their possible solutions and draw their solution plans by labelling all materials needed. Let them explain how they work among their team members on:

   a. the materials they need
   b. the reasons for using that materials
   c. the steps to carry out their project

d. the reasons for each step they take
e. the assessment of their project
f. the achievement criteria

5. Allow students to do further research online about other similar project and let them tell the similarities and differences between their project and the project found on the internet to the class. Ask them whether they want to improve their plan or not. Is it necessary? Will it be better? Why? Guide them by using these questions:
   a. What will they use as the lungs?
   b. What will they use as the chest cavity?
   c. What will they use as the diaphragm?
   d. How do their artificial lungs work?
   e. How can they use their artificial lungs to show the effects of smoking?
   f. What will they put in the artificial lungs to trap the bad materials in the cigarette smoke?
   g. Can they puncture their artificial chest cavity to show the consequences of a punctured real one?

Then, let them choose the best one.

6. Ask students to draw a prototype in great details and build their prototype following their plan.

7. After their project is finished, ask them to assess their work; what works and what does not work? How will they make it better?

Conclusion:

8. Get each group to present their projects using digital presentation tools and explain their process of creation.

9. Encourage them to share their experiences by asking these questions:
   a. Why did each group come up with the different solutions and designs?
   b. Which stage of the production process causes the project to have different outcomes?
   c. What are other factors that affect the outcomes?
   d. Can they control those factors?

e. If their project is successful, will it be beneficial to humans and the environment in general?
f. Is it possible to carry out on a large scale? How?

10. For groups with their projects that do not work well, encourage them to think the possible causes and ways to improve them, if they are given a chance to repeat the project.

Learning Outcome Form

Name-Surname: ..... **No.** .....

Mathayom: ..... **Date:** .....

Chapter 1 Human Body Systems

Explanation: Summary of learning outcomes

Feeling after learning this chapter:

.....

.....

.....

.....

Contents that you need for teacher to explain further:

.....

.....

.....

.....

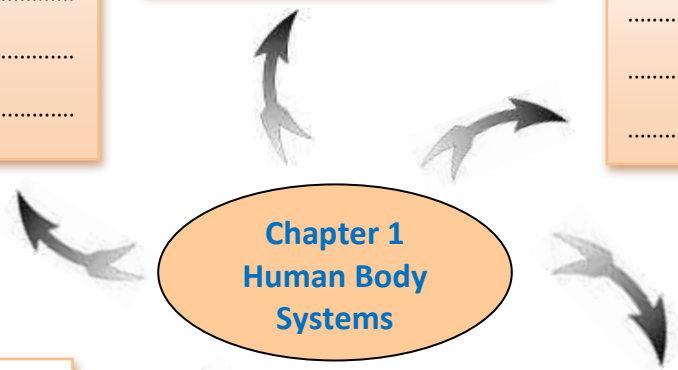
Knowledge gained from this chapter:

.....

.....

.....

.....



Application of knowledge from this chapter on your daily life:

.....

.....

.....

.....

Exercises that you like and want to be selected as the outstanding work:

.....

.....

.....

.....

Contents that you like the most in this chapter (give your reason):

.....

.....

.....

.....

Chapter 2 – Human Reproduction (15 hours)

Learning Standards and Learning Areas

Learning Standards	Learning Areas
Standard Sc. 1.2 12. Identify organs and describe the functions of the male and female reproductive system using a model.	• Male reproductive system • Female reproductive system
13. Explain the effects of testosterone and estrogen hormone that regulate body changes when become puberty. 14. Realise the physical changes when become puberty and know how to take care of themselves both mentally and physically during the changes.	• Puberty
15. Explain the menstrual cycle, fertilization, pregnancy, zygote development and giving birth.	• Menstrual cycle • Fertilization and pregnancy • Importance of pre-natal care
16. Choose a proper method of birth control. 17. Realise the impacts of teenage pregnancy by conduct themselves properly.	• Importance of research in human reproduction

Learning Outcomes

Students will be taught to:

1. Understand the human reproduction system.
2. Understand fertilization and pregnancy.
3. Understand the biotechnology in animal reproduction.

Learning Outcomes

Students will be able to:

1. State the structures in male and female reproductive systems and their functions.
2. Describe puberty and the hormones involved.
3. Describe the menstrual cycle.
4. Describe fertilization and pregnancy in humans.
5. State steps for pre-natal care.
6. State ways to overcome sterility and methods of birth controls.

Teaching and Learning Activities

1st hour (Male reproductive system)

1. Using the diagrams on 29, guide students to identify parts of a male reproductive system and their functions.
2. Ask students to do Question2 1 and 2 on page 16 of the workbook as their homework.
3. Explain the structure of a sperm.
4. Ask students to do Question 3 on page 16 of the workbook as their homework.
5. Have students try Test Yourself 2.1 and discuss the answers with them.

2nd – 3rd hours (Female reproductive system)

1. Using the diagrams on page 31, guide students to identify parts of a female reproductive system and their functions.
2. Ask students to do s 1 and 2 on page 17 of the workbook as their homework.
3. Explain the structure of an ovum.
4. Ask students to do Question 3 on page 17 of the workbook as their homework.
5. Compare and contrast between a male gamete and a female gamete.
6. Ask students to do Question 4 on page 17 of the workbook as their homework.
7. Have students try Test Yourself 2.2 and discuss the answers with them.

4th – 5th hours (Puberty)

1. Explain what puberty is.
2. Guide students to understand hormones and the types of hormones that involved in puberty.
3. Ask students to do Questions 1 and 2 on page 18 of the workbook as their homework.
4. Ask students the changes they experience during the onset of puberty. What are the changes that are experience by both genders? What changes are experienced by boys only? What changes are experienced by girls only?
5. Discuss with students ways to cope with puberty.
6. Ask students to do Question 3 on page 18 of the workbook as their homework.
7. Have students try Test Yourself 2.3 and discuss the answers with them.

6th – 7th hours (Menstrual cycle)

1. Explain that girls will experience menstruation when they reach puberty. This repeats almost every 28 days. It prepares the uterus for pregnancy.
2. Watch the animation by scanning the QR code below to understand more about the menstrual cycle.
3. Explain the menstrual cycle and how the lining of the uterus and ovum change or develop.
4. Ask students to do Questions 1 and 2 on pages 19 and 20 of the workbook as their homework.
5. Emphasize that personal hygiene is important during menstruation.
6. Have students try Test Yourself 2.4 and discuss the answers with them.

8th – 9th hours (Fertilization and pregnancy)

1. Watch this animation to know how fertilization occurs by scanning the QR code below. Discuss how fertilization occurs that leads to pregnancy.
2. Briefly explain how the embryo develops into a fetus during pregnancy. Watch this animation by scanning the QR code below.

How does an embryo or fetus get its nutrition and excrete its waste?

3. Ask students to work on the questions of this subtopic on page 20 of the workbook as their homework.
4. Have students try Test Yourself 2.5 and discuss the answers with them.

10th hour (Importance of pre-natal care)

1. During pregnancy, what does a mother to-be need to do to ensure the health of her unborn child? Explain that mother to-be needs to have a good balanced diet to cater the needs of two persons. Certain minerals are needed for the growth of the fetus.
2. What should a pregnant woman avoid? Cigarette smoke, alcoholic drinks and drug abuse should be avoided. Explain how these affect the fetus.
3. Ask students to answer the questions of this subtopic on pages 20 and 21 of the workbook as their homework.
4. Have students try Test Yourself 2.6 and discuss the answers with them.

11th - 14th hours (Importance of research in human reproduction)

1. Explain the meaning of sterility or infertility.
2. Discuss the reasons for infertility and ways to overcome it – nutrition, hormonal treatment, surgery, in-vitro fertilization
3. Explain the meaning of birth control.
4. Discuss some methods of birth control – rhythm, condom, intrauterine contraceptive device, contraceptive pills, spermicides, vasectomy, tubal ligation.
5. Have debate on the advantages and disadvantages of birth control.
6. Ask students to do Questions 1 and 2 on pages 21 and 22 of the workbook as their homework.
7. Discuss the effects of teenage pregnancy.

8. Ask students to do Question3 on page 22 of the workbook as their homework.
9. Have students try Test Yourself 2.7 and discuss the answers with them.

15th hour (Conclusion)

1. Use the Conceptual Map on page 46 to help students to understand the relationship of all the subtopics learnt in this chapter.
2. Revise the lesson using Basic Recall page 47.
3. Randomly select 5 objective questions in QR Quiz and 1 subjective question from the Mastery Practice in the Textbook and have students solve them in the class. Have students work on the rest of the questions at home.
4. Ask students to do the Map It Out and the Enrichment Exercises in the Workbook to test their understanding of this chapter as their homework.

Emphasized Skills:

1. Observing
2. Classifying
3. Making inferences
4. Comparing and contrasting
5. Communicating

Learning Materials:

- Focus Smart Plus Textbook Science M2
- Focus Smart Plus Workbook Science M2

Learning Outcome Form

Name-Surname: ..... **No.**.....

Mathayom: ..... **Date:** .....

Chapter 2 Human Reproduction
Explanation: Summary of learning outcomes

Feeling after learning this chapter:

.....

.....

.....

.....

Contents that you need for teacher to explain further:

.....

.....

.....

.....

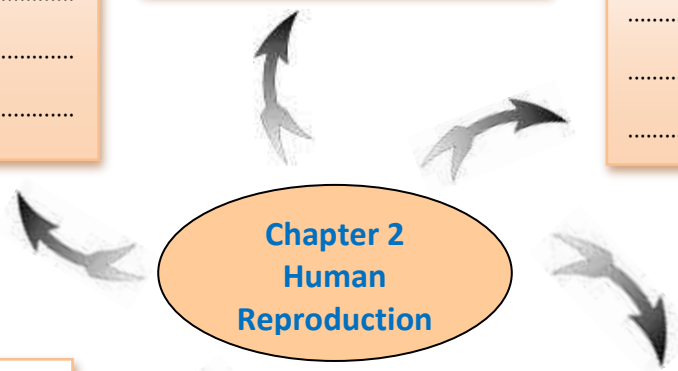
Knowledge gained from this chapter:

.....

.....

.....

.....



Application of knowledge from this chapter on your daily life:

.....

.....

.....

.....

Exercises that you like and want to be selected as the outstanding work:

.....

.....

.....

.....

Contents that you like the most in this chapter (give your reason):

.....

.....

.....

.....

Chapter 3 – Mixtures (11 hours)

Learning Standards and Learning Areas

Learning Standards	Learning Areas
Standard Sc. 2.1 1. Explain separation of mixtures by applying methods of dry evaporation, crystallisation, simple distillation, paper chromatography and solvent extraction using empirical evidence. 2. Separate substances by dry evaporation, crystallization, simple distillation, paper chromatography and solvent extraction. 3. Apply methods of separating substances to solve the problems in daily life by integrating science, mathematics, technology and engineering.	• Separating mixtures
4. Design and conduct experiment to explain the results of solute, solvent, temperature that affect to solubility of matters. In addition, explain the impacts of pressure on solubility of matters using information. 5. Indicate the quantity of solvent in solution; concentration unit; volume per volume, mass per mass and mass per volume. 6. Recognise the importance and apply the knowledge of the concentration of substances. By giving an example, using solutions in daily life properly and safely.	• Solutions

Learning Objectives

Students will be taught to:

1. Understand what mixtures are.
2. Understand the separation methods such as evaporation, crystallization, simple distillation, paper chromatography, solvent extraction and steam distillation.
3. Understand what solutions and solutes are.
4. Understand the types of solutions such as dilute, concentrated and saturated solutions.
5. Understand solubility and concentration of solutions.

Learning Outcomes

Students will be able to:

1. Understand what mixtures are and able to give examples.
2. Realize how some separation methods such as evaporation, crystallization, simple distillation, paper chromatography, simple distillation, paper chromatography, solvent extraction and steam distillation work.
3. Able to apply these separation methods to separate substances.
4. Realize the differences between solutions and solutes.
5. Able to give examples of solutions.
6. Compare and differentiate between dilute, concentrated and saturated solutions.
7. State the factors affecting solubility.
8. Calculate the concentration of solutions in mass/mass percentage, volume/volume percentage and mass/volume percentage.

Teaching and Learning Activities

1st – 6th hours (Separating mixtures)

1. Guide students to understand what mixtures are. Ask them to give examples of mixtures and their components found around them.
2. Ask them if they can separate the mixtures into their components.
3. Explain how evaporation, crystallization, simple distillation, paper chromatography, solvent extraction and steam distillation separate the components from the mixtures. Explain also why certain separation methods work for certain mixtures only.
4. Ask students to answer the questions of this subtopic on pages 28 to 30 of the workbook as their homework.
5. Have students try Test Yourself 3.1 and discuss the answers with them.

7th – 10th hours (Solutions)

1. Explain that solutions are mixtures and how solutions are formed.
2. Ask students to name some solutions with components of different states of matter.
3. Guide students to compare and differentiate between dilute, concentrated and saturated mixtures.
4. Ask students to do Questions 1 to 3 on pages 30 and 31 of the workbook as their homework.
5. Guide students to understand solubility and the factors that affect solubility.
6. Ask students to do Question 4 on page 31 of the workbook as their homework.
7. Explain that we can calculate the concentration of solution using mass/mass percentage, volume/volume percentage and mass/volume percentage. Show more calculation.

8. Ask students to do Questions 5 to 8 on pages 31 and 32 of the workbook as their homework.
9. Have students try Test Yourself 3.2 and discuss the answers with them.

11th hour (Conclusion)

1. Use Conceptual Map on page 60 to help students to understand the relationship of all the subtopics learnt in this chapter.
2. Revise the lesson using Basic Recall on page 61.
3. Randomly select 5 objective questions in QR Quiz and 2 subjective questions from the Mastery Practice in the Textbook and have students solve them in the class. Have students work on the rest of the questions at home.
4. Ask students to do the Map It Out and the Enrichment Exercises in the workbook to test their understanding of this chapter as their homework.

Emphasized Skills:

1. Observing
2. Classifying
3. Making inferences
4. Making hypothesis
5. Predicting

Learning Materials:

- Focus Smart Plus Textbook Science M2
- Focus Smart Plus Workbook Science M2

STEM Activity: A clean-up water project

Group size: 3 to 4 persons
Suggested time: 4-5 hours

Overview:
This activity will encourage students to combine different materials to create a water filter. They will understand the importance of water filtration and how to filter contaminated water.

Procedure:
1. Review their knowledge of filtration and water treatment. Show pictures of contaminated water and get students to answer these questions:
   a. Why does water get contaminated?
   b. What are the water contaminants?
   c. How is water purified in water treatment plants? What are the steps?

2. Let students read a situation on page 62 and identify the problem. Tell them to describe their mission and set their goal.

3. Ask students to do some research on the word *water filter*. Then, encourage them to explore and integrate their knowledge of Science, Technology, Engineering and Mathematics by asking them these questions:
   a. What does '*water filter'* mean?
   b. Are there many types of water filters?
   c. How are students going to apply that understanding in their project?
   d. What are in a commercial water filter?
   e. What are their functions?

4. Brainstorm their possible solutions and draw their solution plans by labelling all materials needed. Let them explain how they work among their team members on:
   a. the materials they need
   b. the reasons for using that materials
   c. the steps to carry out their project
   d. the reasons for each step they take
   e. the assessment of their project
   f. the achievement criteria

5. Allow students to do further research online about the similar project and let them tell the similarities and differences between their project and the project found on the internet to the class. Ask them whether they want to improve their plan or not. Is it necessary? Will it be better? Why? Guide them by using these questions:

a. What container will they use as the filter?
b. What materials will they pack in their filter?
c. What are the functions of these materials?
d. How will they pack them? Why?
e. Will the arrangement of layers of the materials affect the outcomes?
f. Do they need to pour the water into the filter fast or slow? Why?

Then, let them choose the best one.

6. Ask students to draw a prototype in great details and build up their prototype following their plan.

7. After their project is finished, ask them to assess their work; what works and what does not work? How to make it better?

Conclusion:

8. Get each group to present their projects using digital presentation tools and explain their process of creation.

9. Encourage them to share their experiences by asking these questions:

a. Why did each group come up with the different solutions and designs?
b. Which stage of the production process causes the project to have different outcomes?
c. What are other factors that affect the outcomes?
d. Can they control those factors?
e. If their project is successful, will it be beneficial to humans and the environment in general?
f. Is it possible to carry out on a large scale? How?

10. For groups with their projects that do not work well, encourage them to think the possible causes and ways to improve them, if they are given a chance to repeat the project.

Learning Outcome Form

Name-Surname: ..... **No.** .....

Mathayom: ..... **Date:** .....

Chapter 3 Mixtures

Explanation: Summary of learning outcomes

Feeling after learning this chapter:

.....

.....

.....

.....

Contents that you need for teacher to explain further:

.....

.....

.....

.....

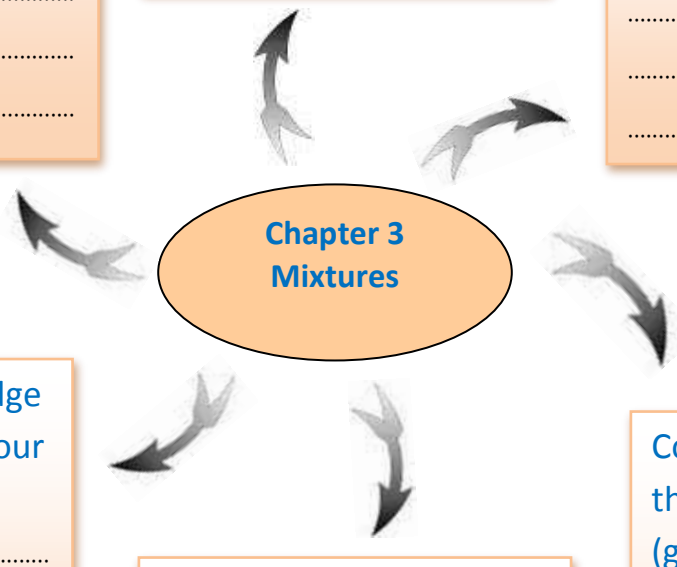
Knowledge gained from this chapter:

.....

.....

.....

.....



Application of knowledge from this chapter on your daily life:

.....

.....

.....

.....

Exercises that you like and want to be selected as the outstanding work:

.....

.....

.....

.....

Contents that you like the most in this chapter (give your reason):

.....

.....

.....

.....

Chapter 4 – Forces (27 hours)

Learning Standards and Learning Areas

Learning Standards	Learning Areas
Standard Sc. 2.2 1. Predict the object moving as a result of resultant force of several forces acting on an object in the same plane based on empirical evidence. 2. Draw a diagram presenting of force and resultant force of several forces acting on an object in the same plane.	• Resultant force on the same plane (net force)
3. Design and conduct an experiment in a suitable method to explain the factors affecting liquid pressure. 4. Analyse buoyant force, sinking and floating of objects in liquids using empirical evidence. 5. Draw a diagram showing force acting on an object in liquids.	• Liquid pressure and buoyancy
6. Explain static friction and kinetic friction based on empirical evidence. 7. Design and conduct an experiment in a proper method to explain the factors that affect to the size of friction. 8. Draw a diagram to show the friction force and other forces acting on objects. 9. Realize the benefits of friction by analyzing problem situations and offering solutions to	• Friction

decrease or increase friction force that is useful for activities in everyday life.	
10. Design and conduct experiment with appropriate methods to explain moment of force when an object is balance to turn and calculate using $M=FI$.	• Moment of force
11. Compare the source of magnetic field, electrical field, gravitational field and the directions of each force acting on objects based on collected data. 12. Draw a diagram to illustrate magnetic force, electric force and gravitational force acting on objects.	• Natural fields

Learning Objectives

Students will be taught to:

1. Understand what resultant force or net force is.
2. Understand the effect of a resultant force on a static object and on a moving object.
3. Understand liquid pressure and buoyance.
4. Understand Archimedes' principle.
5. Understand static friction and kinetic friction.
6. Understand moment of force.
7. Understand the three natural fields – gravitational field, magnetic field and electric field.

Learning Outcomes

Students will be able to:

1. Calculate the resultant force due to two or more than two parallel forces that act on an object.
2. Calculate the resultant force due to two non-parallel forces that act on an object.
3. Predict the effect of a resultant force on a static object and a moving object with a constant velocity.
4. Realize that the weight of the liquid exerts pressure.
5. Calculate liquid pressure and the factors affecting it.
6. Realize the buoyancy force is the upward force acting on an immersed or partially immersed object.
7. Calculate the buoyancy force acting on an object.
8. Realize Archimedes' principle in explaining floating and sinking of objects.
9. Know the factors affecting friction and the advantages and disadvantages of friction.
10. Compare and differentiate between static friction and kinetic friction.
11. Calculate the moment of force and its applications in daily life.
12. Compare the sources of gravitational field, magnetic field and electrical field.

Teaching and Learning Activities

1st – 6th hours (Resultant force on the same plane)

1. Ask students why it is easier to get a static car moving when it is pushed by two persons than by a person.
2. Explain what a resultant force is and how it is calculated for parallel and non-parallel forces. Remind students that the directions of the force are important to take note of.

3. Ask students to do Questions 1 and 2 on pages 38 and 39 of the workbook as their homework.
4. Predict how a resultant force affects a static object and a moving object with a constant velocity.
5. Ask students to do Questions 3 to 7 on pages 40 to 42 of the workbook as their homework.
6. Have students try Test Yourself 4.1 and discuss the answers with them.

7th – 14th hours (Liquid pressure and buoyancy)

7. Explain that a liquid exerts pressure due to its weight and that this pressure is exerted on every surface in contact with.
8. Explain the factors affecting liquid pressure.
9. Ask students to do Question 1 on page 42 of the workbook as their homework.
10. Guide students to do calculations of liquid pressure.
11. Ask students to do Questions 2 and 3 on page 43 of the workbook as their homework.
12. Explain what buoyant force is.
13. Explain what Archimedes' principle states. To understand more, watch the animation by scanning the QR code below.

14. Explain why objects sink or float on water with Archimedes' principle.
15. Explain how submarines float and sink.
16. Ask students to do Questions 4 to 6 on pages 43 and 44 of the workbook as their homework.
17. Have students try Test Yourself 4.2 and discuss the answers with them.

15th – 19th hours (Friction)

18. Guide students to recall the factors affecting friction.
19. Ask students to do Question 1 on pages 44 to 45 of the workbook as their homework.
20. Guide students to understand the advantages and disadvantages of having friction in life.
21. Ask students to do Question 2 on page 45 of the workbook as their homework.
22. Explain what static friction and kinetic friction are. How are they differed?
23. Ask students to do Questions 3 and 4 on pages 45 and 46 of the workbook as their homework.
24. Have students try Test Yourself 4.3 and discuss the answers with them.

20th – 23th hours (Moment of force)

25. Explain what moment of force is.
26. Ask students to do Question 1 on page 46 of the workbook as their homework.
27. Guide students to calculate moment of force. Remind students to take note of the direction of the force.
28. Guide students to apply the principle of moments in a lever.
29. Ask students to do Questions 2 and 3 on pages 16 and 17 of the workbook as their homework.
30. Have students try Test Yourself 4.4 and discuss the answers with them.

24th – 26th hours (Natural fields)

31. Explain what gravitational field and gravitational field strength are.
32. Ask students to do Question 1 on pages 47 and 48 of the workbook as their homework.

33. Help students to compare and differentiate between mass and weight.
34. Ask students to do Question 2 on page 48 of the workbook as their homework.
35. Guide students to understand magnetic field.
36. Ask students to do Question 3 on page 48 of the workbook as their homework.
37. Guide students to understand electric field.
38. Ask students to do Question 4 on pages 48 and 49 of the workbook as their homework.
39. Have students try Test Yourself 4.5 and discuss the answers with them.

27th hour (Conclusion)

40. Use Conceptual Map on page 97 to help students to understand the relationship of all the subtopics learnt in this chapter.
41. Revise the lesson using Basic Recall on page 98.
42. Randomly select 5 objective questions in QR Quiz and 2 subjective questions from the Mastery Practice in the Textbook and have students solve them in the class. Have students work on the rest of the questions at home.
43. Ask students to do the Map It Out and the Enrichment Exercises in the workbook to test their understanding of this chapter as their homework.

Emphasized Skills:

1. Observing
2. Classifying
3. Making inferences
4. Making hypothesis
5. Predicting

Learning Materials:

- Focus Smart Plus Textbook Science M2
- Focus Smart Plus Workbook Science M2

STEM Activity: Moving a structure without breaking it

Group size: 3 to 4 persons
Suggested time: 4-5 hours

Overview:
This activity will allow students to think critically and creatively in order to find a way to move the structure. They can analyze how other objects move and apply it in their project.

Procedure:
1. Review their knowledge of motion and friction. Show students pictures of land transport and get students to answer these questions:
    a. What make these vehicles move?
    b. Without them, can they move easily on land? Why?
    c. Should the friction be reduced in order for the objects to move faster?

2. Let students read a situation on page 99 and identify the problem. Tell them to describe their mission and set their goal.

3. Ask students to do some research on the word *moving*. Then, encourage them to explore and integrate their knowledge of Science, Technology, Engineering and Mathematics by asking them these questions:

    a. What does ‘moving’ mean?

    b. How are students going to apply that understanding in their project?
    c. Is force needed to make an object move?
    d. How can they make the object move with ease and more stability?

4. Brainstorm their possible solutions and draw their solution plans by labelling all materials needed. Let them explain how they work among their team members on:

a. the materials they need
b. the reasons for using that materials
c. the steps to carry out their project
d. the reasons for each step they take
e. the assessment of their project
f. the achievement criteria

5. Allow students to do further research online about the similar project and let them tell the similarities and differences between their project and the project found on the internet to the class. Ask them whether they want to improve their plan or not. Is it necessary? Will it be better? Why? Guide them by using these questions:

a. Have they analyzed the tall structure that they are going to move? Is it very stable? Will it topple over easily when it is moved?
b. What do they use to make it move? Is it stable?
c. Are they going to push or pull it? How are they going to do it?
d. Should they move it slowly or fast?

Then, let them choose the best one.

6. Ask students to draw a prototype in great details and build up their prototype following their plan.

7. After their project is finished, ask them to assess their work. What works and what does not work? How to make it better?

Conclusion:

8. Get each group to present their projects using digital presentation tools and explain their process of creation.

9. Encourage them to share their experiences by asking these questions:

a. Why did each group come up with the different solutions and designs?

b. Which stage of the production process causes the project to have different outcomes?
c. What are other factors that affect the outcomes?
d. Can they control those factors?
e. If their project is successful, will it be beneficial to humans and the environment in general?
f. Is it possible to carry out on a large scale? How?

10. For groups with their projects that do not work well, encourage them to think the possible causes and ways to improve them, if they are given a chance to repeat the project.

Learning Outcome Form

Name-Surname: ..... **No.** .....

Mathayom: ..... **Date:** .....

Chapter 4 Forces

Explanation: Summary of learning outcomes

Feeling after learning this chapter:

.....

.....

.....

.....

Contents that you need for teacher to explain further:

.....

.....

.....

.....

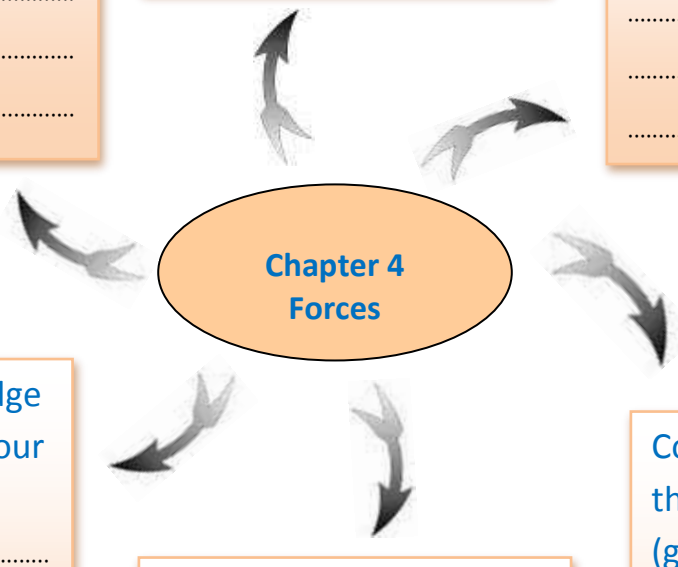
Knowledge gained from this chapter:

.....

.....

.....

.....



Application of knowledge from this chapter on your daily life:

.....

.....

.....

.....

Exercises that you like and want to be selected as the outstanding work:

.....

.....

.....

.....

Contents that you like the most in this chapter (give your reason):

.....

.....

.....

.....

Chapter 5 – Motion (10 hours)

Learning Standards and Learning Areas

Learning Standards	Learning Areas
Standard Sc. 2.2 14. Explain and calculate the rate of speed and velocity of objects V= $\frac{s}{t}$ and V = $\frac{s}{t}$ using empirical evidence.	• Scalar and vector quantities • Distance and displacement
15. Draw a diagram to show displacement and speed.	• Speed and velocity

Learning Objectives

Students will be taught to:

1. Understand what scalar and vector quantities are.
2. Understand what distance and displacement are.
3. Understand what speed and velocity are.

Learning Outcomes

Students will be able to:

1. Compare and differentiate between scalar and vector quantities.
2. Give examples of scalar and vector quantities.
3. Draw scaled vector diagrams.
4. Compare and differentiate distance and displacement.
5. Calculate distance and displacement.
6. Compare and differentiate speed and velocity.
7. Calculate speed and velocity.

Teaching and Learning Activities

1st – 3rd hours (Scalar and vector quantities)

1. Explain what scalar and vector quantities.
2. Guide students to compare and differentiate between scalar and vector quantities.
3. Guide them to draw scaled vector diagrams. Remind them that the direction and magnitude of the vector are important.
4. Ask students to do Questions 1 to 3 on pages 57 and 58 of the workbook as their homework.
5. Have students try Test Yourself 5.1 and discuss the answers with them.

4th – 6th hours (Distance and displacement)

6. Explain what distance and displacement are.
7. Guide students to compare and differentiate between distance and displacement.
8. Guide them how to calculate distance and displacement.
9. Ask students to do Questions 1 to 3 on pages 58 and 59 of the workbook as their homework.
10. Have students try Test Yourself 5.2 and discuss the answers with them.

6th – 8th hours (Speed and velocity)

11. Explain what speed and velocity are.
12. Guide students to compare and differentiate between speed and velocity
13. Guide them how to calculate distance and speed and velocity.
14. Ask students to do Questions 1 and 2 on pages 59 and 60 of the workbook as their homework.

9th hour (Conclusion)

15. Use Conceptual Map on page 112 to help students to understand the relationship of all the subtopics learnt in this chapter.
16. Revise the lesson using Basic Recall on page 113.
17. Randomly select 5 objective questions in QR Quiz and 1 subjective question from the Mastery Practice in the Textbook and have students solve them in the class. Have students work on the rest of the questions at home.
18. Ask students to do the Map It Out and the Enrichment Exercises in the workbook to test their understanding of this chapter as their homework.

Emphasized Skills:

1. Observing
2. Classifying
3. Making inferences
4. Comparing and contrasting
5. Predicting

Learning Materials:

- Focus Smart Plus Textbook Science M2
- Focus Smart Plus Workbook Science M2

STEM Activity: A balloon rocket

Group size: 3 to 4 persons
Suggested time: 4-5 hours

Overview:
This activity introduces a new concept of action and reaction to students. Through this concept, students will understand that for every action there is an equal and opposite reaction.

Procedure:

1. Review their knowledge of force. Show a video or a picture of a man rowing his boat and a picture or video of a rocket being launched. Get students to answer these questions:
    a. When the man rows his boat, in which direction dose he push the water?
    b. In which direction does the boat move when the man rows his boat?
    c. What comes out from the end of the rocket? In what direction does it come out?
    d. What pushes the rocket upward into the sky?
    e. Why do we not move to the back when we throw a ball to the front?

2. Let students read a situation on page 114 and identify the problem. Tell them to describe their mission and set their goal.

3. Ask students to do some research on the word action and reaction. Then, encourage them to explore and integrate their knowledge of Science, Technology, Engineering and Mathematics by asking them these questions:
    a. What does ‘action and reaction’ mean?
    b. How are students going to apply that understanding in their project?
    c. In order for the balloon to move further, is it better to have more backward force? How will they do it?
    d. How do they make the balloon move smoothly along the line?
    e. What kinds of materials should they use for the line?

4. Brainstorm their possible solutions and draw their solution plans by labelling all materials needed. Let them explain how they work among their team members on:
    a. the materials they need
    b. the reasons for using that materials
    c. the steps to carry out their project
    d. the reasons for each step they take
    e. the assessment of their project
    f. the achievement criteria

5. Allow students to do further research online about the similar project and let them tell the similarities and differences between their project and the project found on the internet to the class. Ask them whether they want to improve their plan or not. Is it necessary? Will it be better? Why? Guide them by using these questions:
    a. Does the size of the balloon affect how far the balloon travels? How?
    b. Does the shape of the balloon affect how far the balloon travels? How?
    c. What will you do to ensure the balloon moves along the line, not sticks on the line?
    d. How will you ensure the air from the balloon is not released until it is needed to be done so?
    e. Does the type of material used for the line affect how far the balloon travels?
    f. What material will you use for the line?
    g. Does the angle of the line affect how far the balloon travels?

   Then, let them choose the best one.

6. Ask students to draw a prototype in great details and build up their prototype following their plan.

7. After their project has finished, ask them to assess their work. What works and what does not work? How to make it better?

Conclusion:

8. Get each group to present their projects using digital presentation tools and explain their process of creation.

9. Encourage them to share their experiences by asking these questions:
    a. Why did each group come up with the different solutions and designs?
    b. Which stage of the production process causes the project to have different outcomes?
    c. What are other factors that affect the outcomes?
    d. Can they control those factors?
    e. If their project is successful, will it be beneficial to humans and the environment in general?
    f. Is it possible to carry out on a large scale? How?

10. For groups with their inventions that do not work well, encourage them to think the possible causes and ways to improve them, if they are given a chance to repeat the project.

Learning Outcome Form

Name-Surname: ..... **No.** .....

Mathayom: ..... **Date:** .....

Chapter 5 Motion

Explanation: Summary of learning outcomes

Feeling after learning this chapter:

.....

.....

.....

.....

Contents that you need for teacher to explain further:

.....

.....

.....

.....

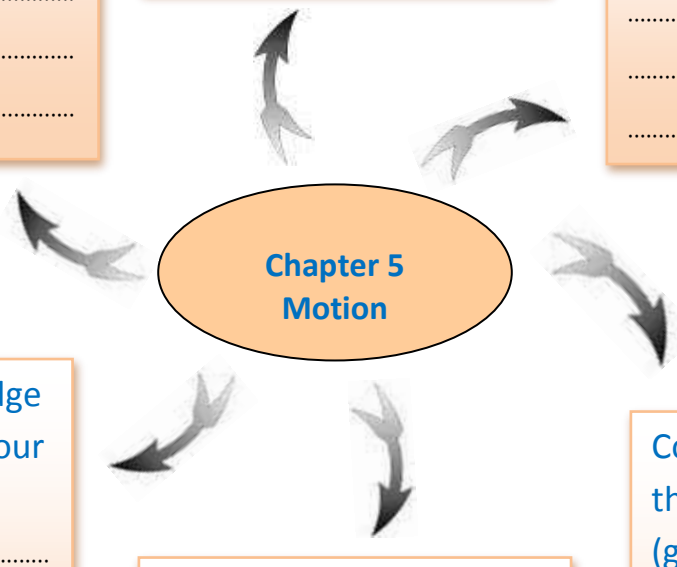
Knowledge gained from this chapter:

.....

.....

.....

.....



Application of knowledge from this chapter on your daily life:

.....

.....

.....

.....

Exercises that you like and want to be selected as the outstanding work:

.....

.....

.....

.....

Contents that you like the most in this chapter (give your reason):

.....

.....

.....

.....

Chapter 6 – Work and Energy (11 hours)

Learning Standards and Learning Areas

Learning Standards	Learning Areas
Standard Sc. 2.3 1. Analyze the situation and calculate work and energy which occurs from force acting on the object using W = Fs and P = $\frac{W}{t}$ based on collected data.	• Work and power
2. Analyze the working principle of the simple machine using collected information. 3. Realise the use of knowledge of the simple machines by describing the benefits and applications in daily life.	• Simple machines
4. Design and experiment using proper methods to explain the factors that affect to kinetic energy and gravitational potential energy. 5. According to collected information, interpret data and explain the change between gravitational potential energy and kinetic energy in the objects when mechanical energy of the object has a constant value. 6. Analyze the situations and explain the change and transfer of energy by using the law of conservation of energy	• Energy

Learning Objectives

Students will be taught to:

1. Understand work and power.
2. Understand how simple machines make our life easier.
3. Understand law of conservation of energy.

Learning Outcomes

Students will be able to:

1. Realize work is done when there is a force and a displacement.
2. Realize power is the rate at which work is done.
3. Calculate work done and power.
4. Realize that simple machines help us do work easier.
5. State the forms of energy.
6. State the law of conservation of energy.
7. Realize that when an object has a change of energy between gravitational energy and kinetic energy, the total energy of mechanical energy is constant.

Teaching and Learning Activities

1st – 3rd hours (Work and power)

1. Explain what work is.
2. Explain the relation between work and energy.
3. Ask students to do Question 1 on page 64 of the workbook as their homework.
4. Explain that no work is done when there is no force or no displacement
5. Ask students to do Questions 2 to 4 on page 64 of the workbook as their homework.
6. Guide students to calculate work.

7. Ask students to do Questions 5 and 6 on page 65 of the workbook as their homework.
8. Explain what power is.
9. Ask students to do Question 7 on page 65 of the workbook as their homework.
10. Guide students to calculate power.
11. Ask students to do Question 8 on page 65 of the workbook as their homework.
12. Have students try Test Yourself 6.1 and discuss the answers with them.

4th – 6th hours (Simple machines)

13. Explain what simple machines are and how they help us do work easier.
14. Ask students to do Question 1 on page 66 of the workbook as their homework.
15. Guide them to understand the 6 types of simple machines and how we apply them in our daily life.
16. Ask students to do Questions 1 to 3 on pages 66 to 67 of the workbook as their homework.
17. Have students try Test Yourself 6.32 and discuss the answers with them.

7th – 10th hours (Energy)

18. Explain the forms of energy.
19. Explain that mechanical energy is the sum of kinetic energy and potential energy.
20. Ask students to do Questions 1 and 2 on pages 67 and 68 of the workbook as their homework.
21. Guide students to understand the law of conservation of energy.
22. Ask students to do Question 3 on page 69 of the workbook as their homework.

23. Use a few examples to explain energy changes.
24. Ask students to do Questions 4 and 5 on pages 69 and 70 of the workbook as their homework.
25. Guide students to understand more on the changes between gravitational potential energy and kinetic energy.
26. Ask students to do Questions 6 and 7 on pages 70 and 71 of the workbook as their homework.
27. Have students try Test Yourself 6.3 and discuss the answers with them.

11th hour (Conclusion)

28. Use Conceptual Map on page 127 to help students to understand the relationship of all the subtopics learnt in this chapter.
29. Revise the lesson using Basic Recall on page 128.
30. Randomly select 5 objective questions in QR Quiz and 1 subjective question from the Mastery Practice in the Textbook and have students solve them in the class. Have students work on the rest of the questions at home.
31. Ask students to do the Map It Out and the Enrichment Exercises in the workbook to test their understanding of this chapter as their homework.

Emphasized Skills:

1. Observing
2. Classifying
3. Making inferences
4. Predicting

Learning Materials:

- Focus Smart Plus Textbook Science M2
- Focus Smart Plus Workbook Science M2

STEM Activity: Roller Coaster

Group size: 3 to 4 persons
Suggested time: 4-5 hours

Overview:
This activity will allow students to build their own roller coasters that are completely driven by gravity. They can analyze the conversions between kinetic and potential energy and frictional effects.

Procedure:
1. Review their knowledge of forces, gravity and friction. Get students to answer these questions:
    a. What are forces?
    b. What are their effects on motion?
    c. What is gravity?
    d. Does gravity affect everything on Earth?
    e. What does friction do?
    f. How can we reduce friction?

2. Let students read a situation on page 129 and identify the problem. Tell them to describe their mission and set their goal.

3. Ask students to do some research on the word *roller coaster*. Then, encourage them to explore and integrate their knowledge of Science, Technology, Engineering and Mathematics by asking them these questions:
    a. What does 'roller coaster' mean?
    b. How are students going to apply that understanding in their project?
    c. What makes the roller coaster move?
    d. Is electricity involved?
    e. Why must the roller coaster start from the tallest hill?
    f. Why does the roller coaster not fall when it goes around a loop?

4. Brainstorm their possible solutions and draw their solution plans by labelling all materials needed. Let them explain how they work among their team members on:
    a. the materials they need

b. the reasons for using that materials
c. the steps to carry out their project
d. the reasons for each step they take
e. the assessment of their project
f. the achievement criteria

5. Allow students to do further research online about the similar project and let them tell the similarities and differences between their project and the project found on the internet to the class. Ask them whether they want to improve their plan or not. Is it necessary? Will it be better? Why? Guide them by using these questions:
    a. Where will the tallest hill be? Why?
    b. Is the end part of the track the lowest? Why?
    c. What do you do to reduce the friction between the marble and the track?
    d. How many loops do they include?
    e. How do they make the loop?

    Then, let them choose the best one.

6. Ask students to draw a prototype in great details and build up their prototype following their plan.

7. After their project is finished, ask them to assess their work; what works and what does not work? How to make it better?

Conclusion:

8. Get each group to present their projects using digital presentation tools and explain their process of creation.

9. Encourage them to share their experiences by asking these questions:
    a. Why did each group come up with the different solutions and designs?
    b. Which stage of the production process causes the project to have different outcomes?
    c. What are other factors that affect the outcomes?
    d. Can they control those factors?

e. If their project is successful, will it be beneficial to humans and the environment in general?
f. Is it possible to carry out on a large scale? How?

10. For groups with their projects that do not work well, encourage them to think the possible causes and ways to improve them, if they are given a chance to repeat the project.

Learning Outcome Form

Name-Surname: ..... **No.** .....

Mathayom: ..... **Date:** .....

Chapter 6 Work and Energy

Explanation: Summary of learning outcomes

Feeling after learning this chapter:

.....

.....

.....

.....

Contents that you need for teacher to explain further:

.....

.....

.....

.....

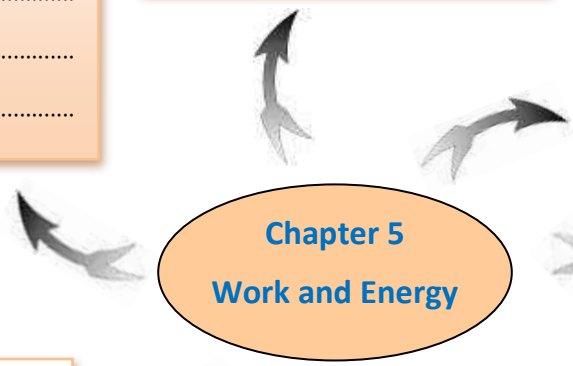
Knowledge gained from this chapter:

.....

.....

.....

.....



Application of knowledge from this chapter on your daily life:

.....

.....

.....

.....

Exercises that you like and want to be selected as the outstanding work:

.....

.....

.....

.....

Contents that you like the most in this chapter (give your reason):

.....

.....

.....

.....

Chapter 7 - Earth (12 hours)

Learning Standards and Learning Areas

Learning Standards	Learning Areas
Standard Sc. 3.2 4. Make a model to explain the Earth's internal structure by chemical composition based on collected information.	• Layers of the Earth
5. Describe the process of weathering; erosion and sedimentation from the model, including examples of the results of such processes that change the Earth's surface.	• Slow processes that change the Surface of the Earth
1. Compare the formation process, properties and usage, and explain the effects of utilization of fossil fuels based on collected data. 2. Show awareness of the impacts of using fossil fuels by offering guidelines for fossil fuels usage. 3. Compare the advantages and disadvantages of each type of renewable energy by gathering information and present the guidelines for the use of renewable energy suited to local.	• Sources of energy

Learning Objectives

Students will be taught to:

1. Understand the three layers of the Earth.
2. Understand weathering, erosion and deposition.
3. Understand the formation, properties and usage of fossil fuels.
4. Understand renewable energy sources.

Learning Outcomes

Students will be able to:

1. State the three layers of the Earth.
2. Compare and differentiate the layers of the Earth.
3. Compare and differentiate weathering, erosion and deposition.
4. Describe how weathering, erosion and deposition change the surface of the Earth.
5. Describe the formation, properties and uses of fossil fuels such as coal, petroleum and oil shale.
6. State the disadvantages of using fossil fuels.
7. State the advantages and disadvantages of using renewable energy sources such as the Sun, wind, running water, waves, biomass, heat from inside the Earth and hydrogen.

Teaching and Learning Activities

1st – 2nd hours (Layers of the Earth)

1. Explain the three layers of the Earth, namely the crust, mantle and core.
2. Guide students to compare and differentiate the layers.
3. Ask students to do Questions 1 and 2 on page 77 of the workbook as their homework.
4. Have students try Test Yourself 7.1 and discuss the answers with them.

3rd – 5th hours (Slow processes that change the surface of the Earth)

5. List the three processes that change the surface of the Earth.
6. Ask students to recall what weathering is.
7. Guide them to understand the three types of weathering, namely physical weathering, biological weathering and chemical weathering.
8. Ask students to do Questions 1 and 2 on pages 77 and 78 of the workbook as their homework.
9. Guide students to understand erosion.
10. Ask students to differentiate between weathering and erosion.
11. Ask students to do Question 3 on page 78 of the workbook as their homework.
12. Explain deposition and how it changes the surface of the Earth.
13. Ask students to do Questions 4 and 5 on page 78 of the workbook as their homework.

6th – 10th hours (Sources of energy)

14. Ask students to recall non-renewable energy sources and renewable energy source, and list some examples.
15. Ask students to do Question 1 on page 79 of the workbook as their homework.
16. Explain the formation of coal and how we use it.
17. Explain the formation of petroleum and how we use it.
18. Explain the formation of oil shale and how we use it.
19. Ask students to do Questions 2 and 3 on page 79 of the workbook as their homework.
20. Guide students to understand the disadvantages of using fossil fuels.
21. Ask students to brainstorm on how to reduce the negative impact of using fossil fuels.

22. Ask students to do Question 4 on pages 79 and 80 of the workbook as their homework.
23. Guide students to list the renewable energy sources and their advantages and disadvantages.
24. Ask students to do Questions 5 and 6 on pages 80 and 81 of the workbook as their homework.
25. Have students try Test Yourself 7.3 and discuss the answers with them.

11th hour (Conclusion)

26. Use Conceptual Map on page 142 to help students to understand the relationship of all the subtopics learnt in this chapter.
27. Revise the lesson using Basic Recall on page 143.
28. Randomly select 5 objective questions in QR Quiz and 1 subjective question from the Mastery Practice in the Textbook and have students solve them in the class. Have students work on the rest of the questions at home.
29. Ask students to do the Map It Out and the Enrichment Exercises in the workbook to test their understanding of this chapter as their homework.

Emphasized Skills:

1. Observing
2. Classifying
3. Making inferences
4. Predicting

Learning Materials:

- Focus Smart Plus Textbook Science M2
- Focus Smart Plus Workbook Science M2

STEM Activity: Earth model

Group size: 3 to 4 persons
Suggested time: 4-5 hours

Overview:
This activity will allow students to design and build a scale model of the Earth. Besides learning the structure of the Earth, students will realize the importance of using scale models to test concepts without wasting costly resources.

Procedure:

1. Review their knowledge of structure of the Earth. Show a globe and get students to answer these questions:
    a. Where is Thailand?
    b. How big is the Earth?
    c. How many layers are there in the Earth?
    d. Are they of the same thickness?

2. Let students read a situation on page 144 and identify the problem. Tell them to describe their mission and set their goal.

3. Ask students to do some research on the word *Earth model*. Then, encourage them to explore and integrate their knowledge of Science, Technology, Engineering and Mathematics by asking them these questions:
    a. What does '*Earth model'* mean?
    b. How are students going to apply that understanding in their project?
    c. How big will their model be?
    d. What are they going to use to make the model?
    e. How are they going to differentiate the layers of the Earth?

4. Brainstorm their possible solutions and draw their solution plans by labelling all materials needed. Let them explain how they work among their team members on:
    a. the materials they need
    b. the reasons for using that materials
    c. the steps to carry out their project

d. the reasons for each step they take
e. the assessment of their project
f. the achievement criteria

5. Allow students to do further research online about the similar project and let them tell the similarities and differences between their project and the project found on the internet to the class. Ask them whether they want to improve their plan or not. Is it necessary? Will it be better? Why? Guide them by using these questions:
    a. What materials are they going to use for the model? Why?
    b. What is the ratio of the model to the real Earth? Will this model be big enough to be used in a big class?
    c. How are they going to show the layers of the Earth?
    d. How are they going to differentiate the layers?
    e. What are the ratios of the thickness of the layers?

    Then, let them choose the best one.

6. Ask students to draw a prototype in great details and build up their prototype following their plan.

7. After their project is finished, ask them to assess their work. What works and what does not work? How to make it better?

Conclusion:

8. Get each group to present their projects using digital presentation tools and explain their process of creation.

9. Encourage them to share their experiences by asking these questions:
    a. Why did each group come up with the different solutions and designs?
    b. Which stage of the production process causes the project to have different outcomes?
    c. What are other factors that affect the outcomes?
    d. Can they control those factors?
    e. If their project is successful, will it be beneficial to humans and the environment in general?
    f. Is it possible to carry out on a large scale? How?

10. For groups with their projects that do not work well, encourage them to think the possible causes and ways to improve them, if they are given a chance to repeat the project.

Learning Outcome Form

Name-Surname: ..... **No.** .....

Mathayom: ..... **Date:** .....

Chapter 7 Earth

Explanation: Summary of learning outcomes

Feeling after learning this chapter:

.....

.....

.....

.....

Contents that you need for teacher to explain further:

.....

.....

.....

.....

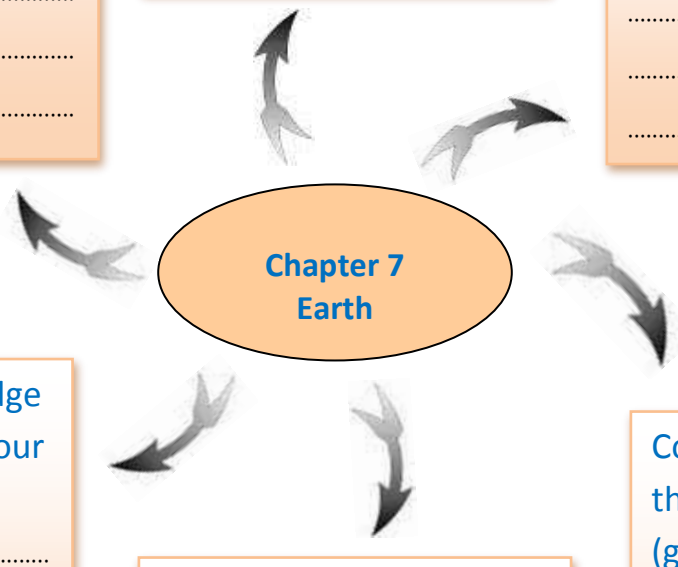
Knowledge gained from this chapter:

.....

.....

.....

.....



Application of knowledge from this chapter on your daily life:

.....

.....

.....

.....

Exercises that you like and want to be selected as the outstanding work:

.....

.....

.....

.....

Contents that you like the most in this chapter (give your reason):

.....

.....

.....

.....

Chapter 8 - Soil (10 hours)

Learning Standards and Learning Areas

Learning Standards	Learning Areas
Standard Sc. 3.2 6. Describe the characteristics of soil horizon and the process of soil formation from the model including identify the factors that make the characteristics and properties of soils different.	• Soil • Soil formation
7. Measure some properties of soils by using appropriate tools and present the guidelines for the use of benefits of soil based on the data of soil properties.	• Soil uses and soil improvement

Learning Objectives

Students will be taught to:

1. Understand what soil is.
2. Understand the soil properties and soil profile.
3. Understand how soil is formed.
4. Understand the uses of soil.

Learning Outcomes

Students will be able to:

1. List the components of soil.
2. State the soil properties such as soil color, soil texture, soil structure and soil consistency.
3. State the soil profile.
4. Describe the formation of soil.
5. State the uses of soil.
6. State ways to improve soil.

Teaching and Learning Activities

1st – 4th hours (Soil)

1. Ask students what they predict to find in soil. List the components of soil.
2. Ask students to recall the three types of soil, namely loamy soil, sandy soil and clay soil. Guide them on how to find out the type of soil.
3. Guide students to understand the soil properties such the soil color, soil texture, soil structure and soil consistency.
4. Ask students to do Questions 1 to 3 on page 87 of the workbook as their homework.
5. Guide students to list and describe the layers in a soil profile.
6. Ask students to do Question 4 on page 87 of the workbook as their homework.
7. Have students try Test Yourself 8.1 and discuss the answers with them.

5th – 6th hours (Soil formation)

8. Explain the factors affecting soil formation.
9. Ask students to do Question 1 on page 88 of the workbook as their homework.
10. Guide students to understand the process of soil formation.
11. Ask students to do Question 2 on page 88 of the workbook as their homework.
12. Have students try Test Yourself 8.2 and discuss the answers with them.

7th – 9th hours (Soil uses and soil improvement)

13. Guide students to understand the uses of soil.
14. Ask students to do Questions 1 to 4 on pages 88 and 89 of the workbook as their homework.
15. Guide students to realize the ways to improve the soil.

16. Ask students to do Question 5 on page 89 of the workbook as their homework.
17. Have students try Test Yourself 8.3 and discuss the answers with them.

11th hour (Conclusion)

18. Use Conceptual Map on page 157 to help students to understand the relationship of all the subtopics learnt in this chapter.
19. Revise the lesson using Basic Recall on page 158.
20. Randomly select 5 objective questions in QR Quiz and 1 subjective question from the Mastery Practice in the Textbook and have students solve them in the class. Have students work on the rest of the questions at home.
21. Ask students to do the Map It Out and the Enrichment Exercises in the workbook to test their understanding of this chapter as their homework.

Emphasized Skills:

1. Observing
2. Classifying
3. Making inferences
4. Predicting

Learning Materials:

- Focus Smart Plus Textbook Science M2
- Focus Smart Plus Workbook Science M2

STEM Activity: Solving soil erosion problem

Group size: 3 to 4 persons
Suggested time: 4-5 hours

Overview:
This activity will allow students to realize that soil erosion is a real problem. They need to think of ways to slow down or stop soil erosion.

Procedure:

1. Review their knowledge of soil erosion and get students to answer these questions:
    a. What is soil erosion?
    b. Why does it happen?
    c. What happens when soil erosion is severe?
    d. What can we do to stop it?

2. Let students read a situation on page 159 and identify the problem. Tell them to describe their mission and set their goal.

3. Ask students to do some research on the word '*soil erosion prevention'*. Then, encourage them to explore and integrate their knowledge of Science, Technology, Engineering and Mathematics by asking them these questions:
    a. What does 'soil erosion prevention' mean?
    b. How are students going to apply that understanding in their project?
    c. What are the factors that affect the rate of soil erosion?

4. Brainstorm their possible solutions and draw their solution plans by labelling all materials needed. Let them explain how they work among their team members on:
    a. the materials they need
    b. the reasons for using that materials
    c. the steps to carry out their project
    d. the reasons for each step they take
    e. the assessment of their project
    f. the achievement criteria

5. Allow students to do further research online about the similar project and let them tell the similarities and differences between their project and the project found on the internet to the class. Ask them whether they want to improve their plan or not. Is it necessary? Will it be better? Why? Guide them by using these questions:
    a. What are they using to stop the soil erosion?
    b. How much will they use?
    c. Will the materials they used be washed away by the water?
    d. Does the arrangement of the soil have influence on the rate of soil erosion?

   Then, let them choose the best one.

6. Ask students to draw a prototype in great details and build up their prototype following their plan.

7. After their project is finished, ask them to assess their work; what works and what does not work? How to make it better?

Conclusion:

8. Get each group to present their projects using digital presentation tools and explain their process of creation.

9. Encourage them to share their experiences by asking these questions:
    a. Why did each group come up with the different solutions and designs?
    b. Which stage of the production process causes the project to have different outcomes?
    c. What are other factors that affect the outcomes?
    d. Can they control those factors?
    e. If their project is successful, will it be beneficial to humans and the environment in general?
    f. Is it possible to carry out on a large scale? How?

10. For groups with their projects that do not work well, encourage them to think the possible causes and ways to improve them, if they are given a chance to repeat the project.

Learning Outcome Form

Name-Surname: ..... **No.** .....

Mathayom: ..... **Date:** .....

Chapter 8 Soil

Explanation: Summary of learning outcomes

Feeling after learning this chapter:

.....

.....

.....

.....

Contents that you need for teacher to explain further:

.....

.....

.....

.....

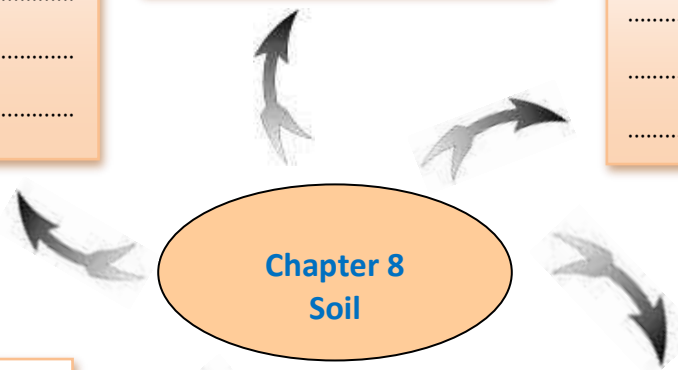
Knowledge gained from this chapter:

.....

.....

.....

.....



Application of knowledge from this chapter on your daily life:

.....

.....

.....

.....

Exercises that you like and want to be selected as the outstanding work:

.....

.....

.....

.....

Contents that you like the most in this chapter (give your reason):

.....

.....

.....

.....

Chapter 9 - Water (6 hours)

Learning Standards and Learning Areas

Learning Standards	Learning Areas
Standard Sc. 3.2 8. Explain the factors and processes of surface water and underground water from the model. 9. Make a model to explain water usage and introduce the ways to use water sustainably in your local areas.	• Surface water and groundwater
10. Make a model to explain the formation and the impact of floods, soil erosions, landslides, sinkholes and land subsidence.	• Hazards due to surface water and groundwater

Learning Objectives

Students will be taught to:

1. Understand what surface water and groundwater are.
2. Understand the uses of water.
3. Understand the hazards due to surface water and groundwater.

Learning Outcomes

Students will be able to:

1. Compare and differentiate surface water and groundwater.
2. State the uses of water.
3. State ways to conserve water.
4. Describe the formation and impact of surface water flooding, soil erosion, landslides, sinkholes and land subsidence.

Teaching and Learning Activities

1st hour (Surface water and groundwater)

1. Guide students to understand surface water and groundwater.
2. Have students compare and differentiate surface water and groundwater.
3. Guide students to compare and differentiate zone of saturation and zone of aeration in groundwater.
4. Explain how surface water and groundwater can trade places.
5. Ask students to list the uses of water.
6. Ask students to brainstorm on how to conserve water.
7. Ask students to do Questions 1 to 3 on pages 95 to 96 of the workbook as their homework.
8. Have students try Test Yourself 9.1 and discuss the answers with them.

2nd – 5th hours (Hazards due to surface water and groundwater)

9. Guide students to understand how surface water flooding occurs and its effects.
10. Guide students to understand how surface soil erosion occurs and its effects.
11. Guide students to understand how surface a landslide occurs and its effects.
12. Guide students to understand how surface a sinkhole occurs and its effects.
13. Guide students to understand how surface land subsidence occurs and its effects.
14. Ask students to do Questions 1 to 4 on pages 96 and 97 of the workbook as their homework.
15. Have students try Test Yourself 9.2 and discuss the answers with them.

6th hour (Conclusion)

16. Use Conceptual Map on page 168 to help students to understand the relationship of all the subtopics learnt in this chapter.
17. Revise the lesson using Basic Recall on page 169.
18. Randomly select 5 objective questions in QR Quiz and 1 subjective question from the Mastery Practice in the Textbook and have students solve them in the class. Have students work on the rest of the questions at home.
19. Ask students to do the Map It Out and the Enrichment Exercises in the workbook to test their understanding of this chapter as their homework.

Emphasized Skills:

1. Observing
2. Classifying
3. Making inferences
4. Predicting

Learning Materials:

- Focus Smart Plus Textbook Science M2
- Focus Smart Plus Workbook Science M2

Learning Outcome Form

Name-Surname: ..... **No.** .....

Mathayom: ..... **Date:** .....

Chapter 9 Water

Explanation: Summary of learning outcomes

Feeling after learning this chapter:

.....

.....

.....

.....

Contents that you need for teacher to explain further:

.....

.....

.....

.....

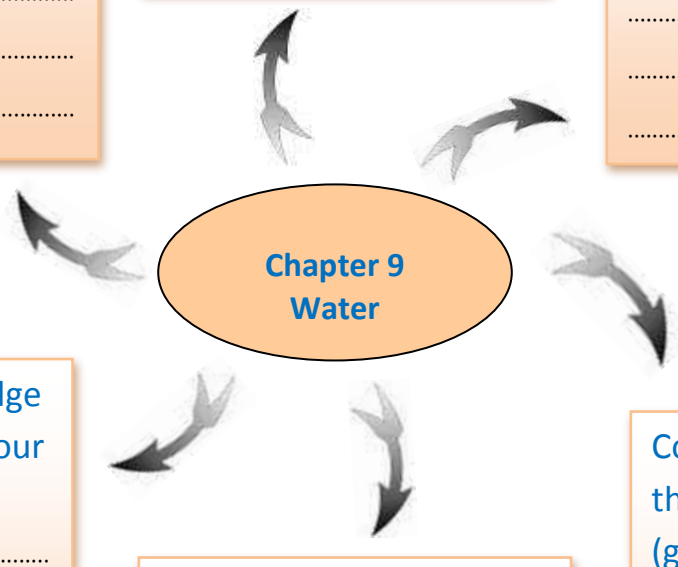
Knowledge gained from this chapter:

.....

.....

.....

.....



Application of knowledge from this chapter on your daily life:

.....

.....

.....

.....

Exercises that you like and want to be selected as the outstanding work:

.....

.....

.....

.....

Contents that you like the most in this chapter (give your reason):

.....

.....

.....

.....