



PHILIPPINE
NORMAL
UNIVERSITY



Graduate Theses

CGSTER

April 2019

The Development of SIMs on Earth Science for Students of Eastern Samar State University

Delbert A. Dala

Philippine Normal University

Follow this and additional works at
pnu-onlinecommons.org/omp/index.php



Online Commons Citation

Dala, D.A. & Concepcion, M.G.O. (2019)
The Development of SIMs on Earth Science for Students of Eastern Samar
State University
(Master's Thesis, Philippine Normal University)
Retrieved from pnu-onlinecommons.org/omp/index.php/pnu-oc/catalog/book/1329

**THE DEVELOPMENT OF SIMs ON EARTH SCIENCE FOR STUDENTS OF
EASTERN SAMAR STATE UNIVERSITY**

A Thesis Presented to the
College of Graduate Studies and Teacher Education
Philippine Normal University

In Partial Fulfillment of the Requirements for the Degree
Master of Arts in Education with specialization in Science Education

by

DELBERT A. DALA

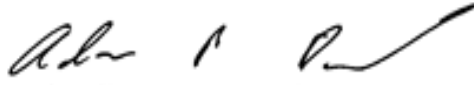
April 2019

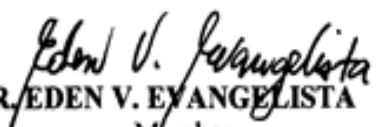
APPROVAL SHEET

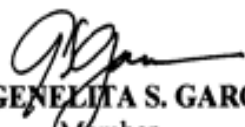
This thesis entitled "**The Development of SIMs on Earth Science for Students of Eastern Samar State University**" prepared and submitted by **DELDERT A. DALA** in partial fulfilment of the requirements for the degree of **Master of Arts in Education with specialization in Science Education**, is hereby recommended for approval and acceptance.


DR. MEL GREG O. CONCEPCION
Adviser

Approved in partial fulfilment of the requirements for the degree **Master of Arts in Education with specialization in Science Education** by the Oral Examination Committee.


ADONIS P. DAVID, Ph.D.
Chairperson


DR. EDEN V. EVANGELISTA
Member


PROF. GENELITA S. GARCIA
Member


DR. VIRGIL D. DUAD
Member

Accepted in partial fulfilment of the requirements for the degree **Master of Arts in Education with specialization in Science Education**

3/7/19
Date


RONALD ALLAN S. MABUNGA, Ph.D.
Dean
College of Graduate Studies
and Teacher Education Research

ABSTRACT

**Title : THE DEVELOPMENT OF SIMS ON EARTH SCIENCE
FOR STUDENTS OF EASTERN SAMAR STATE
UNIVERSITY**

Name : DELBERT A. DALA

**Key Concepts : Strategic Intervention Material (SIM), Academic Performance,
Critical Thinking Skills, and Problem-Solving Skills**

Degree : Master of Arts in Education

Specialization : Science Education

Adviser : Dr. Mel Greg O. Concepcion

This study was conducted to determine effective teaching strategy that will address the pressing needs of the workplace and cultivate appropriate strategic intervention materials (SIMs) that will develop the academic performance, critical thinking skills, and problem-solving skills of the students. The study was conducted using the developmental design method. The setting includes three weeks of the curriculum calendar year with one and one-half hours allotted in the subject (earth science) using the SIMs. It also employed the use of researcher- developed test questionnaires for the pre-test and post-test to determine if there is a change before and after intervention and further determine the effects of the strategic intervention materials (SIMs) on students' academic performance, critical

thinking and problem-solving skills regarding earth science subject. A 50-item multiple choice test was used because it is the most relevant to the study. The modules using SIMs were validated by the experts to be acceptable and marked substantial in improving the academic performance, critical thinking skills, and problem-solving skills. The results showed the extremely significant difference on the mean scores of the pre and post-tests in the academic performance and critical thinking skills. The SIMs-based modules help in the improvement of the students' academic performance in general but not necessarily improving problem-solving skills.

ACKNOWLEDGEMENT

The research becomes a possibility because of the different individuals and institution who give support to the fulfilment of the study:

Eastern Samar State University – the institution where the study will be conducted

Dr. Eduardo A. Campoto– president of the university

Blessed Trinity School – for the help extended in making this thesis possible

Mrs. Gemma D. Garcia – my sister who one way or the other gives her encouragement to pursue this study

Faculty of BS Biology & Natural Sciences Department (College of Arts & Sciences) ESSU – the support extended to the researcher

Dr. Mel Greg Concepcion – my very understanding professor of research and scientific writing

The Almighty God for the many blessings He has given, especially the gift of perseverance in continuing this study

DEDICATION

The study is being dedicated to my mother who was the greatest teacher I have ever known.

TABLE OF CONTENTS

Title	
Approval	
Abstract	 i-ii
Acknowledgement	 iii
Dedication	 iv
Table of Contents	 v-vi
List of Figures	 viii
List of Tables	 ix

Chapter I

Introduction	 1
The Problem and its Background	 1
Statement of Purpose	 6
Significance of the Study	 6
Scope and Delimitation of the Study	 7
Definition of Terms	 8
Research Conceptual Framework	 9

Chapter II

Review of Related Literature	 11
Academic Performance	 12
Critical Thinking Skills	 15
Problem Solving Skills	 18
Strategic Intervention Materials	 21

Chapter III

Methodology	25
Research Design	25
Research Locale and Subjects	25
Research Instruments	26
Data Gathering Procedure	27
Statistical Analysis	28
Ethical Consideration	30

Chapter IV

Results and Discussion	32
------------------------	----

Chapter V

Summary, Conclusion, and Recommendations	64
--	----

References	67
-------------------	----

Appendices	79
-------------------	----

LIST OF FIGURES

Figure		Page
1.1	Research Conceptual Framework	9
4.1	Screenshot Sample page of the module #1	38
4.2	Screenshot Sample page of the module #2	39

LIST OF TABLES

Table	Page
3.1 Interpretation of Acceptability Scores	29
3.2 Interpretation of Percentage Agreement	29
3.3 Interpretation of p-level	30
4.1 Contents, Learning Objectives, and Strategies Used in the Module	34
4.2 Experts' Validation of Module: Objectives	40
4.3 Experts' Validation of Module: Subject Matter	42
4.4 Experts' Validation of Module: Values	43
4.5 Experts' Validation of Module: Organization	45
4.6 Experts' Validation of Module: Effectiveness	46
4.7 Experts' Validation of Module: Summary	47
4.8 Experts' Validation of Test: Specification	49
4.9 Experts' Validation of Test: Format and Direction	50
4.10 Experts' Validation of Test: Items (General)	51
4.11 Experts' Validation of Test: Multiple Choice Items	52
4.12 Experts' Validation of Test: Summary	53
4.13 Distribution of Test Scores	54
4.14 Test Scores: Pre VS Post	55
4.15 ANOVA Test Scores: Pre – Post	56
4.16 Number Correct Per Item: Critical Thinking Skills	56
4.17 Number Correct All Items: Critical Thinking Skills	58
4.18 ANOVA ^a – Number Correct All Items: Critical Thinking Skills	59
4.19 Number Correct Per Item: Problem Solving Skills	59

4.20	Number Correct All Items: Problem Solving Skills	61
4.21	ANOVA ^a – Number Correct All Items: Problem Solving Skills	61
4.22	Significant Difference	62

CHAPTER I

THE PROBLEM AND ITS BACKGROUND

INTRODUCTION

Learning is a lifetime process that leads to change which occurs as a result of instructional experience. It increases the potential of improved performance and future learning (Ambrose, 2016). It is not contained within the boundaries of formal education. Life experiences outside of the four corners of the classroom are some of the most relevant sources of lasting learning. Vicarious experiences, those which an individual observes from the situation of others, can also provide important insights that one may find useful in the future. The materials that an individual read or those that he listens to outside the context of school may be rich sources of information and learning that are related to what are written in textbooks used in educational institutions. There are innumerable sources of information that every individual can use towards the advancement of knowledge in any particular field of learning.

Attending a formal school provides structured and planned learning competencies designed for a particular field of study. Learners are shown a variety of methods and approaches to attract to all kinds of learning styles (Koltookian, 2012). It equips the learners with functional skills necessary to become capable and responsible members of society. Knowledgeable society is vital to the development of a nation. It also offers solutions to a mixture of social evils like poverty and multiple crimes that can greatly affect the progress of a developing nation.

Today, in the effort to be at par with international standards, the Philippines is taking tentative steps towards embracing the K to 12 educational curriculum by virtue of the Enhanced basic Education Act of 2013, DO 43, s. 2013. The K to 12 curriculum has adapted the spiral methodology of concept development. This methodology allows the learner to master the intricacies of the topic from its simplest concepts towards the most complex. What has been mastered in a particular grade level will be reintroduced and explained in detail during the next grade level. This methodology makes use of prior knowledge as springboard for introducing the more complicated aspects of a particular concept or topic. What the learner has learned in the past plays a significant role in his future learning.

This significant change in the Philippine educational curriculum has brought about modifications in the different courses being offered for a particular degree course in the tertiary level. Circular Memorandum Order (CMO) of the Commission on Higher Education has identified innovative inclusion of topics such as Disaster Risk Reduction Management (DRRM) in the curriculum of Bachelor of Science in Business Administration (BSBA). This topic is given emphasis in the course Physical Science.

All the things around us is formed on earth. Plants grow on the earth and animals linger and compete for survival on the surface of the earth. Thus everything depends on the environment of the earth. According to Wesley Coats (2014), earth is our home. We rely upon it for our existence in many different ways. Its resources feed us and provide the materials of our way of life. Even modest changes to the Earth's systems have had

profound influences on human societies and the course of civilization. Understanding these systems and how they interact with us is vital for our survival.

Importance of earth sciences may have something to do with preparing humanity for the hopeful eventuality that we do not become limited as a human entity to this one earth. Knowing one's place, as well as the overall movement of scientific knowledge, will give us a greater perspective of what this endeavor would take this according to Department of Geological Sciences, University of Cape Town.

Our modern environment faces different challenges that utmost attention is necessary in-order to assure the continuation of the existence of living organism (Shah, 2015). However, the solutions to the current Earth-science-related challenges will also come from human creativity, as individuals or corporate businesses. Thus, becoming aware of the different phenomena that happen in our environment gives an individual a sense of calmness and right judgment.

This research was conducted to compliment the adaptation of the CHED – CMO to re-assess knowledge gained by the students from previous studies on selected topics in Earth Science. Consciously, the researcher chose topics in earth science that are considered important like volcanos, plate tectonics, and earthquake and need to be strategized in the present time. Philippines is made up of many active volcanoes and some of these pose imminent danger to the lives of people. The most awaited phenomenon the so-called the “big one” which everyone is talking about and preparing to counteract its devastating effects is quite stirring up fear to individual in every community.

The researcher felt a need to put stress in the development of the critical thinking and problem-solving skills of the students especially when they are confronted with life-threatening situations brought about by different natural phenomena.

The present generation of learners are quite challenging because they possess different personality characteristics unlike the previous generations. They are digital natives who can clearly adapt faster to computer and internet services because they have always had them. They want and expect expert teachers in a face-to-face environment. They are practical and they value processes and services that really work and are fast. They enjoy most interactive full motion, multimedia, graphical presentations, and audio (Borges, 2013). Thus, the use of appropriate teaching method is essential to the realization of the set objectives of the lesson. It may break or make the teacher while delivering a topic in a class. Exposing the learners to different kinds of teaching approaches will encourage and motivate the learners to be part of the lesson and make possible connections to what is happening outside the classroom.

Problem-solving skills also play a significant role in learning. Mayer and Wittrock (2009) define problem-solving skills as a cognitive process directed at transforming a problem from the given state to the goal state when the problem solver is not immediately aware of a solution method. Students need to have five kinds of knowledge in order to be successful problem solvers: (1) facts: knowledge about characteristics of elements or events, (2) concepts: knowledge of categories, principles, or models, (3) strategies: knowledge of general methods, (4) procedures: knowledge of specific procedures, and (5)

beliefs: cognitions about one's problem-solving competence or about the nature of problem solving.

Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from or generated by: observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Scriven & Paul, 2003). Critical thinking enhances language and presentation skills. Thinking clearly and systematically can improve the way one expresses ideas. In learning how to analyze the logical structure of texts, critical thinking also improves comprehension abilities. Critical thinking promotes creativity. To come up with a creative solution to a problem involves not just having new ideas; it must also be the case that the new ideas being generated are useful and relevant to the task at hand. Critical thinking plays a crucial role in evaluating new ideas, selecting the best ones and modifying them if necessary. It is crucial for self-reflection. In order to live a meaningful life and to structure lives accordingly, individuals need to justify and reflect on values and decisions. Critical thinking provides the tools for this process of self-evaluation (Islam, 2015).

The use of appropriate instructional materials is an indispensable tool in enhancing the qualitative teaching and learning process (Sale, 2015). The amount of effort exerted by the teacher should be focused on how the learners will be motivated to learn through the display of different instructional materials suited to the kind of learners the teacher has in the classroom. Also, the teacher qualification and experience are considered major factors affecting the proper execution of appropriate instructional materials (Umaru, 2011).

Statement of Purpose

The main purpose of the study was to determine the effects of strategic intervention materials/strategies on the academic performance, problem solving skills and critical thinking skills of Year 2 BSBA students of eastern Samar State University taking up Earth Science. Specifically, it aims to provide satisfactory answers to the following research problems:

1. Design and develop modules using SIMs;
2. Determine the acceptability of the modules that were developed using SIMs terms of (2.1) objectives, (2.2) subject matter, (2.3) values, (2.4) organization, (2.5) effectiveness, and (2.6) over-all attributes; and,
3. Determine the effectiveness of SIMs on Students in Earth Science in enhancing students' performance, critical thinking and problem-solving skills.

Significance of the Study

The results of the study will provide gainful insights on how academic performance, problem solving and critical thinking skills of the students may be improved and benefits students on how to mitigate natural disasters such as typhoon, volcanic eruption, earthquake, etc.. The research findings may be used by the Eastern Samar State University Main Campus – Department of Natural Sciences in planning, designing and implementing lessons in Earth Science, and in other disciplines as well. The researcher will share the results of the study for the sole purpose of academic undertakings without asking for any form of reward that will result in the sharing of research output. The following stakeholders are deemed to be relevantly benefited by the research results:

a. **School Administrators.** School administrators may gain insights that will aid in the development of school programs and policies that will cater to the improvement of academic performance, critical thinking and problem-solving skills. This may consist of strategically designed teachers' and students' workshops or training activities to such ends.

b. **Teachers and Department Heads.** Teachers and department heads may benefit from the findings of the study through meaningful reflection of the needs of students in terms of academic performance, problem solving and critical thinking skills development strategies that will result in the increase in student achievement especially in Earth Science. These reflections may be employed in planning lessons in Earth Science, among others, in a manner that will be most beneficial to learners in terms of improved academic performance, problem solving and critical thinking skills.

c. **Parents and Industry Partners.** The benefits of the research findings for parents and industry partners consist of the research-based awareness of the learners' academic performance, problem solving and critical thinking skills. This awareness may encourage parents and industry partners to take proactive steps in supporting or encouraging meaningful programs and activities that will be geared towards the development of students' academic performance, problem solving and critical thinking skills so that student participation may be significantly improved.

Scope and Delimitation of the Study

The study took into account the level of academic performance, problem solving and critical thinking skills of the Year 2 Bachelor of Science in Business Administration (BSBA) students of the Eastern Samar State University, Borongan campus who were

officially enrolled in Physical Science for the current semester. The entire population of the students enrolled in the course subject was used to determine whether strategic intervention materials/strategies is significantly related to academic performance, problem solving and critical thinking skills of the subjects. The entire population was used because of the limited number of enrollees in the particular course. The study was conducted during the second semester of school year 2016-2017.

Definition of Terms

The following terms are defined to facilitate readers' comprehension of the research text:

Strategic Intervention Materials/Strategies. These refer to the different teaching strategically developed materials that will promote effective teaching and learning in Earth Science. (Olawale, 2013)

Academic Performance: This refers to how well a student meets standards set out by local government and the institution itself. (Bell, 2014)

Problem Solving Skills: This is defined as a cognitive process directed at transforming a problem from the given state to the goal state when the problem solver is not immediately aware of a solution method (Mayer & Wittrock, 2009).

Critical Thinking Skills. This refers to the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from or generated by: observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Scriven & Paul, cited in the study conducted in 2011).

Research Conceptual Framework

The following diagram represents the conceptual framework of the study

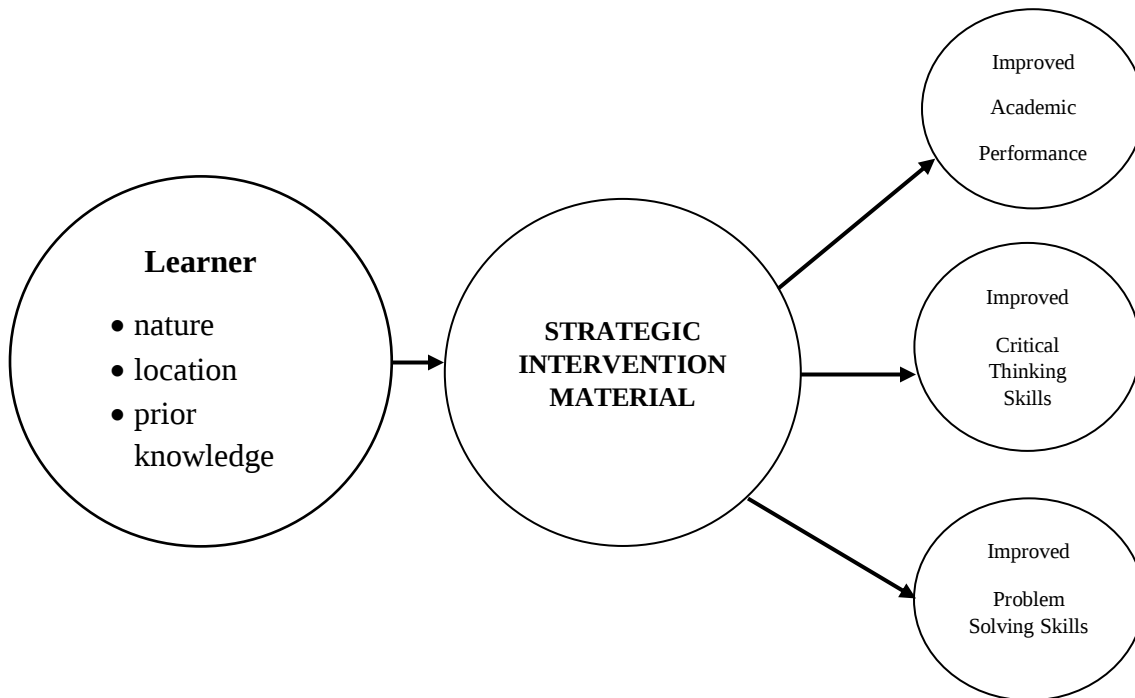


Figure 1.1. The paradigm of the relationship between the strategic intervention materials/strategies and their academic performance, problem solving and critical thinking skills.

Figure 1.1 shows the conceptual framework of the research conducted. It is believed that considering all factors such as nature of the learners, location of the learning institution, prior knowledge of the learners, etc. the strategic intervention materials (SIMs) developed can greatly contribute to the improvement of the academic performance of the students taking up the basic course in Earth Science. The SIMs will allow the students to enhance their learning on the basic ideas in one of the major topics in the said course which is about earthquakes and the ways to mitigate disaster. Likewise, the SIMs bring about

enhancement in the critical and problem-solving skills of the students. Such positive advancement of these learning skills permits life-long dexterities of life (Katamei et al. 2013).

The researcher has a positive assumption that SIM brings about affirmative change in the academic performance, critical thinking skills and problem-solving skills.

The modules that were developed based on SIMs have features that encourage good classroom performance of students. Opportunities to explore varied subjects that increase and sharpen students' competencies in earth science are made possible. Critical and problem-solving skills of the students are developed through the use of outcome-based questions in the modules. Watching earth-science related video clips and movies, pictures, studying and diagrams and using graphic organizers for a clearer presentation of concepts are added features in the modules that contribute largely to the good classroom performance of the students.

CHAPTER II

LITERATURE REVIEW

This chapter presents insightful readings that are viewed to have relevant contribution to the development of the study's framework.

Everyday people from different places are confronted with diverse environmental concerns and problems that one way or the other affect their lives. According to Rivet (2017) the Earth and environment challenges facing our global society in the twenty first century requires a robust understanding of the complexity of the ever-changing world. Therefore, it is critically important for Earth Science to be a central part of the tertiary school science curriculum for all students, regardless of location or status.

Teaching Science is not about preparing students for a world that is static and fixed, but it concerns getting students ready to cope with changes and challenges in their lives (MdShamsudin, Abdullah & Yaamat, 2015). Meaningful science learning could be achieved with the employment of teaching strategies that stimulate student's excitement when learning science. Based on the article by Juuti, et al. (2010), students are more engaged in creative activities if they find the subject relevant to their everyday life. If students are made to understand the relation between how they receive the information and their interest appeal student's attention that science is significant to society.

Based on the study conducted by Candrasekaran (2014) schools need to modify their curricula so that science is not disregarded, but rather taught in a meaningful way in which the students enjoy learning. Not only will the students develop critical thinking and problem-solving skills, but also, they will improve in other subject areas.

Academic Performance

Learners of all academic levels come to the classroom armed with beliefs and life and academic experiences that significantly influence the extent and quality of learning (Campbell & Campbell, 2009). According to the study conducted by Umaru (2011) students perform better when appropriate and improvised materials were made available and utilized in the teaching process. Suitable instructional materials being used in the classroom facilitate better understanding of ideas in the learners as well as ensuring long term retention of ideas and topics (Sale, 2015).

Employing the use of teaching aid make learning real and permanent (Effiong, et al. 2015). With these given findings, agreeing to Sale (2015) the acquisition of sound knowledge depends largely on the teachers' ability to rouse student interest towards learning. Reluctance to the use of different instructional materials may somewhat hamper the academic achievement of the learners. There is a significant difference between academic performance of learners taught with instructional materials and those without instructional materials (Adebule et al. 2015). Olayinka (2015) concluded in his study that learners taught with instructional materials performed better than those taught without.

For an educational program to become successful, government should provide instructional materials to enhance effective teaching and learning (Onyejegbu, 2013).

Although these provisions given by the government may sometimes fail to offer positive impact, teachers should be allowed to attend seminar- workshops on the making and use of instructional materials. Enough time should be allotted for effective use of

instructional materials in the teaching process because according to the study conducted by Ayoola et al. (2015), teachers most of the time are not putting the materials into good use.

Based on the article teaching techniques for science teachers retrieved from Edu Nova (2012), science teachers have an exciting opportunity to teach kids about how science makes the world work. Unfortunately, reduced teaching budgets and apathy on the part of students sometimes make it difficult to get students interested in topics like biology, earth science, anatomy, physics, and chemistry. Some teachers are now using techniques such as peer learning, role-playing, and incorporating current events in science lesson plans. These techniques help engage students and help them understand the importance of science. They also make it fun to teach scientific concepts and help students understand common topics in the scientific world.

To increase students' performance in science, the teacher can consider the following: identify the type of learners and vary teaching strategies suited for every class; know the IQ level of the students per section; and connect theories in lectures to actual laboratory performance of experiments using different apparatus and equipment, Taroc et al. (2015). According to Shah and Rahat (2014) activity-based teaching was much effective than the lecture method teaching of science at elementary level. They found out the positive linkage between teaching technique and student learning.

An excellent combination on the motivational activity and learning strategy. The nature of motivation and learning strategy practiced by the teacher is fundamental to improving student learning outcomes (Gbollie et al. 2016). Also, they believed that

motivational belief component of extrinsic goal orientation was the most preferred belief while test anxiety was the least possessed belief.

From the study conducted by Alos et al. (2015) she found out that teacher-related factors have the highest impact on the academic performance of the students. Teacher's ability to rouse the interest of the students by making the classroom discussion more appealing to the students will lead to a better academic performance.

According to the study conducted by Arieta et al. (2017) study habits play a significant role in the academic performance of the students. How they manage their time, where they study, and the use of social media greatly impact towards the achievement of their dream, and that is to finish school. There are other factors to be considered but how they prepare for school is critical to their academic performance.

How the classroom is managed by the teacher influences the academic performance of the students as mentioned in the study conducted by Falsario et al. (2014). The study also emphasized the ability of the teacher to employ the maximum participation of students individually or collaboratively and the ability of the teacher to create a conducive classroom climate to help students attain academic success.

Student's learning style, motivation, and professor are factors that may affect their academic performance. Thus, De La Cruz et al. (2013) suggested in their study that departments should continue reinforcing student's reasoning and thinking skills because students have shown enthusiasm on how they perform in school, assertive with their learning styles, emphatic about their motivation and express more compassion in their study as compared to their social life.

According to the study conducted by Racca et al. (2016) proficiency in the English language is significant in the academic performance of the students in all subjects. A satisfactory level in the English language may display a good academic performance especially in science and mathematics.

Critical Thinking Skills

Higher order thinking skills include critical, logical, reflective, metacognitive, and creative thinking. They are activated when individuals encounter unfamiliar problems, uncertainties, questions, or dilemmas. Successful applications of the skills result in explanations, decisions, performances, and products that are valid within the context of available knowledge and experience and that promote continued growth in these and other intellectual skills. Higher order thinking skills are grounded in lower order skills such as discriminations, simple application and analysis, and cognitive strategies and are linked to prior knowledge of subject matter content. Appropriate teaching strategies and learning environments facilitate their growth as do student persistence, self-monitoring, and open-minded, flexible attitudes (King et al. 2013).

A study conducted by Aloquali (2012) concerning reading comprehension and critical thinking skills revealed that there is a well-established relationship between reading comprehension and critical thinking skills and that this relationship is rationalized by the schema or prior knowledge theory. This connection consequently leads the readers to reach the critical comprehension level. It likewise implied that an individual's familiarity with the subject matter of a text plays an important part in the person's performance on critical thinking tasks.

Critical thinking skills are both cognitive skills and affective disposition. This idea has disturbed the way teachers relate knowledge to the learner. The study conducted by Adedayo (2014) revealed that there is difficulty by some teachers integrating the concepts in the actual classroom setting that will encourage students to think critically.

According to the study conducted by Kennedy et al. (2011) skills of the students are improved significantly and could produce better results if intervention materials are widely used and stressed the importance of prior knowledge in the student's demonstration of critical thinking skills.

Asking and answering questions for clarification such as defining terms; identifying assumptions; interpreting and explaining; reasoning verbally on related concepts and some uncertainty; predicting; and seeing both sides of an issue are behavioral skills relevant to the development of critical thinking skills, Facione (2010).

Based on the study conducted by Jolo (2016) he mentioned that sufficient practice of critical thinking skills in a variety of domains is critical for effective transfer of the skill. More so, students should be explicitly guided on how this transfer could be done.

Critical thinking fundamentally consists in acquiring, developing, and exercising the ability to grasp inferential connections holding between statements (Mulnix, 2010). However, as mentioned by the researcher, there is difficulty in determining whether critical thinking can be taught or even measured. Critical thinking is also distinguished from other forms of mental processes which is often considered as one.

Agreeing to Thomas (2011), programs and courses in the university should develop critical thinking skills among its students at an early stage. This skill allows students to make well-informed judgment, explain their reasoning and solve unknown problems.

In the study conducted by Wen Quifang et al. (2010), they found out that English major students are significantly better in terms of thinking critically than students enrolled in liberal arts courses but the gap diminishes with the increase of grade. However, based on significant progress across the grades, both groups have shown significant progress in the acquisition of the skill.

Cognitive skills like interpretation, analysis, explanation, evaluation, self-regulation and inference are central to the idea of critical thinking. With these cognitive skills, students are able to analyze and synthesize information and solve problem in broad range of areas, (Facione, 2010).

According to the study conducted by Marin et al. (2011), high school students are capable of developing critical thinking skills if they are exposed to words or given opportunities to do a great deal of reading, engagement in the learning process and practice independence in everyday activities, routines, and transitions. Also, from the research conducted by Cavus et al. (2009) students' attitudes regarding the use of mobile learning system can significantly improve their creativity. Furthermore, working collaboratively and sharing information increase positive attitude towards the learning process.

Based on the paper presented by Stephenson et al. (2015), students taught using the "science writing heuristic approach - SWH" had significantly higher total critical thinking

scores over their traditional counterparts. The results indicate that the SWH approach shows efficacy in improving students' critical thinking skills over the traditional approach.

Problem Solving Skills

The skill to solve problems poses a challenge to students because they lack the understanding of the whole process. Based on the study conducted by Yu et al. (2015), students should be exposed to constructing a context-simulation activity, and introducing a project design to enable them to construct a complete problem-solving skill. The authors also used films as a learning activity that would enhance their knowledge on how to solve problems. Other strategies were identified to enhance the problem-solving skills among the students, in the research conducted by Mohd – Yusof et al. (2013) they used cooperative problem-based learning (CPBL) and have learned that this strategy significantly enhances problem-solving skills among engineering students in a typical course.

In mathematics, a research conducted by Vista (2012) revealed that problem solving skill and reading comprehension skill can predict the achievement of the students in math. However, it is more on the problem-solving ability of the student that can predict its growth and that it could be used towards improving growth rates in math achievement.

According to the study conducted by Surif et al. (2012), there is a correlation between problem solving based on conceptual and procedural knowledge. Increasing conceptual and procedural knowledge of the students in science teaching and learning strategies brings about significant development in the problem-solving skills of the students.

Technical capabilities of people studying in applied science and engineering require the skill to solve problems which can be improved with constant exercise and adequate training. (Ghafoor et al. 2012) The authors also emphasized practical problem-solving skills with clear economically viable, timely and implementable solutions are highly valued.

Problem-solving as defined by the Business dictionary (2016) is the process of applying ideas, experience, skills and understanding to new and unfamiliar situations in order to complete tasks, make decisions, or achieve goals; it is also a process of working in details of a problem to reach a solution. Problem solving may include mathematical and systematic operations and can be a gauge of an individual's critical thinking skills.

Also, based on the study conducted by Jacono (2000), Filipinos undergo the so called pre-conditional stage: childhood where children comply with the values of those who assert power on them (parents, teachers, nuns and priests). In this scenario, children are deprived from uttering reasons on the different situations they are into; thus, their skills needed to solve problems are hampered.

Effective problem solving requires a controlled mixture of analytical and creative thinking. Research has shown that in general terms, each side or hemisphere of the brain is specialized to serve one of these groups of skills. The degree of specialization of each hemisphere varies from person to person but it has given rise to the terms right-brain thinking and left-brain thinking. Left-brain thinking is more logical and analytical, and is predominantly verbal. Right-brain thinking is more holistic and is concerned with feelings and impressionistic relationships. To be a good problem solver, you need to be able to

switch from one group of skills to the other and back again although this is not always easy. Traditional education gives far greater encouragement to the development and use of left-brain thinking. This is reinforced in the way we are required to work, where emphasis is placed on rational, logical analysis of data in drawing conclusions as stated in article of Harrington (2014).

As mentioned by Rube (2017), the ability to solve problems applies to more than just mathematics homework. Analytical thinking and problem-solving skills are a part of many jobs, ranging from accounting and computer programming to detective work and even creative occupations like art, acting, and writing. While individual problems vary, there are certain general approaches to problem-solving such as these four principles – Understanding the Problem, Devising a Plan, Carrying out the Plan, and Looking Back – one can improve one's problem-solving and tackle any issue systematically. Furthermore, in the study conducted by Kem (2016) students should be tested with enough exercises which they can solve with effort. Hence, the number, difficulty, and complexity of their thinking schemas grow, and after a time, they assemble into mechanisms which help them in solving problems that are more difficult.

There are a number of characteristics that differentiate the experts from the novice problem-solvers. The most familiar distinction is that the experts think about, consider, and examine the problem as a whole before beginning to work on a solution. They classify a problem according to its underlying principles deciding to what class of problem it belongs. They engage in a planning stage before attempting a solution. On the other hand, the novices jump right into finding the solution. The experts use a “working forward” method,

while the novices use a “working backward” method. The novices are considered as surface thinkers while the experts are deep thinkers (Helmi, et al. 2013).

Intellectual challenges come in various forms that involve different kinds of cognitive tasks, solving strategies, and heuristics. Problems lie on a spectrum that spans between well-structured problems that converge into a conclusive deterministic solution and ill-structured problems that are set in vague and ambiguous context, are not subject to a deterministic solution, and involve uncertainty in the problem domain and the solution space (Geifman & Raban, 2015).

Strategic Intervention Materials

According to the study conducted by Rodrigo et al. (2015), strategic intervention materials are conceptualized and designed to aid the teacher provide the pupils the needed support to make progress in studies. These will increase and deepen the skills, knowledge and understanding of the child in various subject areas not only in science and math but also including various learning areas in the curriculum. SIM can give the opportunity to explore various ideas and concepts that would enrich their understanding of varied subject matters that sharpen their competencies. Furthermore, the strategic instructional materials tend to reteach the lessons which are not so much clear to the learners and to help them gain mastery of the skills. Similarly, the study of Javier (2015) points out that intervention materials is an effective way of improving students' competence.

In the study performed by Salviejo (2014) on the Strategic Intervention Material-Based Instruction, Learning Approach and Students' Performance in Chemistry, he

emphasized that the use of SIM-BI is effective in terms of improving students' performance and learning approach. The surface learners performed equally well as the deep learners when SIM-BI was used. The positive result of the survey suggested that the SIM was appreciated and appealed to both types of learners. Also, it was suggested that the strategic intervention materials significantly contribute to the mastery of chemistry concepts as revealed in the research conducted by Soberano (2017) entitled *Strategic Intervention Materials in Chemistry: Development and Effectiveness*.

Based on the study conducted by Diaz (2017), she determined the effectiveness of the developed Tri-in-1 SIM for grade 9 Mathematics through Solomon Four Group Design using a total of 60 subject-participants that underwent matching under the quasi experimental method of research. The SIM is incorporated with two-dimensional manipulative and is composed of different activity cards about the parts of a right triangle, proportions of the corresponding parts of similar triangles, geometric mean in a right triangle and word problems involving right-triangle similarity theorem. The study revealed that when students are exposed to Tri-in-1 SIM, their Mathematics achievements are better and higher.

It is also noted that the use of SIM can be considered as a technique in delivering the lessons and is no inferior to traditional method used for developing academic achievement. This finding is noticeable in the study conducted by Ibis (2014) on "The Effect of Strategic Intervention Materials (Sim) on the Students' Academic Achievement in Chemistry".

In the study on "Intervention Strategies to Improve Students' Academic Performance In Public Secondary Schools In Arid And Semi-Arid Lands In Kenya" by Katamei et al.

(2013), it was mentioned that students need an integrated Life Skills program in order to cope with their day to day academic life. Life Skills are essential for successful living and learning. Life skills may include emotional skills, coping skills, health and hygiene skills and communication. It is beneficial as it makes students better members of the society. This enables them not only to solve problems but also to think creatively. Having life skills knowledge enables students to relate well with others in a friendly manner. It also influences academic performance as they are able to become judgmental. Life Skills education when intensified in secondary schools enables students to be confident in solving day to day problems and foster creativity thus improving academic performance.

Strategic intervention material (SIM) will promote autonomous learning and memory enhancement among learners to better their performance in understanding many complicated concepts and skills in science. However, despite these advantages, teachers encounter barriers during preparation and implementation proper of the SIM (Dacumos, 2014). In the study performed by Membrebe (2015) it was suggested that the Strategic Intervention Material (SIM) developed be adopted as instructional material for the improvement in teaching science, to facilitate and carry out the three-way process of learning, most importantly to improve achievement of the students.

Unlikely, the empirical results of the research conducted by Thekedam et al. (2015) indicate that absenteeism is a phenomenon that is controllable through sound policies and support system. While disciplinary measures are still relevant, proactive intervention by the administrators can reduce the rate of class absenteeism. The findings of the study reveal that besides a change in students' own attitude and the efforts of the teachers, the parents

and the community have important roles to play in order to encourage students to attend classes. These findings are significant in my study because life skills are attitudes that individuals should have in order to endure the atrocities of the society.

CHAPTER III

METHODOLOGY

Research Design

The study was conducted using the developmental design method, which is important in the field of instructional technology. It involved situations in which the product-development process is analyzed and described and the final product is evaluated.

The setting includes two weeks of the curriculum calendar year. The month has a minimum number of 8 recitation and assessment days, two times a week and everyday one and one-half hours is allotted in the subject (earth science) using the SIMs.

Before the pre-test was administered, the selected participants were asked to fill-out the consent form prepared for this study. After the pre-test was administered, the participants were exposed to the developed SIMs and the post test was given. These assessment tasks, the pre-test and post-test, composed of 50-item multiple choice tests.

SIMs were given after the analysis of the pre-test scores in-order to improve the level of knowledge the students will be receiving. During the intervention the teacher utilized the developed strategic intervention materials that will ensure greater retention and increased academic performance of the students.

Research Locale, Sampling and Participants

The study was conducted at the College of Arts and Sciences of the Eastern Samar State University, Borongan City. The total population of Year 2 BSBA students was used in the study where the researcher was their teacher. This level has the science curriculum and has a different level of developing understanding of a particular earth science concept.

The level has only one section, with 28 students. However, only the heterogeneous 23 students composed of boys and girls were able to complete the SIMs (criteria of selection will not be considered in the study). In the analysis of data, the researcher considered the initial population that was asked to participate in the study.

Expenses incurred in the conduct of the research were shouldered by the researcher. No contribution was asked from the participants. Likewise, no financial considerations were given as a result of the participation of the students.

Research Instruments

The study used researcher- developed test questionnaires in relation to earth science. They were used on pre-test and post-test achievement to determine if there is a change before and after intervention and further analyzed the effects of the strategic intervention materials/strategies on students' academic performance regarding earth science subject.

The researcher chose the multiple choice type because it is deemed the most relevant to the study. The instrument contains 50 items multiple choice test that measures student's views about nature of knowledge and learning in earth science, and develop critical thinking and problem-solving skills of the students at the same time. The critical thinking questions have been patterned from the CAT – critical thinking assessment test of the Tennessee Technological University supported by the National Science Foundation. Other instruments were also utilized like the California critical thinking skills test (CCTST), Mabruroh et al. (2017) Construction Of Critical Thinking Skills Test Instrument Related The Concept On Sound Wave and others related studies while problem solving

skills questions were patterned from the studies conducted by Herak (2010), Docktor (2009), and Adams et al. (2007).

The evaluation of the SIMs was carried out with the use of the adapted assessment instrument by Concepcion (2004) entitled, Enrichment Learning Module in Biological Science Focused on Environmental Education for Gifted Secondary Students of Xavier School, 2004. The assessment and evaluation were done by distinguished experts in the field of science education. Two experts were from the faculty of science of the Philippine Normal University-Taft Campus namely Dr. Letecia Catris and Prof. Tondo while the other three Dr. Letecia Ladera, Prof. Daisy Acorin, and Ms. Arminda Belizar, were from province of Eastern Samar they are also heads of the departments where they are assigned. The data gathered were analyzed using statistical inter-rater measure of the SIMs.

For the assessment questions, the researcher has adopted the checklist for evaluating achievement test adopted from Duad, C.B. (2016), Development of a Strategic Intervention Material (SIM) for Grade 10 Science: Chemical Equations and Reactions. For this purpose, the researcher has asked distinguished science experts in their field for the evaluation of the test prepared. They are Dr. Josefina Beltran of the Blessed Trinity School of Las Pinas, and Ms. Hazel Samala and Ms. Elizabeth Lusanta who both are MA degree holders. Similarly, the pre and post tests were analyzed using the inter-rater measure of the assessment test.

Data Gathering Procedure

Data for this study were collected as part of the research on strategic intervention materials (SIMs) on earth science, its effects on the academic performance, problem

solving and critical thinking skills of year 2 BSBA students of the Eastern Samar State University. The subject teacher conducted the pre-test and post-test separately during the allotted time. Each test was administered in an hour after which scores of the correct answers were tallied for the statistical analysis.

This study was conducted for a period of two weeks allotted for the specific topic in Earth Science. In the allotted time, all activities necessary in the conduct of the research were carried out.

Statistical Analysis

Different statistical analyses were used for the objectives of the study conducted such as:

Objectives 1 and 2- arithmetic mean, standard deviation, coefficient of variation and inter-rater agreement.

Objective 3 - repeated –measures design for analysis of the data and the descriptive statistic measures such as arithmetic mean, standard deviation, coefficient of variation and f-test using ANOVA for correlated groups procedure.

The following tables were used in the interpretation of the gathered data.

Acceptability

Table 3.1 *Interpretation of Acceptability Scores* was used in the analysis of the data gathered from the evaluators on the different areas of the developed module and assessment tool used in the study.

Table 3.1 Interpretation of Acceptability Scores

Range	Remark	
	Module (1-5)	Test (1-4)
$4.50 \leq B^a \leq 5.00$	highly acceptable	
$3.50 \leq B \leq 4.49$	very acceptable	highly acceptable
$2.50 \leq B \leq 3.49$	acceptable	very acceptable
$1.50 \leq B \leq 2.49$	fairly acceptable	acceptable
$1.0 \leq B \leq 1.49$	not acceptable	not acceptable

Table 3.2 Interpretation of Percentage Agreement

Range (%)	Remark
100.0	perfect
$90.0 < A^a < 100.0$	very high
$80.0 < A \leq 90.0$	high
$60.0 < A \leq 80.0$	marked substantial
$40.0 < A \leq 60.0$	moderate
$20.0 < A \leq 40.0$	low
$0.0 < A \leq 20.0$	negligible
0.0	complete disagreement

Percentage agreement

Table 3.2 *Interpretation of Percentage Agreement* was used in the determination of the different domains of the experts' validation on both the developed module and the assessment tool.

Table 3.3 Interpretation of p-level

Range	Remark
≤ 0.050	not significant
$0.010 \leq p < 0.050$	significant
$0.001 \leq p < 0.010$	highly significant
< 0.001	extremely significant

The assessment tool was interpreted using the ANOVA statistical design. This table shows the measured *p-level* and its description.

Ethical Consideration

Confidentiality was imposed in the identification of the participants. Numbers were used instead of the names of the participant/examinee. The examinees were informed of the purpose of the said activity and its results were used only for the purpose of this study by the researcher. More so, the results were not in any way used as data for other purpose and will be under the protection and storage of the researcher and were shared to the participants that gave them the idea how they performed in the study.

Protection and safety of the examinees were taken into great consideration. The participants/examinees were treated as normal and typical students who were undergoing

routine classroom activities. In the course of the study, the participants were not treated differently and felt that what they were into was just a customary classroom interest activity

CHAPTER IV

RESULTS AND DISCUSSION

This chapter presents the data gathered from the study and the results of the analysis that were made to these data. The order of presentation follows the order of the specific question presented in Chapter 1.

The following presents the results of the study.

1) The modules using SIMs have been structured and organized based on the desire of the teacher/researcher to have learning materials that would encourage students to engage in an active learning environment like earthquake drills. The researcher used strategic intervention materials-based modules to emphasize the importance of the chosen topics.

ESSU regularly conducts earthquake drills. The activity prepares employees and students to be aware of what to do in case of an earthquake. These SIMs-based modules are used in educating drill participants about earth dynamics and disaster management.

The topics chosen by the researcher are about volcanoes, plate tectonic, earthquake, and earthquake safety management. The modules were anchored on the different learning competencies in physical science, and these are:

- a) to describe and illustrate the fundamental concepts and principles of physical science, which will serve as sufficient background for further study and/or use in everyday life;

- b) to develop appreciation and interest in the course, and be aware of the practical applications and social implications;
- c) to apply the knowledge, skills, and attitudes in doing exercises and experiments, and
- d) to relate each concept to the activities of daily living

Each module emphasizes big science ideas, and contains outcome-based questions that are to be answered by the students. The same module provides opportunities for students to view science-related movies and video clips, study pictures and diagrams, simulations, and use graphic organizers for concept presentations.

The activities and exercises contained in the modules were anchored on the use of critical thinking strategies, cooperative learning techniques, scaffolding techniques and differentiated activities.

The use of critical thinking strategies is based on Piaget's view of children as active learners and thinkers. In addition, the use of cooperative learning techniques is based on Vygotsky's view of learners as children who learn through social interactions. The use of differentiated activities is based on Bruner's view of learners as children who can easily learn through scaffolding by adults.

Using and interpreting graphic organizers, analyzing pictures and diagrams are activities that promote critical thinking. Simulations based on different concepts are

cooperative learning activities. Answering outcome-based questions that are formulated from easy to difficult is a scaffolding task.

Table 4.1 Contents, Learning Objectives, and Strategies Used in the Module

Module	Contents	Learning Objectives	Learning Strategy/Activity
1	Earth and Its Features	1. Differentiate Earth from the other planets in the solar system. 2. Identify and describe some features of the Earth. 3. Explain and generalize motions of the Earth and moon. 4. Distinguish the types of plates of the earth. 5. Compare and contrast the different types of plate boundaries. 6. Show appreciations to the different features of the earth. 7. Use knowledge in the proper dissemination of information.	watching video clips reading/interpreting graphic organizers answering questions
2	Parts of a Volcano	1. Characterize volcano as an Earth feature. 2. Identify the different parts of a volcano. 3. Discuss and characterize the different parts of a volcano. 4. Make a geographical map of the Philippines with the different volcanoes.	simulation – geographic map answering questions reading/interpreting graphic organizers

3	Formation of Volcanoes	1. Explain how volcanoes are formed. 2. Identify places where volcanoes are usually formed. 3. Recognize the dynamism of the earth.	watching a movie making reaction paper answering questions reading/interpreting graphic organizers
4	Types of Volcano	1. Classify the different types of volcano. 2. Characterize the different types of volcano. 3. Classify the different volcanoes in the Philippines. 4. Show appreciation on the different types of volcano. 5. Construct model on the different types of volcano.	simulation – volcano answering questions reading/interpreting graphic organizers
5	Volcanic Eruptions	1. Identify the different types of volcanic eruption. 2. Contrast the different types of volcanic eruptions and their effects. 3. Distinguish between non-explosive and explosive volcanic eruptions 4. Show concerns to people when a volcano erupts.	watching a movie making reaction paper

		5. Draw a labelled Philippine volcano with its characteristics and a) facts about the eruption; b) causes of the eruption; c) primary and secondary effects; and, d) short-term and long-term responses	reading/ interpreting graphic organizers poster making answering questions
6	Volanic Eruption Safety Management	1. Identify the different ways to mitigate destruction brought about by a volcanic eruption. 2. Evaluate the given ways of mitigating destruction during a volcanic eruption. 3. Design your own procedures, using the spoken dialect in your area, on how to lessen loss of lives during a volcanic eruption or evacuation plan. 4. Recognize and show appreciation for the efforts done by the government to mitigate destruction during a volcanic eruption.	reading/ interpreting graphic organizers making reaction paper making warning signs using mother tongue answering questions
7	Earthquake	1. Define an earthquake, as well as its epicentre and focus.	watching a movie

		2. Explain the occurrence of earthquakes according to elastic rebound theory. 3. Explain the relationship between earthquakes and faults. 4. Describe where (in a Plate Tectonic sense) different types of earthquakes are generated. 5. Describe the process of locating earthquake epicentres using P and S waves. 6. Describe the Richter magnitude scale for measuring the size of an earthquake. 7. Recognize the role of modern science in studying the occurrence of an earthquake.	experiments reading/ interpreting graphic organizers answering questions
8	Earthquake Risk Reduction Management	1. Identify the measures done by the government to lessen the destructive effects of an earthquake. 2. Demonstrate safety precautions during an earthquake. 3. Express familiarization of the different fault-lines in the Philippines. 4. Evaluate the different programs of the NDRRMC (National Disaster Risk Reduction Management Council) and PHILVOLCS on earthquake mitigation. 5. Show empathy to areas in the country displaced/destroyed by an earthquake. 6. Translate the earthquake safety precautions in the dialect spoken in your area.	earthquake drill making reaction paper making warning signs using mother tongue answering questions

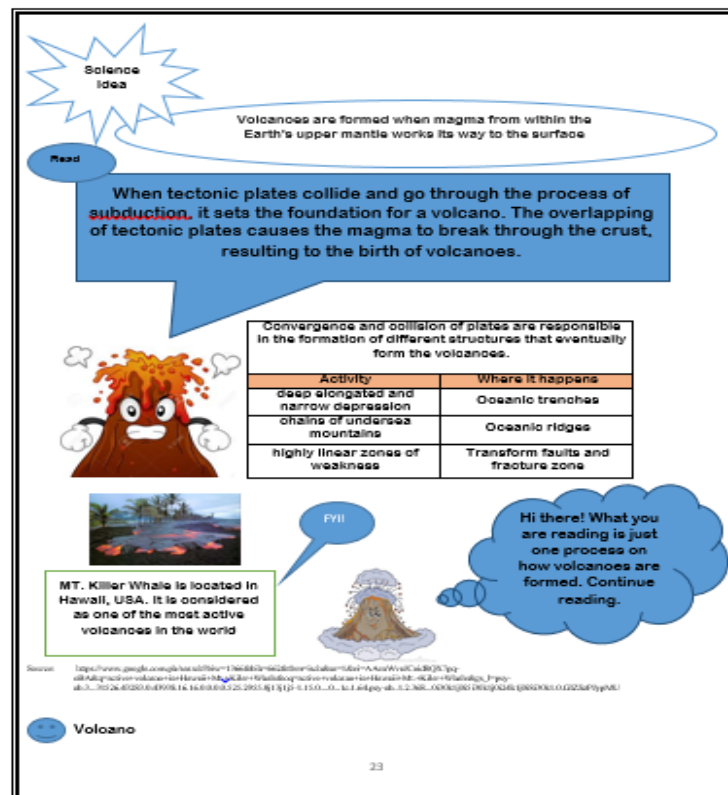
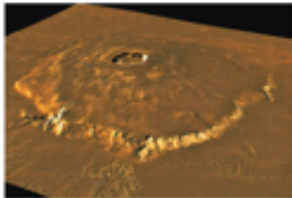


Figure 4.2 Screenshot Sample page of the module #2

Read

Mother of all volcanoes: Olympus Mons



34 Kms High (3 times Mt. Everest), 600 Kms across (as big as Missouri)

Source: <https://www.google.com/photos/10646604626248164816/dm/10646604626248164816/10646604626248164816/CBGY00&hl=de>

Check this out!!!

Philippine volcanoes come in different types.

Module Output: (See Rubrics at the end page of this module)

Using discarded cardboard and recycled papers, construct models of the different types of volcanoes. (*size: l = 1 ft; h = 4 inches; w = 1 ft*)

End here!!!

SW Check What You Learned:

Encircle the letter of the best answer:

- Which type of volcano is commonly composed of basalt?
 - Cinder volcano
 - Shield volcano
 - Composite volcano
- How is Mt. Mayon classified as a volcano?
 - Cinder volcano
 - Shield volcano
 - Composite volcano
- This type of volcano has a gentle eruption with oozing lava flows.
 - Cinder volcano
 - Shield volcano
 - Composite volcano

Critical Thinking Question:

What do you consider the most destructive type of volcano?

Explain.

2) Tables 4.2 to 4.12 present the acceptability of the modules according to the experts' validation of the modules and tests.

Table 4.2 Experts' Validation of Module: Objectives

Facet	Acceptability				Agreement ^a
	M	SD	CV	Remark ^b	Index Interpretation ^c
1. are clearly stated	3.80	1.166	0.307	acceptable	
2. are attainable and measurable	4.20	0.980	0.233	very acceptable	
3. include cognitive, affective, psychomotor domains	4.20	0.748	0.178	very acceptable	
4. includes awareness of and concern for social issues and problems	4.20	0.400	0.095	very acceptable	
5. include development of creative and critical thinking	3.80	1.166	0.307	acceptable	
6. contribute to the holistic development of the student	4.00	0.894	0.224	very acceptable	
7. address the need to translate theory to practice, knowledge to action	4.20	0.980	0.233	very acceptable	
Domain	4.06	0.954	0.253	very acceptable	70.0 marked substantial

a. Percent (linear weights)

b. based on M

c. based on Index

The table above, facets 2, 3, 4, 6, and 7 were marked very acceptable based on the arithmetic mean. This indicates that objectives cater to the well development of the learners. The set objectives exposes learners to real life situations where they can apply their skills. However, written objectives were only marked acceptable together with developing critical thinking skills. This implies that to ensure clarity and effectiveness in improving critical thinking skills of the learners, learning objectives must be sufficiently practiced for effective transfer of the skill as mentioned by the study of Jolo (2016).

Table 4.3 *Experts' Validation of Module: Subject Matter* shows that facet on social relevance got the highest mean score which signifies that this module caters to the current issues of the society. Majority of the facets registered a 4.20 arithmetic mean and were marked very acceptable this agrees closely with the facet that got the highest mean score. This means further that the module developed which employs acquisition of knowledge depends largely on the teacher's ability to rouse student's interest toward learning Sale (2015). On the other hand, two facets registered mean scores of 3.60 which denote that subject matter is not enough to serve what lies ahead in the future and combining ideas and deed.

Table 4.3 Experts' Validation of Module: Subject Matter

Facet	Acceptability				Agreement ^a	
	M	SD	CV	Remark ^b	Index Interpretation ^c	
1. is accurate and up-to-date	4.20	0.748	0.178	very acceptable		
2. is adequate to achieve the objectives	3.80	1.166	0.307	very acceptable		
3. is not only confined to the present or the past but also to the future	3.60	1.020	0.283	acceptable		
4. is attuned to the Philippine conditions, environment, and society	4.20	0.748	0.178	very acceptable		
5. is within the comprehension and interest of the students	4.20	0.748	0.178	acceptable		
6. uses concepts and information that are universal and lasting	4.00	0.894	0.224	very acceptable		
7. uses concepts of social relevance (present needs, problems and concern of people)	4.40	0.800	0.182	very acceptable		
8. provides an integration of relevant knowledge and appropriate action	3.60	0.800	0.222	very acceptable		
Domain	4.00	0.922	0.230	very acceptable	71.9 marked substantial	

a. Percent (linear weights)

b. based on M

c. based on Index

Table 4.4 Experts' Validation of Module: Values

Facet	Acceptability				Agreement ^a
	M	SD	CV	Remark ^b	Index Interpretation ^c
1. avoids playing up customs that are not appropriate to current time or situation	3.80	0.980	0.258	very acceptable	
2. are sensitive to the needs, traditions, and beliefs of different ethnic groups	3.80	1.166	0.307	very acceptable	
3. develops respect for life of all kinds on planet earth	4.40	0.800	0.182	Very acceptable	
4. develops understanding, respect and appreciation of Philippine culture	4.00	0.632	0.158	very acceptable	
5. develops national identity and pride	4.20	1.166	0.278	Very acceptable	
6. stresses the need for kindness, compassion, honesty, self-reliance, and thrift	4.00	0.632	0.158	very acceptable	
7. provides realistic and credible models with whom the students can identify	4.20	0.748	0.178	very acceptable	
8. allows for understanding, appreciation, and practice of peace, justice, harmony, solidarity, and social responsibility	4.20	1.166	0.278	very acceptable	
Domain	4.08	0.959	0.235	very acceptable	71.2 marked substantial

- a. **Percent (linear weights)**
- b. **based on M**
- c. **based on Index**

The module enriches the values being developed in the learners. Significantly, a 4.40 arithmetic mean-score points out to the attitude on the care and respect to all organisms that roam around. All facets were marked very acceptable as far as development of values are concerned. Over-all domain suggests that value attitude implied by the module is noted as extensive in the cultivation of good character among the users. These findings agree with the research output of Cavus et al. (2009) which states that positive attitudes of the learners can significantly improve the learning process and their creativity.

Planning and organization of the module was perceived by the experts to be very acceptable and was marked substantial. The presentation of the different elements of a module was found to be present and was adequate inputs to the development of the learner's knowledge in earth science. As observed from Table 4.5 *Experts' Validation of Module: Organization*, specific facets were mostly assessed by the experts to have suitable and appropriate organization. This evaluation corresponds to the study conducted by Falsario et al. (2014), which suggests that the manner by which the teacher manages the activities in the classroom influences performance among the learners.

Table 4.5 Experts' Validation of Module: Organization

Facet	Acceptability				Agreement ^a
	M	SD	CV	Remark ^b	Index Interpretation ^c
1. unit goals/lesson objectives are clear	4.00	1.265	0.316	very acceptable	
2. lessons are simple and easy to present to students	4.20	0.980	0.23	very acceptable	
3. lessons can be adjusted in terms of time needed	4.00	0.894	0.224	very acceptable	
4. flexibility in design can be modified to be more effective for students' needs	4.20	0.980	0.233	very acceptable	
5. activities are sufficient for development and skill enhancement	3.80	1.166	0.307	very acceptable	
6. instructional materials are presented in an interesting ways	4.00	0.894	0.224	very acceptable	
7. conceptual framework and unifying philosophy are present	3.80	1.166	0.307	very acceptable	
8. accepted psychological and pedagogical principles are consistent	3.60	1.020	0.283	very acceptable	
9. logical sequence and gradation of concepts are followed	4.00	1.265	0.316	very acceptable	
10. adequate study aids such as questions, problems, and exploration are provided	4.00	1.265	0.316	very acceptable	
11. strategies are used to develop problem solving skills	3.40	0.800	0.235	very acceptable	
12. conventional and modern learning and teaching strategies were used	3.80	1.166	0.307	acceptable	
Domain	3.90	1.106	0.284	very acceptable	65.0 marked substantial

b. Percent (linear weights)

c. based on M

d. based on Index

Table 4.6 Experts' Validation of Module: Effectiveness

Facet	Acceptability			Agreement ^a	
	M	SD	CV	Remark ^b	Index Interpretation ^c
1. involves students in active learning through appropriate and sufficient activities and experiences	4.00	0.894	0.224	very acceptable	
2. utilizes practical applications and real-life situations whenever possible	3.80	0.748	0.197	very acceptable	
3. uses strategies that allow for development of social skills such as cooperation, working harmoniously with others	3.80	1.166	0.307	very acceptable	
4. uses methods to develop higher cognitive skills, problem solving skills, and creativity	4.00	1.265	0.316	very acceptable	
5. balances presentation of positive and negative aspects of argument/issues/theories	4.00	1.095	0.274	very acceptable	
6. highly encourages discovery/ inquiry method of teaching-learning	4.4	0.800	0.182	very acceptable	
7. generally allows the student to initiate the activity/ exploration	4.00	1.265	0.316	very acceptable	
8. encourages wider vision and inclination to social interaction	3.80	0.400	0.105	very acceptable	
9. inspires respect for all forms of life and peaceful processes	4.40	0.800	0.182	very acceptable	
10. encourages learning to be extended outside the classroom	4.40	0.800	0.182	very acceptable	
Domain	4.06	0.988	0.243	very acceptable	70.5 marked substantial

- a. **Percent (linear weights)**
- b. **based on M**
- c. **based on Index**

Table 4.6 *Experts' Validation of Module: Effectiveness* shows that the developed learning module got an individual remark of very acceptable. This point towards a positive output as far as developing life skills among the learners. It can also boost greater interactions among members of a society or community. This result is validated by the study of Onyejegbu (2013) which suggests that educational programs should provide instructional materials to enhance effective teaching and learning.

Table 4.7 Experts' Validation of Module: Summary

Facet	Acceptability				Agreement ^a	
	M	SD	CV	Remark ^b	Index	Interpretation ^c
I. Objectives	4.06	0.954	0.253	very acceptable	70.0	marked substantial
II. Subject Matter	4.00	0.922	0.230	very acceptable	71.9	marked substantial
III. Values	4.08	0.959	0.235	very acceptable	71.2	marked substantial
IV. Organization	3.90	1.106	0.284	very acceptable	65.0	marked substantial
V. Effectiveness	4.06	0.988	0.243	very acceptable	70.5	marked substantial
Domain	4.01	1.002	0.250	very acceptable	69.3	marked substantial

- a. **Percent (linear weights)**
- b. **based on M**
- c. **based on Index**

The over-all assessment and evaluation of experts showed that the module developed is very acceptable and marked substantial in improving the academic performance, critical thinking skills, and problem-solving skills of the subjects. It was rated by the experts as reliable and consistent. The use of module to enhance performance of the subjects agrees with the study conducted by Gbolliet al. (2016) stating that an excellent combination of motivational activity and learning strategy is fundamental in improving student learning outcomes. These findings agree with the study conducted by Umaru (2011) explaining that students perform better when appropriate materials/strategy were made available and utilized in the teaching process. Equally, the findings of Ibis (2014) suggests that SIMs can be used as a technique for teaching basic science and is no inferior to traditional method used for developing academic achievement. Also, the study conducted by Anadia (2015) suggested that the Strategic Intervention Material (SIM) can be adopted as instructional material for the improvement in teaching science, to facilitate and carry out the three way process of learning and most importantly, to improve achievement of the students. As mentioned by Effiong et al. (2015), employing the use of teaching aid make learning real and permanent.

The evaluation of the experts is also confirmed by the study conducted by Katamei et al. (2013) saying that SIMs developed can enhance life skills education when intensified

in secondary schools and enable students to be confident in solving day to day problems and foster creativity thus, improving academic performance.

Table 4.8 Experts' Validation of Test: Specification

Facet	Acceptability				Agreement ^a
	M	SD	CV	Remark ^b	Index Interpretation ^c
1. Do the test specifications describe the nature and limits of the achievement domain to be measured?	3.00	0.00	0.00	very acceptable	
2. Are the intended learning outcomes stated in performance (measurable) terms?	4.00	0.00	0.00	highly acceptable	
3. Do the test specifications indicate the nature and distribution of items to be included in the test?	3.67	0.471	0.129	highly acceptable	
Domain	3.56	0.497	0.140	highly acceptable	92.6 marked substantial

a. Percent (linear weights)

b. based on M

c. based on Index

The table indicates that developed table of specification used was validated by the experts as highly acceptable and was marked as highly substantial. This specifies that items constructed were consistent with the calculated learning outcomes. In terms of measurability, nature and distribution of items, the experts apparently rated it as highly acceptable.

Table 4.9 Experts' Validation of Test: Format and Direction

Facet	Acceptability			Remark ^b	Agreement ^a
	M	SD	CV		Index Interpretation ^c
1. Item arrangement contributes to ease of reading and responding.	3.33	0.471	0.141	very acceptable	
2. Items of the same type are placed together in the test.	3.00	0.00	0.00	very acceptable	
3. Items are arranged in order of increasing difficulty within each section of the test.	2.67	0.471	0.177	very acceptable	
4. The method of answering and the location of the answer space contribute to efficient test taking.	4.00	0.00	0.00	highly acceptable	
5. Items are numbered in consecutive order throughout the test.	4.00	0.00	0.00	highly acceptable	
6. Correct answers are balanced of proportion.	3.67	0.47	0.129	highly acceptable	
7. The sequence of answers is free from patterns.	4.00	0.00	0.00	highly acceptable	
8. Directions provided for the test, as a whole and for separate sections, are clear and concise.	4.00	0.00	0.00	highly acceptable	
9. Final copy of the test is satisfactory in terms of spacing, legibility, and freedom from errors.	3.33	0.943	0.283	very acceptable	
Domain	3.56	0.692	0.177	highly acceptable	100 perfect

a. **Percent (linear weights)**

b. **based on M**

c. **based on Index**

Format and direction shows a perfect assessment and evaluation by the experts. This means that learners who will be using this assessment tool will find it easy and comprehensible to go through. It was found to be free from patterns and structured questions were arranged in an order of increasing difficulty.

Table 4.10 *Experts' Validation of Test: Items (General)* presents a highly acceptable remark and marked with high agreement on the general features of the test developed. This provides an idea that the items in the assessment tool are relevant and coherent with the different tasks being established.

Specific facets like formulated tasks, use of clear language, free from hints, and do not express ideological and sexual bias were also marked highly acceptable.

Table 4.10 Experts' Validation of Test: Items (General)

Facet	Acceptability			Remark ^b	Agreement ^a	
	M	SD	CV		Index	Interpretation ^c
1. Each test items is relevant to an important learning outcome	3.33	0.471	0.141	very acceptable		
2. Each item type is appropriate for the particular learning outcome to be mastered.	3.33	0.471	0.141	very acceptable		
3. Each item presents a clearly formulated task.	3.67	0.471	0.129	highly acceptable		
4. Each item is stated in simple, clear language, and free of non-functional material.	0.00	0.00	0.00	highly acceptable		
5. Each item is free of extraneous clues.	3.67	0.471	0.129	highly acceptable		
6. The difficulty of each item is appropriate for the task and for the use to be made of the results	3.33	0.471	0.141	very acceptable		
7. The answer to each item is one that would be agreed upon by experts.	3.33	0.471	0.141	very acceptable		
8. There is an adequate number of items for each interpretation to be made.	3.67	0.471	0.129	highly acceptable		
9. The items are sufficiently independent that one item does not aid in answering.	4.00	0.00	0.00	highly acceptable		
10. The items are free from ethnic, racial, ideological, religious, and sexual bias.	4.00	0.00	0.00	highly acceptable		
Domain	3.63	0.482	0.133	highly acceptable	84.4	high

- a. **Percent (linear weights)**
- b. **based on M**
- c. **based on Index**

Table 4.11 *Experts' Validation of Test: Multiple Choice Items* shows that elements of a multiple choice type of test in the assessment tool is highly acceptable and is marked very high on linear weights agreement.

Table 4.11 Experts' Validation of Test: Multiple Choice Items

Facet	Acceptability				Agreement ^a
	M	SD	CV	Remark ^b	Index Interpretation ^c
1. The stem of each item presents a single, clearly formulated problem	4.00	0.00	0.00	highly acceptable	
2. The stem of each item is stated in simple, readable language	4.00	0.00	0.00	highly acceptable	
3. The stem of each item is worded so that there is no repetition of material in the alternatives.	3.67	0.471	0.129	highly acceptable	
4. The stem of each item is stated in positive form, whenever possible	4.00	0.00	0.00	highly acceptable	
5. If negative wording is used in the stem, it is emphasized by capitalization, italic, or underlining.	3.33	0.471	0.141	very acceptable	
6. The intended answer is correct or clearly best.	3.33	0.471	0.141	very acceptable	
7. All alternatives are grammatically consistent with the stem and are parallel in form.	3.33	0.471	0.141	very acceptable	
8. The alternatives are free from verbal clues to the correct answer	3.33	0.471	0.141	very acceptable	
9. The distracters are plausible and attractive to the uninformed.	4.00	0.00	0.00	highly acceptable	
10. The relative length of the correct answer varies to eliminate length as a clue	4.00	0.00	0.00	highly acceptable	
11. The alternative "all of the above" has been avoided and "none of the above" used sparingly	3.00	0.00	0.00	very acceptable	
12. The position of the correct answers varies so that there is no detectable pattern	4.00	0.00	0.00	highly acceptable	
Domain	3.67	0.471	0.129	highly acceptable	90.7 very high

- a. **Percent (linear weights)**
- b. **based on M**
- c. **based on Index**

Table 4.12 Experts' Validation of Test: Summary

Facet	Acceptability				Agreement ^a	
	M	SD	CV	Remark ^b	Index	Interpretation ^c
I. Specification	3.56	0.497	0.140	highly acceptable		
II. Format and Direction	3.56	0.629	0.177	highly acceptable		
III. Items (General)	3.63	0.482	0.133	highly acceptable		
IV. Multiple Choice Items	3.67	0.471	0.129	highly acceptable		
Domain	3.62	0.525	0.145	highly acceptable	88.2	high

- a. **Percent (linear weights)**
- b. **based on M**
- c. **based on Index**

The validation of the experts showed a highly acceptable assessment tool in earth science on the following subjects: features of the earth, plate tectonic, volcanism, earthquake, and related disaster management. The high acceptability was based on the average mean which was 3.62 and has a high rating on inter-rater agreement based on the average linear weights of 88.2. Specifically, the experts validated each facet as the following: specification highly acceptable with very high agreement; format and direction

highly acceptable with perfect agreement; items were found to be highly acceptable with high agreement; and multiple choice items were also found to be highly acceptable with very high agreement.

The analysis shows that achievement test developed indicates validity manifested by highly acceptable content and quality. This assessment tool can measure the intended function as presented by this study.

3) Tables 4.13 to Table 4.22, Distribution of Test Scores, show the scores of the respondents to the assessment of Earth Science (see Appendix D) before and after the use of the modules using SIMs.

Table 4.13 Distribution of Test Scores

(N=23)

Examinee	Pre	Post	Change
1	24	31	+
2	23	33	+
3	23	33	+
4	22	23	+
5	22	22	
6	20	25	+
7	20	20	
8	19	30	+
9	15	18	+
10	18	24	+
11	16	17	+
12	16	21	+

13	10	12	+
14	16	23	+
15	17	20	+
16	14	16	+
17	15	18	+
18	17	29	+
19	18	25	+
20	25	33	+
21	19	21	+
22	17	27	+
23	14	24	+

This table indicates that twenty one (21) out of twenty three (23) test items or equivalent to 91.3% showed a positive change and improvement of students' academic performance exposed to the use of the strategic intervention material - module.

Table 4.14 Test Scores: Pre vs Post
(N=23)

Phase	Min	Max	M	SD	CV	Mean Difference^a
Post	12	33	23.70	5.827	0.246	5.44
Pre	10	25	18.26	3.720	0.204	

The table indicates a significant difference in the over-all performance of the students as indicated by the difference in the mean scores. This implies that developed strategic intervention material-SIMs can greatly enhance the performance of the subjects in the course.

Table 4.15 ANOVA Test Scores: Pre – Post

Source of Variation	Sum – of Squares	df	Mean Squares	F-value		p-level	Remark
Phases	339.674	1	339.674	46.178	4.300	0.000+	Extremely significant
Subjects	889.478	22	40.431				
Error	161.826	22	7.356				
Total	1390.978	45					

Table 4.15 *ANOVA Test Scores: Pre – Post* shows an extremely significant remark of p-level. This emphasizes the importance of SIMs in the enrichment of the over-all performance on the subjects. It also indicates that the use of SIMs is extremely significant in improving the academic performance of the students in earth science. This results confirms the study conducted by Onyejegbu (2013) stating that instructional materials are vital to enhance effective teaching and learning. Ayoola et al. (2015) also mentioned that enough time should be allotted to the use of instructional materials like module in the teaching process to be effective.

Table 4.16 Number Correct Per Item: Critical Thinking Skills

(N=38)

Item	Pre	Post	Change
1	1	6	+
2	5	7	+
3	3	5	+
4	10	9	–
5	10	13	+
6	11	14	+
7	7	11	+
8	3	7	+
9	8	12	+

10	4	3	—
12	3	14	+
13	9	7	—
15	5	5	
16	5	20	+
18	13	18	+
19	14	6	—
21	1	9	+
22	2	3	+
23	4	9	+
24	9	9	
26	6	8	+
27	9	6	—
29	2	11	+
30	6	10	+
31	12	15	+
35	17	20	+
36	10	5	—
37	4	7	+
38	9	14	+
39	3	6	+
41	11	15	+
42	16	18	+
43	9	15	+
44	15	19	+
45	14	16	+
46	16	16	
49	2	0	—
50	10	10	

The data show that 27 out of 38 test items or an equivalent to 71.1% indicated improvement, reduction in the difficulty encountered and a positive change in the development of their critical thinking skills. The given data were analyzed using repeated-measures design.

Table 4.17 Number Correct All Items: Critical Thinking Skills

(N=38)

Phase	Min	Max	M	SD	CV	Mean Difference ^a
Post	0	20	10.58	5.1861	0.490	2.74
Pre	1	17	7.84	4.647	0.593	

Pre – Post

The table shows that there is a difference on the mean scores of the students in the pre and post- test. This indicates that there is a true difference in the performance of subjects in the pre and post-test scores. This difference cannot be attributed to chance/random causes.

It also implies that there is a significant difference on the mean scores of the post and pre-test on critical thinking skills items. This entails an extremely significant remark. This suggests that the use of strategic intervention material-SIMs can supplement in developing the critical thinking skills of the students. The author signifies consistency with the study conducted by Kennedy (2011), stating that the critical thinking skills of the students are improved significantly and could produce better results if intervention instructional material are widely used towards the demonstration of critical thinking skills of the students. Also, higher order thinking skill like critical thinking skills can be developed using appropriate teaching strategies and learning environment to facilitate the growth in the students, King et al. (2013).

Table 4.18 ANOVA^a – Number Correct All Items: Critical Thinking Skills

Source of Variation	Sum – of – Squares	df	Mean Squares	F-value		p-level	Remark
				obs	crit		
Phases	142.316	1	142.316	27.907	4.110	0.000+	Extremely significant
Items	1605.632	37	43.395				
Error	188.684	37	5.100				
Total	1936.632	75					

Correlated groups

The data suggest that the items developed in the assessment tool that will specify enhancement of the critical thinking skills of the subjects are extremely significant as shown in the value of p-level. This statistical analysis of the experts' validation puts forward the ability of the module and assessment tool to describe the level of skills among the subjects on how to think critically and logically.

Table 4.19 Number Correct Per Item: Problem Solving Skills

(N=12)

Item	Pre	Post	Change
11	17	13	-
14	12	12	
17	10	18	+
20	12	15	+
25	0	10	+
28	6	6	
32	19	18	–

33	9	12	+
34	5	11	+
40	12	9	-
47	19	21	+
48	4	1	-

The table shows that six (6) out of twelve (12) or an equivalent to 50.0% of the test items indicates a positive change in the development of their problem-solving skills. This also implies that the students showed reduction in the difficulty encountered and the overall improvement in the skill developed. The table suggests that there is a difference in the mean score of the subjects on items developed to enhance the problem-solving skills. This also suggests the effectiveness of the module and measurability of the items intended for problem solving skills development. The small difference can be attributed to other factors like reading comprehension, attitude of the subjects towards the course among others.

The data found in Table 4.20. *Number Correct All Items: Problem Solving Skills* indicate a small difference in the mean scores of the post and pre-tests. It also received a p-level of not significant as far as performance of the subjects was concerned in improving their problem-solving skills. On the other hand, the SIMs have shown potential in improving the problem-solving skills of the subjects. According to the study conducted by Harrington (2014), effective problem solving requires a controlled mixture of analytical and creative thinking. This attributes to how an individual can easily switch from one group of skill to other which is quite difficult to achieve. The author compliments the study as this may have a negative effects on the performance of the subjects in the measure of their

skills on how to solve problems. This outcome could also be attributed to the behavior and attitudes of Filipino children as stated in the study of Jacono 2000. Filipino children are found to be very obedient and respectful to the elders and sometimes this characteristic deprives them from expressing their minds thus hindering practice to become good problem solvers.

Table 4.20 Number Correct All Items: Problem Solving Skills

(N=12)

Phase	Min	Max	M	SD	CV	Mean Difference^a
Post	1	21	12.17	5.508	0.453	1.75
Pre	0	19	10.42	6.022	0.578	

Pre – Post

Table 4.21 ANOVA^a – Number Correct All Items: Problem Solving Skills

Source of Variation	Sum – of Squares	df	Mean Squares	F-value obs crit	p-level	Remark
Phases	18.375	1	18.375	1.835 4.840	0.203	Not significant
Items	622.458	11	56.587			
Error	110.125	11	10.011			
Total	750.958	23				

Correlated groups

The above data show that *p-level* indicates a not significant remark in the development of the problem-solving skills of the subjects. However, it indicates that developed module shows potential in improving subject problem-solving skills.

Table 4.22 Significant Difference

Topics	Pretest	Posttest	p-value	Interpretation
Academic performance	18.26	23.70	0.000+	Extremely significant
Critical thinking skills	7.84	10.58	0.000+	Extremely significant
Problem solving skills	10.42	12.17	0.203	Not significant

It can be observed from the table above that the strategic intervention materials developed in this study are extremely significant in the improvement of the academic performance and critical thinking skills of the learners, although the module shows insufficiency in perking up learner's problem-solving skills.

Implications of the Study

The study can be used as a basis for development of similar modules but with focus on improving problem-solving skills of the students.

The results and/or findings can serve as a basis for development of instructional materials with focus on enhancing critical thinking skills.

Some findings and/or results of the study can be useful to teachers and academic heads in determining relevant teaching techniques and activities that will greatly improve the over-all academic performance of the students.

The SIMs-based modules may also be used as instructional materials in other subject areas as well. Modification can be done in order to meet the objective the module may serve.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

The researcher applied developmental research and pretest-posttest design to study the effects of SIMs using modules in the academic performance, and critical thinking and problem-solving skills of non-science majors taking up physical science at ESSU in Year 2. A total of 28 students enrolled in the course participated in the study. However, only 23 completed the eight earth science modules with assessment tests.

The study, which was administered for three weeks, highlighted the use of SIMs that will encourage autonomous learning and enhance the memory of learners to improve their understanding of many complicated science concepts (Membrere, 2015). The modules and assessment tests have been validated by experts. A pretest was administered before the use of the modules, and a posttest after. The data were gathered and analyzed using different statistical tools. The quantitative data obtained from the experts' evaluation and the students' test results were analyzed to determine their effects on the students' academic performance, and critical thinking and problem-solving skills.

Summary of Results

The following research findings derived from the data collected during the course of the study in accordance with the foregoing chapter are summarized below:

Objective 1: Develop modules using SIMs

Eight learning modules using SIMs in earth science were designed and developed for Year 2 non-science major students taking up physical science.

Objective 2: Acceptability and validity of the research materials

The modules that were developed using SIMs were rated by the experts to be acceptable, and are extensive in enhancing the academic performance, critical thinking skills, and problem-solving skills of the students as shown in Table 4.7 *Expert Validation of Module Summary*.

Objective 3: Effectiveness of SIMs

The modules were found to be *very effective* in improving the academic performance and critical thinking skills of the students as evidenced shown in Table 4.22 *Significance Difference*. While the modules show potential in improving the students' problem-solving skills, they were considered *not significant* as shown in Table 4.21 *ANOVA – Number of Correct All Items: Problem Solving Skills*. The insignificance could be attributed to the behavior and attitude of Filipino children who are very obedient and respectful to elders, which sometimes deprive them from expressing their minds, thus, hindering their practice to become good problem-solver (Jacono, 2000).

Conclusion

The SIMs-based modules help in the improvement of the students' academic performance in general but not necessarily improving problem-solving skills.

Recommendations

1. It is recommended that on the basis of the results of this study a policy on the development of modules using SIMs be formulated to ensure that the advantages of this approach be maximized.
2. It is further recommended that as shown in the results of the study a more extensive use of modules using SIMs be practiced by teachers in order to enhance the academic performance, critical thinking skills and problem-solving skills.
3. It is also recommended that further research be done to explore the effectiveness of the modules using SIMs as to approach to problem-solving skills.

References

- Adedayo, O.A. (2014). Problems of teaching and learning mathematics in secondary schools. Paper presented at workshop on effective teaching mathematics, LSPSSDC, Magodo, Lagos.
- Alos, Sunshine B., Caranto, L C., and David, J J T. (2015). *Factors Affecting The Academic Performance of the Student Nurses at BSU*. Retrieved from article.sapub.org/10.5923.j.nursing.20150502.04.html
- Alter P., Todd Brown E., and Pyle J. (2011). A strategy-based intervention to improve math word problem-solving skills of students with emotional and behavioral disorder
- Aloquali, A. (2012). The relationship between reading comprehension and critical thinking: a theoretical study. Retrieved from:
<http://www.sciencedirect.com/science/article/pii/S2210831911000373>
- Ambrose, S. (2016). Seven research-based principles for smart teaching. Jossey-Bass, A Wiley Imprint. San Francisco, California.
- Arieta, Kaye Marie D., Gementiza, R C., and Saco, C J D. (2017). Factors affecting study habits on the academic performance of senior high school students of Davao Doctors College. Retrieved from <https://www.scribd.com/document/358797618/Factors-Affecting-Study-Habits-on-Academic-Performance-of-Senior-High-School-Students-of-Davao>
- Bayo-ong, Rolly B., Coronacion, L G., Jorda, A T., Restubog, A J., and Mocada, M N M. (2016). Earth and life science for senior high school grade 11. 2016. ISBN: 978 – 971 – 8608 – 66 – 1. Education resources corporation, Cubao Q.C.

Bell, Melissa J. (2014). *Defining the Meaning and Scope of Academic Performance*.

Retrieved from <https://classroom.synonym.com/define-academic-performance-4740750.html>

Borges, J.L. (2013). Study guide and teaching materials. Retrieved at:

<https://www.teacherspayteachers.com/Browse/Search:jorge%20luis%20borges>

California Critical Thinking Skills Test. Retrieved from

<https://www.insightassessment.com/Products/Products-Summary/Critical-Thinking-Skills-Tests/California-Critical-Thinking-Skills-Test-CCTST>

Campbell, L., B. Campbell., *Mindful learning; 101 proven strategies for student and teacher success*. Corwin Press. CA. Retrieved from:

https://www.corwin.com/sites/default/files/upmbinaries/25914_081222_Campbell_Ch1_excerpt.pdf

Candrasekaran, S. (2014). *Productive Methods of Teaching Middle School Science*.

International Journal of Humanities and Social Science Invention ISSN (Online): 2319 – 7722, ISSN (Print): 2319 – 7714

CAT – Critical Thinking Assessment Test of the Tennessee Technological University.

Retrieved from <https://www.tntech.edu/cat/>

Cavus, Nadire and Uzunboylu. (2009). *Improving Critical Thinking Skills In Mobile Learning*. Retrieved from

<https://www.sciencedirect.com/science/article/pii/S1877042809000809>

Coats, Wesley . (2014). *Earth Science*. Retrieved at: [4738-b0e4](#)

[f427b337042e/1/EarthScienceRS.pdf](#).

Coughlan, A. (2008). Learning to learn: creative thinking and critical thinking. Retrieved from:

<https://www4.dcu.ie/sites/default/files/students/studentlearning/creativeandcritical.pdf>

Dacumos, Leo Peter. (2014). Perspective of secondary teachers in the utilization of science strategic intervention material (SIM) in increasing learning proficiency of students in science education. Retrieved from

[file:///C:/Users/Delbert%20A.%20Dala/Downloads/293-1045-1-PB%20\(2\).pdf](file:///C:/Users/Delbert%20A.%20Dala/Downloads/293-1045-1-PB%20(2).pdf)

De la Cruz, Ruby-Ann B., and Guido, R M D. (2013). *Factors Affecting Academic Performance of BS Astronomy Technology Students*. Retrieved from

https://www.researchgate.net/profile/Ryan_Manuel_Guido/publication/305093190_Factors_Affecting_Academic_Performance_of_BS_Astronomy_Technology

Department of Geological Sciences, University of Cape Town. The importance of earth science literacy? Retrieved at: <http://www.geology.uct.ac.za/importance-earth-science-literacy>

Diaz, Ernalyn and Dio, R V. (2017) Effectiveness of tri-in-1 strategic intervention materials for grade 9 students through Solomon four-group design. Retrieved from <http://oaji.net/articles/2017/1710-1485760146.pdf>

EduNova (2012). Teaching techniques for science teachers. Retrieved from: <http://www.edu-nova.com/teaching-techniques-for-science-teachers.html>.

Facione, P.A. (2010). Critical thinking: a statement of expert consensus for purposes of educational assessment and instruction. Millbrae, CA: The California Academic Press.

Falsario, Herminia N., Muyung, R F., and Nuevaespana, J S. (2014). *Classroom Climate And Academic Performance of Education Students*. Retrieved from https://www.dlsu.edu.ph/conferences/dlsu_research_congress/2014/_pdf/proceedings/LLI-I-003-FT.pdf

Flores, Kevin L., Matkin, G S., Burbach, M E., Quinn, C E., and Harding H. (2010). Deficient critical thinking skills among college graduates: Implication for leadership. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1111/j.1469-5812.2010.00672.x/full>

Garrison, Tom. (2009). Essentials of oceanography. Brooks/Cole cengage learning, Belmont, CA USA. ISBN 13: 978 – 0 – 495 – 55531 – 5

Gbolle, Charles and Keamu, H P. (2016). Student academic performance: the role of motivation, strategies, and perceived factors hindering Liberian junior and senior high school students learning. Retrieved from <https://doi.org/10.1155/2017/1789084>

Geifman, D. and D. Raban. (2015). *Collective Problem Solving: The Role of Self-Efficacy, Skill, and Prior Knowledge*. Retrieved from: <http://www.ijello.org/Volume11/IJELLv11p159-178Geifman1967.pdf>

Ghafoor, Nadeem Chaudhry and Ghulam, R. (2012). A case study on improving problem solving skills of undergraduate computer science students. Retrieved from

<https://pdfs.semanticscholar.org/d104/37ab118daca2a4d50828ce980ec26e851889.pdf>

Helmi, S., Khariyah M Y, Shahrin Mohammad, M S A, and Zaidatun T. (2013). Methods to study enhancement of problem-solving skills in engineering students through cooperative problem-based learning. Retrieved from: <http://tree.utm.my/wp-content/uploads/2013/03/Methods-to-Study-Enhancement-of-Problem-Solving-Skills-in-Engineering-Students-through-Cooperative-Problem-Based-Learning.pdf>

Ibis, Noel V. (2014). The effect of strategic intervention materials (SIM) on the students' academic achievement in chemistry. Retrieved from http://www.worldresearchlibrary.org/up_proc/pdf/168-145458176560.pdf

Islam, R. (2015). What are the importance and benefits of critical thinking skills. Retrieved from: <https://www.linkedin.com/pulse/what-importance-benefits-critical-thinking-skills-islam>

ITS (2005). Why people fail to solve problems effectively. Retrieved from: <http://www.itseducation.asia/why-people-fail.htm>.

Jocano, F.L. (2000). *Filipino Culture Values- Sociology*. Retrieved from <http://www.academypublication.com/issues/past/tpls/vol01/02/03.pdf>

Javier Shiela V. (2015). The effectiveness of intervention materials in improving learners' competence in grade 7 biology. Retrieved from http://www.academia.edu/12894496/The_Effectiveness_of_Intervention_Materials_in_Improving_Learners_Competence_in_Grade_7_Students_in_Biology

- Jolo, Jerson D. (2016). Critical thinking skills in problem solving of grade eight students in mathematics. PNU library
- Juuti, et al. (2010). Science teaching methods preferred by grade 9 students in Finland. *International Journal of Science and Mathematics Education* 8(4):611-632.
- Katamei, Jacob and Omwono, G. (2013). Intervention strategies to improve students' academic performance in public secondary schools in arid and semi-arid lands in Kenya. Retrieved from <file:///C:/Users/Delbert%20A.%20Dala/Downloads/796-4766-1-PB.pdf>
- Kem, Gyula Nagy. (2016). Developing problem solving skills. Retrieved from https://www.researchgate.net/publication/314841015_Developing_Problem-solving_Skills
- Kennedy, M. Fisher, M.B., and Ennis, R.H. (2011). Critical thinking: Literature review and needed research. In L. Idol & B.F. Jones (Eds.), *Educational values and cognitive instruction: Implications for reform* (pp. 11-40). Hillsdale, New Jersey: Lawrence Erlbaum & Associates
- King, FJ; L. Goodson, and F Rohani . (2013). *Higher Order Thinking Skills; Definition, Teaching Strategies, Assessment*. Retrieved from: http://www.cala.fsu.edu/files/higher_order_thinking_skills.pdf
- Koltookian, G. (2012). *Totally awesome big book of activity fun!* International Publishing Services Ltd. United Kingdom.

- Kurniawati Y., Permanasari. A. M, and Rohman I. Potential of reflective thinking skills as a bridge for students' prior-knowledge and chemistry experiments skills. Retrieved from: <https://www.ijer.net/archive/v4i9/SUB157911.pdf>
- Mabrurroh, F. and Suhandi, A. (2017). *Construction of Critical Thinking Skills Test Instrument Related to the Concept on Sound Wave*. Retrieved from <http://iopscience.iop.org/article/10.1088/1742-6596/812/1/012056/pdf>
- Marin, Lisa M. and Halpern, D F. (2011). *Pedagogy for Developing Critical Thinking In Adolescents: Explicit Instruction Produces Greatest Gain*. Retrieved from <https://www.sciencedirect.com/science/article/pii/S1871187110000313>
- Mayer, R. and M. Wittrock. (2009). *Problem Solving*. Retrieved from: <http://www.education.com/reference/article/problem-solving1/>
- MdShamsudin, Nurshamshida; Abdullah, N; Yaamat, N. (2015). *Strategies of Teaching Science Using an Inquiry-Based Science Education (IBSE) By Novice Chemistry Teachers*. Retrieved from <https://www.sciencedirect.com/science/article/pii/S187704281302017X>.
- Membrebe, Bernard Q. (2015). Improving student achievement for science in grade seven using strategic intervention materials (SIM). Retrieved from <http://www.iamsted.org/wp-content/uploads/2015/06/Science-Education-Abstract-even-pages.pdf>
- Mohd – Yusof, Khairiyah., Phang, F A., and Helmi, S A. (2013). *How to Develop Engineering Students' Problem-Solving Skills Using Cooperative Problem-Based*

- Learning (CPBL).* Retrieved from <http://www.qscience.com/doi/pdf/10.5339/qproc.2014.wcee2013.30>
- Mulnix, Jennifer W. (2010). *Thinking Critically About Critical Thinking. Educational Philosophy and Theory Journal*. Volume 44, issue 5 July 2012 pages 464 – 479.
- Olawale, S. K. (2013). *The Use of Instructional Materials for Effective Learning of Islamic Studies*. Jihat-al-Islam,6(20, 29-40. Retrieved on December 7, 2015 from <http://pu.pk/images/journal/jihat-ul-islam/PDF>.
- Racca, Robelle Millie Ann B. and Lasaten, R C S. (2016). English proficiency and academic performance of Philippine science high school students. Retrieved from <http://www.ijlll.org/vol2/65-LL0011.pdf>
- Raven, Oeter H., Berg, L R., and Hassenzahl, D M.(2015).Seventh edition environment. Booklore publishing.John Wiley & Sons Pte Ltd. ISBN: 978 – 981–25– 3333 – 3.
- Rivet, E. Ann. (2017). Teaching methods for earth science. Retrieved from: https://link.springer.com/chapter/10.1007/978-94-6300-881-5_12
- Rochelle, J. (2005). Learning in interactive environments: prior knowledge and new experience. Retrieved from: <http://www.exploratorium.edu/ifi-archive/resources/museumeducation/priorknowledge.html>
- Rodrigo, Rosario T. (2015). Importance of strategic intervention materials. Retrieved from http://udyong.gov.ph/index.php?option=com_content&view=article&id=6925:importance-of-strategic-intervention-materials&catid=90&Itemid=1267

- Ross, Frederick., Enger, E. E. and Tillery, B. W. (2013). Integrated science – 6th international edition. McGraw Hill International edition. ISBN: 978 – 1 – 259 – 01008 – 8.
- Rube, Tasha. (2017). *How to Improve Problem Solving Skills*. Retrieved from <https://www.wikihow.com/Improve-Problem-Solving-Skills>
- Salandanan, Gloria G., Faltado, R. E. III., and Lopez, M. B. (2016) Earth and life sciences for senior high school. Lorimar publishing, inc.. ISBN: 978 – 621– 8003 – 501 - 0
- Sale, M. (2015). *The Place of Instructional Materials in Quality Teaching At Primary School Level in Katsina Metropolis, Katsina State. International Journal of Humanities and Management Sciences: Volume 4, Issue 2.*
- Salviejo, Edwin I., Aranes F, and Espinosa A. A. (2014). Strategic intervention material-based instruction, learning approach and students' performance. Retrieved from <http://ftp.recsam.edu.my/cosmed/cosmed09/AbstractsFullPapers2009/Abstract/Science%20Parallel%20PDF/Full%20Paper/04.pdf>
- Shah, Iqbal, and Rahat, T. (2014). *Effect of Activity-Based Teaching Method in Science*. Retrieved from *International Journal of Humanities and Management Sciences (IJHMS)* Volume 2, Issue 1 (2014) ISSN 2320–4044 (Online)
- Soberano, Andy L. (2015). Strategic intervention materials in chemistry: development and effectiveness. Retrieved from <http://ftp.recsam.edu.my/cosmed/cosmed09/AbstractsFullPapers2009/Abstract/Science%20Parallel%20PDF/Full%20Paper/04.pdf>

- Scriven M., and Richard P. (2003). Defining critical thinking. Retrieved from: (<http://www.criticalthinking.org/University/univclass/Defining.html>)
- Stephenson, N.S. and Sadler-McKnight, N.P. (2015). *Developing Critical Thinking Skills Using the Science Writing Heuristic in Chemistry Laboratory*. Retrieved from <http://pubs.rsc.org/-/content/articlehtml/2016/rp/c5rp00102a>
- Surif, Johari., Ibrahim, N H., and Mahani, M. (2012). Conceptual and procedural knowledge in problem solving. Retrieved from <http://tree.utm.my/wp-content/uploads/2013/03/1569582727.pdf>
- Tarbuck, Edward J., Tasa, D., and Lutgens, F K. (2009). Twelfth edition earth science. By Pearson Education, Inc. ISBN: 978 – 981 – 0697 – 43 – 3.
- Taroc, Roel D., Paculba, H L., Tan, R A M., and Maghonoy, M C. (2015). The performance of bachelor of science in maritime education students of Siquijor State College, Siquijor, Philippines in general chemistry and their attitudes towards the subject. Retrieved from <http://jhe.cnu.edu.ph/index.php/cnuijhe/article/view/47>
- Thomas, Theda Ann. (2011). *Developing First Year Student's Critical Thinking Skills*. Retrieved from <http://www.ccsenet.org/journal/index.php/ass/article/view/9389>
- Tillery, Bill. Physical science – 9th edition. McGraw Hill International edition
- Tiruneh, D.;Verburgh A.;and Elen J. (2013). Effectiveness of critical thinking instruction in higher education: a systematic review of intervention studies from <http://dx.doi.org/10.5539/hes.v4n1p1>

- Thekedam, Joseph and Kottaram, S. (2015). Strategic intervention techniques to reduce chronic absenteeism and truancy among students. Retrieved from <http://www.ijmbs.com/Vol5/2/1-Dr-Joseph-Sebastian-Thekedam.pdf>
- Umaru, K. I. (2011) influence of instructional materials on the academic performance of students in Agricultural Science in Secondary Schools in Kwara State, Nigeria. M.Sc in Agricultural Science Education of Ahmadu Bello University. pdf.
- Utah State Board of Education (2017). Earth Science 2017-2018. Retrieved from: <https://eq.uen.org/emedial/file/c97b1a9f-976b-4738-b0e4-f427b337042e/1/EarthScienceRS.pdf>.
- Vista, Dr. Alvin. (2012). *The Role Of Problem Solving And Reading Comprehension Skill in Predicting Growth Trajectories of Mathematics Achievement Between ESB And NESB Students*. Retrieved from <https://minerva-access.unimelb.edu.au/handle/11343/37570>
- Wen, Quifang., Wang, H., Wang, J., Zhao, C. and Lui, Y. (2010). *A Comparative Study of Critical Thinking Skills Between English and Other Liberal Arts Major*. Retrieved from http://en.cnki.com.cn/Article_en/CJFDTOTAL-WJYY201005007.htm
- Wilson, Jerry D., Higgins, CA. Jr., Shipman, J T. and Torres, O. (2013). An introduction to physical science – 14th edition. Rex Book Store Inc. Manila, Philippines. ISBN 978-23-7843-0
- Xu, Jun. (2011). Application of critical thinking in teaching English reading. Retrieved from <http://www.academypublication.com/issues/past/tpls/vol01/02/03.pdf>

Yu, Kuang-Chao., Fan, S., and Lin, K. (2015). *Enhancing Student's Problem-Solving Skills Through Context-Based Learning*. Retrieved from <https://link.springer.com/article/10.1007/s10763-014-9567-4>

Appendix A

Sample of Request Letter



Philippine Normal University
The National Center for Teacher Education
College of Graduate Studies and Teacher Education Research



September 20, 2017

Date

MS. ARMINDA BELIZAR

District Supervisor – Science
Borongan City

Dear Madam,

Good Day!

I'm Delbert A. Dala who is currently conducting my thesis entitled: *Strategic Intervention Materials (SIMs) On Earth Science: Its Effects on the Academic Performance and Problem Solving Skills of Year II Non-Science Majors Students of the Eastern Samar State University* at the Philippine Normal University, Manila Campus.

In this regard, I would like to humbly ask favour if you can evaluate my Assessment Tool in Earth Science which will be used in the conduct of my study. Please feel free to give your honest evaluation for it will be of great help on my part.

I am hoping for your favourable response on my request.

Sincerely yours,

DELBERT A. DALA
PNU – Grad. Student

Appendix B

Strategic Intervention Materials –SIMs on Earth Science



STRATEGIC INTERVENTION MATERIAL:

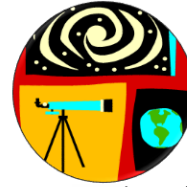
Learning Modules in Earth Science

Delbert A. Dala
2019
Borongan, Eastern Samar
Philippines

**This learning module is specifically designed for
College Students (Non-Science Major) taking up
Earth Science / Physical Science**



EARTH SCIENCE



Earth Science centers on the study of the different components of the environment. Earth, the planet where we live in, and Science, the never ending quest for knowledge and explanations of many different phenomena. Therefore, Earth Science is the division of scientific knowledge, which needs the understanding and explanation of the processes of and changes on the earth.

Earth Science, emphasizes on the mechanism and explanation of natural events related to earth. These may be ascribed to weather changes and patterns that will help us explain regional climates, sections of, and how the earth's crust moves and its provenance to the formation of earthquakes, mountains, and volcanic eruptions.

Now, when asking questions about the natural world there are certain skills and practices that can help you generate better conclusions, explanations, and inferences. These include:

- asking questions and defining problems
- developing and using models
- planning and carrying out investigations
- analyzing and interpreting data
- using mathematics and computational thinking
- constructing explanations and designing solutions
- engaging in argument from evidence
- obtaining, evaluating, and communicating information

While these exercises and crosscutting concepts are crucial to your overall success in science and in order to be most meaningful, they need some framework. This is where the study of disciplinary core ideas is most meaningful. If you study *Earth Science* or any other scientific discipline without the crosscutting concepts and scientific practices, then you constraint yourself to fact memorization and miss how these concepts relate to everyday life and society as a whole. Studying individual scientific disciplines is the medium for understanding crosscutting concepts and gaining scientific skills. When individual disciplines are studied within the context of practices and crosscutting concepts they become more meaningful and more influential.

Science and Engineering Practices are what scientists do to investigate and explore natural phenomena.



Hello, I am Earth, for you to thoroughly understand me; you should consider the following procedures!

SCIENCE & ENGINEERING PRACTICES	
<i>Asking questions and defining problems</i>	<i>Developing and using models</i>
<i>Planning and carrying out investigations</i>	<i>Analyzing and interpreting data</i>
<i>Using mathematical and computational thinking</i>	<i>Constructing explanations and designing solutions</i>
<i>Engaging in argument from evidence</i>	<i>Obtaining, evaluating, and communicating information</i>

Source: https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=If-mWuXDB8ex8wXQwruwDw&q=science+and+engineering+practices&oq=+science+practices&gs_l=psy-ab.1.5.0l3j0i7i30k1l2j0i8i30k1l5.78493.79959.0.84304.15.7.0.0.0.309.940.2-3j1.4.0....0...1c.1.64.psy-ab..13.2.509...0i8i7i30k1.0.0ZkEyNYBUpc

LEARNING MODULE 1

Earth and Its Features

Time Frame: 3 hrs (two meetings)

Learning Objectives:

- 1. Differentiate Earth from the other planets in the solar system.**
- 2. Identify and describe some features of the Earth.**
- 3. Explain and generalize motions of the Earth and moon.**
- 4. Distinguish the types of plates of the earth.**
- 5. Compare and contrast the different types of plate boundaries.**
- 6. Show appreciations to the different features of the earth.**
- 7. Use knowledge in the proper dissemination of information.**

Read

Fun Fact!



This is the Milky Way Galaxy, the galaxy where our solar system and our earth is contained.

Source: https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=6_-mWubwL4yp8QWUkrTIDA&q=milky+way&oq=milky+way&gs_l=psy-ab.3..0i67k112j0i67k1j0i67k1j0i4.388793.391705.0.393032.9.7.0.2.2.0.207.1250.0j6j1.7.0....0...1c.1.64.psy-ab..0.9.1271....0.966IJA-iwkU

Read

The Earth

Earth is the third planet from the Sun. Because it is our planet, we know a lot more about Earth than we do about any other planet. What are some of the main features of Earth?

Oceans and Atmosphere



Earth is a very diverse planet. Water is stored in vast oceans, lakes, rivers, and groundwater. Water is also stored as ice at the poles or as gas in clouds. Earth also has large masses of land. Earth's average surface temperature is 14°C. At this temperature, water is a liquid. The oceans and the atmosphere help keep Earth's surface temperatures fairly steady. Earth is the only planet known to have life. Conditions on Earth are ideal for life. It has an atmosphere that keeps it from getting too hot in the day and too cold at night.

Source: https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=dwGnWsmZC9DQ8wXM6r_IDQ&q=earth&oq=earth&gs_l=psy-ab.3..0i67k112j0i67k112j0i67k1j0i67k1.191755.193121.0.194245.5.4.0.1.1.0.204.395.0j1j1.2.0....0...1c.1.64.psy-ab..2.3.406....0.T5nnehX6NxM

Earth also has a magnetic field that filters out harmful radiation. On the surface, liquid water is abundant. Early life forms indicates the availability of carbon dioxide. The evolution of plants introduced more oxygen for animals. When scientists look at other planets in the universe to see if they might support life they consider what life on Earth needs to survive. Things such as liquid water, enough but not too much warmth from the sun, and an atmosphere to regulate temperatures.

Read

Earth's Motions and Moon

Earth rotates on its axis once every day. It rotates once in about 24 hours with respect to the sun and once every 23 hours, 56 minutes and 4 seconds with respect to the stars. Earth orbits the Sun once every 365.24 days. This is the length of an Earth year. Earth has one large moon. The moon orbits Earth once every 29.5 days with respect to the sun. This moon is covered with craters and also has large impact basins that were later filled with lava. Many astronomers think that the Moon came into being from material that flew into space after Earth and a Mars-sized object collided during the formation of the solar system. Earth's moon is not a captured asteroid like other moons in the solar system. According to a recent theory, the Earth captured the moon, that the moon fissioned out of the Earth, or that Earth may even have stolen the moon from Venus.

I am the third planet from the Sun. I guess I am the only planet with large amounts of liquid water, and the only planet known to support life. I am also the only inner planet that has a large round moon.





Check What You Learned: Write the answer on the space after each question.

- 1. What keeps the Earth from getting too hot in the day and too cold at night?**

- 2. What is the name of the natural satellite that orbits our planet?**

- 3. What living systems generated the elevation of Oxygen on Earth?**

**That's it, now you
know me, so welcome
and enjoy Earth
Science!**



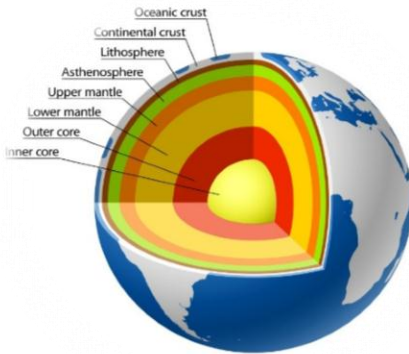
References:

USBEOER (2017). Earth Science 2017-2018. CK-12. Flexbook.

www.ck12.org



Plate Tectonics

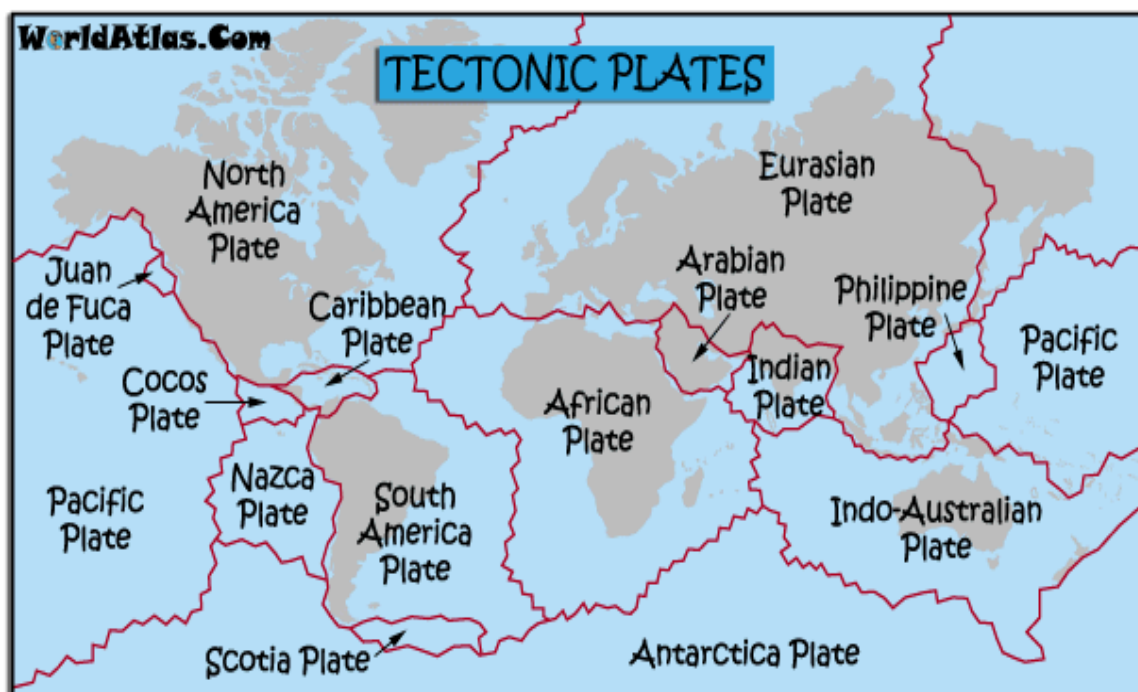


The three major layers (crust, mantle, and core) within the earth are identified by the basis of their different compositions. Moreover, the uppermost mantle and crust can be subdivided vertically into two layers with contrasting mechanical (physical) properties. The outer layer, the **lithosphere**, is composed of the crust and uppermost mantle and forms a rigid outer shell down to a depth of approximately 100 km (63 miles). The underlying **asthenosphere** is composed of partially melted rocks in the upper mantle that acts in a plastic manner on long time scales.

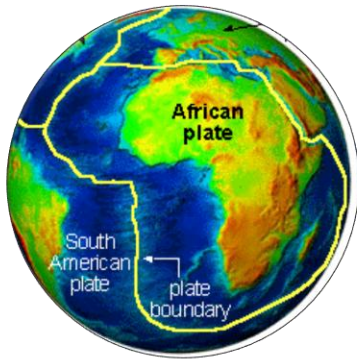
The asthenosphere extends from about 100 to 300 km (63-189 miles) in depth. The theory of plate tectonics proposes that the lithosphere is divided into a series of plates that fit together like the pieces of a jigsaw puzzle.

Now, you may be wondering, what is/are the roles of the earth's parts to Plate Tectonics? Well, let's define first what is Plate Tectonics.

First of all, the Earth's outer shell is broken into sections called plates, and these plates move around or glide over on top of the mantle. These my friends, are Tectonic Plates.



Source: https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=OwKnWprgJcyd8QXC9bZY&q=plate+tectonic&oq=plate+tectonic&gs_l=psy-ab..3..0110.167193.173321.0.174440.14.9.0.5.5.0.204.1416.0j7j1.8.0....0...1c.1.64.psy-ab..1.13.1477...0i67k1.0.2bodIKYLEt0



Come to think of this!

Read

The idea about **plate tectonics** is a relatively young in comparison with unifying theories from other sciences. Some of the basic observations that represent the foundation of the theory were made many centuries ago when the first maps of the Atlantic Ocean were drawn (<http://www.uzinggo.com/plate-tectonics-atlantic-ocean/plate-tectonics-earths-dynamics/earth-space-science-middle-school#zingpath>).

Read

What is the Lithosphere?

The crust and part of the upper mantle, is the lithosphere having 100 km thick and is less dense than the material below it, so it “floats”.

What is the Asthenosphere?

The asthenosphere is the layer of the Earth that lies below the lithosphere. It is a layer of solid rock that has so much pressure and heat the rocks can flow like a liquid. The rocks are less dense than the rocks in the lithosphere. This allows the tectonic plates in the lithosphere to move around the Earth's surface by “floating” on the rocks that are slowly flowing like a liquid.

Types of Plates

OCEAN PLATES

Plates found below the ocean

CONTINENTAL PLATES

Plates below the continents

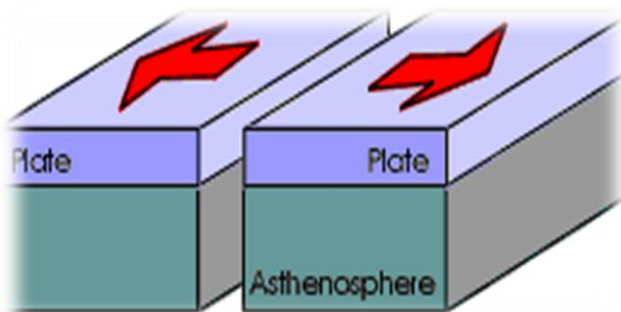
Fun Fact about a plate:

The African plate is composed of both oceanic lithosphere (below Atlantic and Indian Oceans) and continental lithosphere (beneath Africa). The boundary with the adjacent North American and South American plates lies along the center of the Atlantic Ocean.

Read

Generally, there are three types of Plate Boundaries, these are the **Divergent Boundary**, **Convergent Boundary** and **Transform Plate Boundary**.

Divergent Boundary occurs when two tectonic plates move away from each other. Lava spews from long fissures and geysers spurt superheated water. Moreover, there is frequent earthquake strikes along the rift and Basaltic oceanic crust is created.

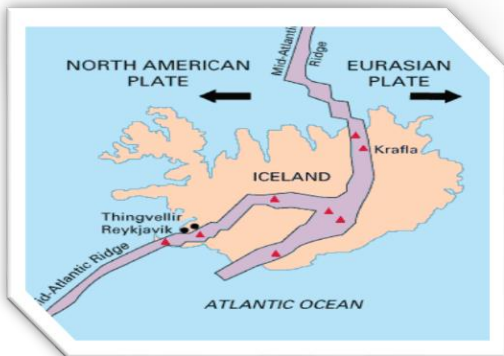


Features of Divergent Boundaries

- ▶ MID-OCEAN RIDGES
- ▶ RIFT VALLEYS
- ▶ FISSURE VOLCANOES

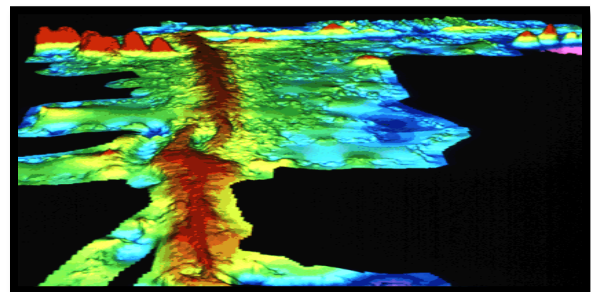


Mid-Ocean Ridges



Rift Valley

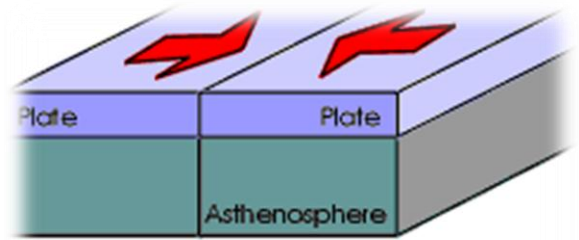
Samples of Divergent Boundaries around the world.



Fissure Volcanoes

Source: https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=OwKnWprgJcyd8QXC9bZY&q=plate+tectonic&oq=plate+tectonic&gs_l=psy-ab.3..0l10.167193.173321.0.174440.14.9.0.5.5.0.204.1416.0j7j1.8.0....0...1c.1.64.psy-ab..1.13.1477...0i67k1.0.2bodIKYLEt0

Convergent Boundary happens when two plates come together. The impact of the two colliding plates buckles the edge of one or both plates up into a rugged mountain range, and sometimes bends the other down into a deep seafloor trench. Powerful earthquakes shake a wide area on both sides of the boundary, continental crust, made of granite, is created, and oceanic crust is destroyed.

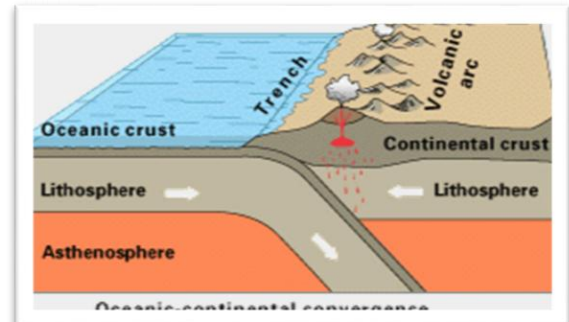


1

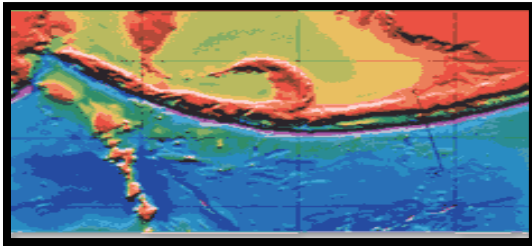
Types of Convergence

... OCEAN PLATE
COLLIDING WITH
A LESS DENSE
CONTINENTAL
PLATE

... WHERE THE LESS
DENSE PLATE
SLIDES UNDER THE
MORE DENSE PLATE
... VOLCANOES ARE
FORMED



Andes Mountain Range of Western South America



2

Aleutian Islands, Island Chain in Alaska, USA

Types of Convergence

... A
CONTINENTAL
PLATE
COLLIDING WITH
ANOTHER
CONTINENTAL
PLATE

... A PLACE
WHERE FOLDED
AND THRUST
FAULTED
MOUNTAINS
FORM

Types of Convergence

... OCEAN PLATE
COLLIDING WITH
ANOTHER
OCEAN PLATE

... THE LESS DENSE
PLATE SLIDES UNDER
THE MORE DENSE
PLATE CREATING A
SUBDUCTION ZONE
... TRENCHES ARE
FORMED

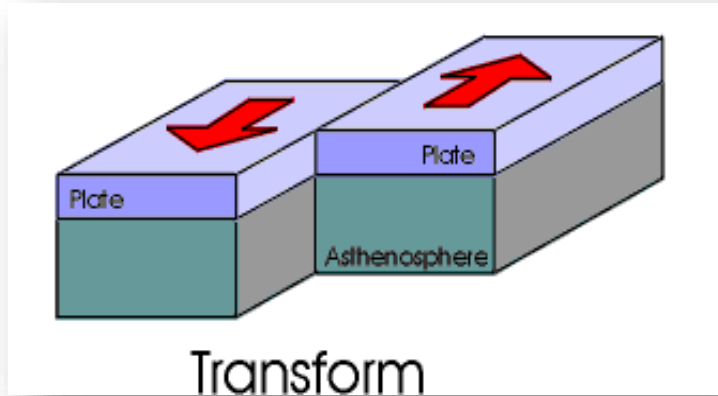
3



Arabian and African plates formed the Red Sea

Source:

https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=dQSnWqmzDIyO8wXa2LfICg&q=types+of+convergent+boundaries&oeq=types+of+convergence+bou&gs_l=ps-y-ab.1.0.0i13k1j0i113i5i30k113j0i8i113i30k1.194866.207929.0.210556.24.18.0.5.5.0.473.2252.0j2j6j0j1.9.0....0...1c.1.64.psy-ab..10.13.2103...0j0i67k1j0i30k1j0i5i30k1j0i24k1.0.GuU5VHWKC5U



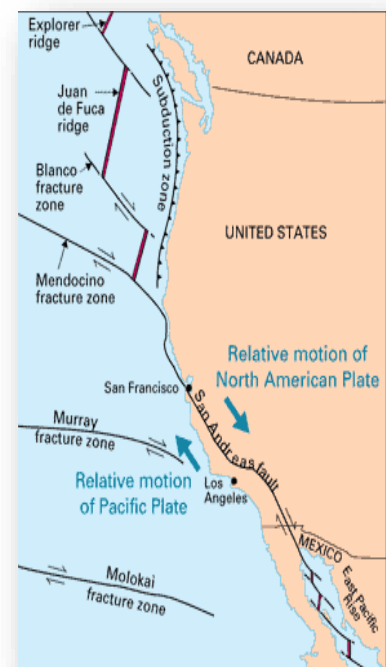
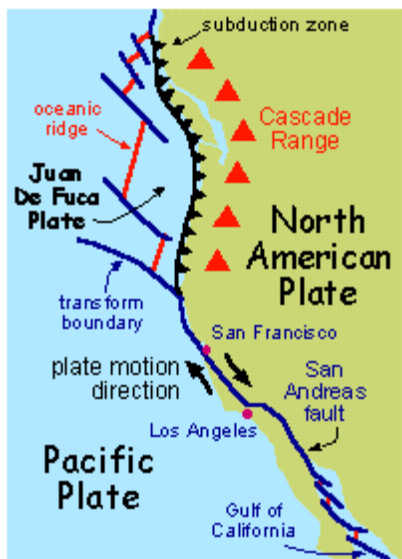
Transform Plate Boundary happens when two plates slides past each other. Rocks that line the boundary are pulverized as the plates grind along, creating a linear fault valley or undersea canyon as the plates alternately jam and jump against each other and earthquakes rattle through a wide boundary zone. Crust is cracked and broken at transform margins, but is not created or destroyed.

Most transform boundaries occur in ocean basins where they offset oceanic ridges.

Read

Additional Information!!!

The San Andreas Fault is a transform boundary that separates the North American and Pacific Plates. The smaller Juan de Fuca Plate lies between these two plates opposite Oregon, Washington, northern California, and part of British Columbia. The Pacific Plate moves northwest relative to the North American Plate. Los Angeles will migrate toward San Francisco over the next several million years.



Source: https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=6wKnWtauOMTy8AXdrrDgDw&q=san+andreas+fault+tectonic+plates&oq=san+andreas&gs_l=psy-ab.1.2.0i67k1j0j0i67k1l3j0j0i67k1j0j0i67k1j0.384874.388217.0.391388.11.7.0.4.4.0.233.944.0j3j2.5.0.....1c.1.64.psy-ab..2.9.990....0.qknt93CTQbE



Plate Tectonics



Check What You Learned!!! Write the answers in your notebook.

1. Characterize each type of plate boundaries.
2. Which of the following processes continually adds the new crust?
 - A. Convection
 - B. Earthquakes
 - C. Subduction
 - D. Sea-floor spreading
3. The ring of fire is a ring of volcanoes and earthquakes that occur along
 - A. Hot spots
 - B. Plate boundaries
 - C. The mid-ocean ridge
 - D. Only transform boundaries
4. Which of the following happens when subduction take place?
 - A. New crust is formed
 - B. New islands are formed
 - C. One plate slides under another
 - D. Earthquakes occur along a transform boundary

Volcano

The Philippines is an archipelagic country composed of many islands. Geographically, it is located in the “Pacific Ring of Fire” where most of the dynamic activities of the earth are experienced. Such processes greatly influence the shapes of its different landforms and indirectly, the lives of the inhabitants.

Within the Pacific Ring of fire, numerous numbers of volcanoes are lined and convergence of plates happen all the time. It is a direct result of plate tectonics: the movement and collisions of lithospheric plates. We mostly tend to think of when we think of the following of volcanoes –it is beautiful, it has conical peaks and sometimes even snowy-capped.

However, there are many kinds of volcanoes that are available in this world, including the Philippines. There are many forms of volcanoes and some of the examples are Mayon Volcano and Taal Volcano, both volcanoes, having different characteristics.

Without further ado, let us look into the world of volcano. The study or science of volcano is termed “Volcanology”.

Familiarize yourself with my body parts then turn to the other page and answer questions that will differentiate said body parts?

Hi! I’m Vulcan, your guide as you go through this module.



Answer to Check What You Learned:

A. Earth and Its Features

1. Atmosphere
2. Moon
3. Plants

B. Plate Tectonics

1. Answers may vary
2. C
3. A
4. C

Learning Module 2

Parts of a Volcano

Time Frame: 1.5 h (one meeting)

Learning Objectives:

1. Characterize volcano as an Earth feature.
2. Identify the different parts of a volcano.
3. Discuss and characterize the different parts of a volcano.
4. Make a geographical map of the Philippines with the different volcanoes.



Science Idea

Volcano is a vent, hill or mountain from which molten materials from the inside of the earth are ejected

Read

There are, however, many kinds of volcanoes. A volcano does not have to be a beautiful snowcapped conical peak. It can be a hole in the ground, or a crack in the earth's surface.

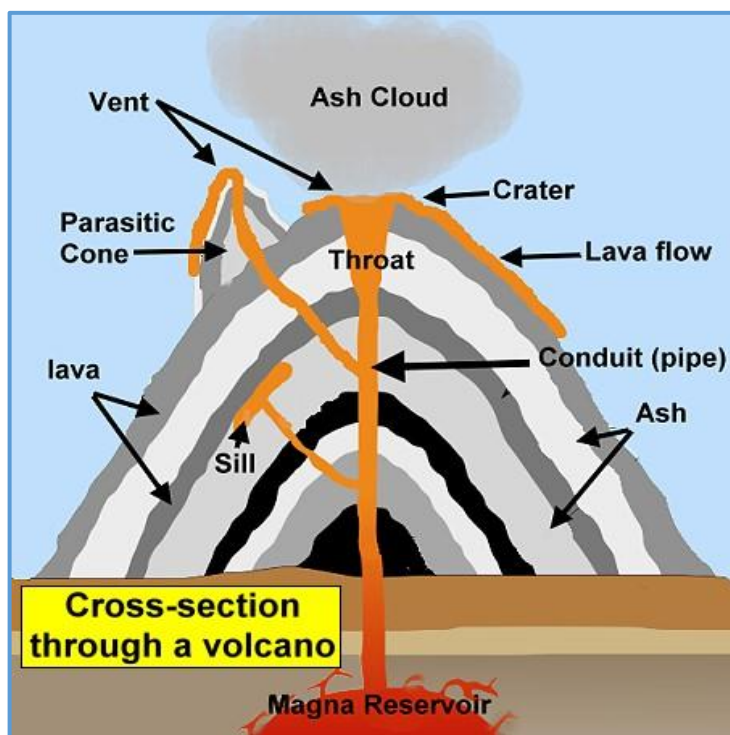
FYI!!!

Parts of a Volcano

List of Active Volcanoes in the Philippines

Volcano	Province
Amabalatungan Group	Kalinga
Babuyan Claro	Cagayan
Banahaw	Laguna, Quezon
Biliran	Biliran
Bulusan	Sorsogon
Cabalian	S. Leyte
Cagua	Cagayan
Camiguin de Babuyan	Cagayan
Didicas	Cagayan
Hibok-Hibok	Camiguin
Iraya	Batanes
Iriga	Camarines Sur
Jolo Group	Sulu
Kanlaon	Negros Occidental, Oriental
Leonard Kniaeff	Compostela Valley
Makaturing	Lanao del Sur
Matutum	South Cotabato
Mayon	Albay
Musuan	Bukidnon
Parker	South Cotabato
Pinatubo	Zambales, Tarlac
Ragang	Cotabato, Lanao del Sur
San Pablo Volcanic Field	Laguna
Smith	Cagayan
Taal	Batangas

Source: Wikipedia



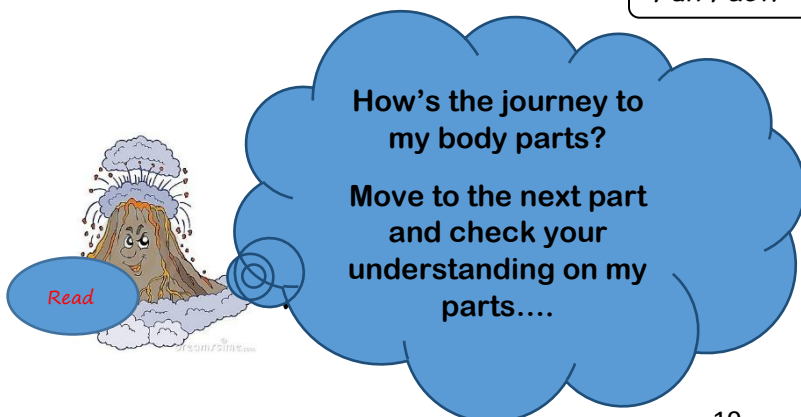
- Mayon, also known as Mount Mayon or Mayon Volcano
- Found in the province of Albay in Bicol Region, on the island of Luzon in the Philippines
- Last Eruption: 18 September 2014
- Elevation: 2,463 m



Read

PARTS	CHARACTERISTICS/FUNCTIONS
Vent	an opening, serving as an outlet for air, smoke, fumes, or the like
Crater	a bowl-shaped geological formation at the top of a volcano
Conduit	an underground passage magma travels through
Parasitic Cone/Secondary Vent	vent or tube that connects to the secondary cone for the lava to flow
Throat	entrance of a volcano; the part of the conduit that ejects lava and volcanic ash
Sill	an intrusive body of magma that pushes its way between layers of sediments
Magma Chamber	a reservoir of magma in the earth's crust where the magma may reside temporarily on its way from the upper mantle to the earth's surface
Lava Flow	a stream or sheet of molten or solidified lava

Fun Fact!



Taal was declared one of the "Decade Volcanoes" in the Decade Volcanoes program of the 1990s in order to study and monitoring of the volcano. Taal is today one of the most closely monitored volcanoes in the region. An increase in seismic activity under Taal was recorded in November 2006, followed by an increase in hot water springs in the crater in April 2007.

Interesting Facts

Over the world there are more than 1,500 active volcanoes.

The Olympus Mons is the tallest known volcano in our solar system, located on the planet Mars. Is three times higher than Mount Everest.

BasicPlanet.com



**YOUR
ASSIGNMENT**

© Can Stock Photo

Module Output: *(with Rubrics at the end page of this module)*

In a short bond paper, make a geographical map of the Philippines showing the locations of the different volcanoes in the country.

CHECK WHAT YOU LEARNED:

Unscramble the letters inside the parenthesis to come up with the correct idea. Write the answer on the space provided.

_____ (ARTCER) is where materials from the inside of the earth moves out to the surface.

_____ (SICPATIAR ECNO) is a small outgrow from the slope of a volcano that has a vent and can also eject molten materials.

_____ (DOTUNCI) serves as passageway of molten materials from the inner part of the earth to the vent of a volcano.

_____ (TEVN) is the external opening of a volcano.

_____ (ALAV) refers to hot materials flowing out from a volcano.

Critical Thinking Question?

Are the parts of a volcano permanent structures? When can it be changed?

References:

Ditan, Carolina (2007). Elements of Physical Science. Mandaluyong City: National Bookstore

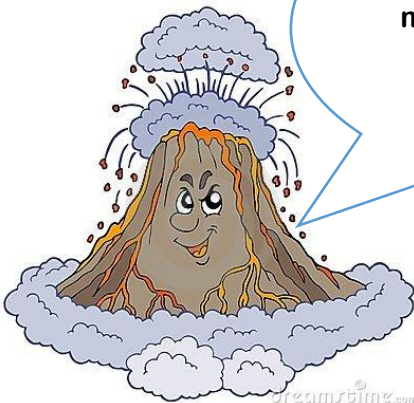
<https://www.volcanodiscovery.com/taal.html>

<https://www.universetoday.com/29125/parts-of-a-volcano/>

<https://www.universetoday.com/29125/parts-of-a-volcano/>

https://www.google.com.ph/search?q=Parts+of+a+volcano&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiW2LWj8efZAhUQhrwKHemFAMgQ_AUICigB&biw=1366&bih=662

Congratulations! You made it. You can now move to the next module.....



Answer to module No. 1.

Answers:

1. Crater
2. Parasitic core
3. Conduit
4. Vent
5. Lava



Critical Question Rubrics:

Criteria	3 pts	2 pts	1 pt	0 pt
Organization of ideas	Ideas are well organized, stated, and consistent with the question asked	Ideas are organized, stated, and consistent with the question asked	Ideas are NOT organized and NOT consistent with the question asked	No answer
Use of Science ideas to explain the answer	Appropriate and logical science ideas were used	Appropriate ideas were used	Inappropriate and illogical ideas were used	No answer

Rubrics for the Geographical Map

Criteria	3 pts	2 pts	1 pt
Presentation of output	Output is clear, neat, and well organized	Output is clear and well organized	Output is clear
Content	Map is with complete and appropriate information	Map is complete but lacks appropriate information	Map is incomplete

Learning Module 3

Formation of Volcanoes

Time Frame: 3.0 hrs (two meetings)

Learning Objectives:

1. Explain how volcanoes are formed.
2. Identify places where volcanoes are usually formed.
3. Recognize the dynamism of the earth.



Science Idea

Volcanoes are formed when magma from within the Earth's upper mantle works its way to the surface

Read

When tectonic plates collide and go through the process of subduction, it sets the foundation for a volcano. The overlapping of tectonic plates causes the magma to break through the crust, resulting to the birth of volcanoes.



Convergence and collision of plates are responsible in the formation of different structures that eventually form the volcanoes.

Activity	Where it happens
deep elongated and narrow depression	Oceanic trenches
chains of undersea mountains	Oceanic ridges
highly linear zones of weakness	Transform faults and fracture zone



MT. Killer Whale is located in Hawaii, USA. It is considered as one of the most active volcanoes in the world

FYI!



Hi there! What you are reading is just one process on how volcanoes are formed. Continue reading.

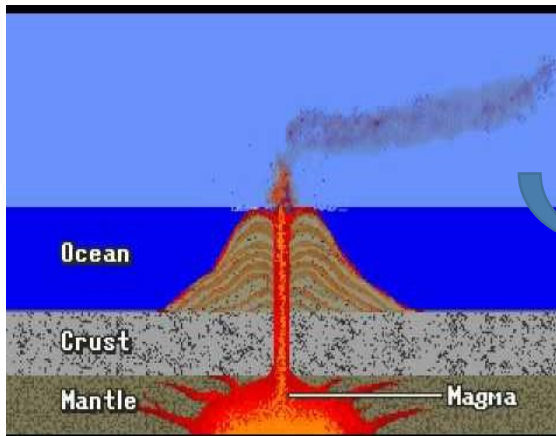
Source: https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=AAenWvaJCoid8QX7pq-oBA&q=active+volcano+in+Hawaii+Mt.+Kiler+Whale&oq=active+volcano+in+Hawaii+Mt.+Kiler+Whale&gs_l=psy-ab.3...31526.43283.0.43938.16.16.0.0.0.525.2955.0j13j1j5-1.15.0....0...1c.1.64.psy-ab..1.2.368...0i30k1j0i5i30k1j0i24k1j0i8i30k1.0.GlZSzPjypMU



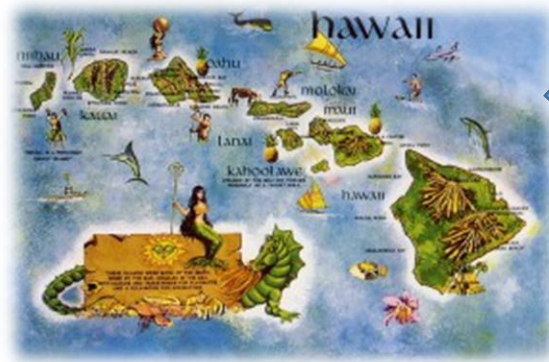
Volcano

Read

Scientists at UC Berkeley have detected previously unknown channels of slow-moving seismic waves in Earth's upper mantle, a discovery that helps explain "hotspot volcanoes" that give birth to island chains such as Hawaii and Tahiti (*real-clear science newsletter of the University of California-Berkeley, Sept 2013*)



... when hot rocks from near the core rise up through the mantle, and when it reaches near the surface it melts burning through the crust and forms a volcano
... as plates move slowly across a hot spot over millions of years, a line of volcanoes form



Source:

https://www.google.com.ph/search?biw=1366&bih=662&tbn=isch&sa=1&ei=9EyoWr-gCszN0gTXgo6wDA&q=hawaiian+map&oq=hawaiian+map&gs_l=psy-ab.1.0.0l3j0i8i30k117.34963.35492.0.42305.3.3.0.0.0.0.201.554.0j2j1.3.0...0...1c.1.64.psy-ab..0.3.550...0.IQIT5GYBGuM

In 1963, geologist John Tuzo Wilson hypothesized the origins of the Hawaiian–Emperor seamount chain, explaining that they were created by a hotspot of volcanic activity that was essentially stationary as the Pacific tectonic plate drifted in a northwesterly direction, leaving a trail of increasingly eroded volcanic islands and seamounts in its wake.

FYI!!!

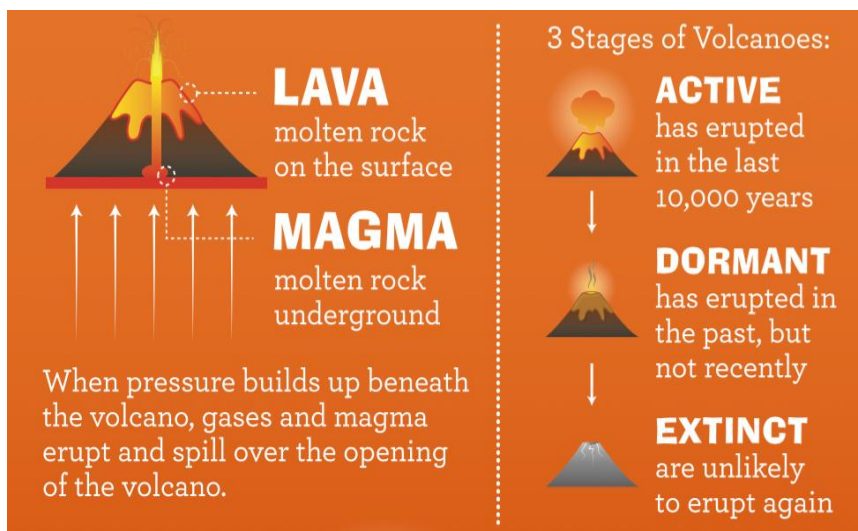
That's how volcanoes are formed.
Did you learn something new?
Turn to the next page...



Volcanoes are formed by plate movements and hot spots

Read

Other Volcano Facts!!!



Source:

https://www.google.com.ph/search?biw=1366&bih=662&tbn=isch&sa=1&ei=IU2oWoebK8bl0gSssKzoDg&q=3+stages+of+volcano&oq=3+stages+of+volcano&gs_l=psy-ab.3...301259.313311.0.313963.31.26.0.0.0.0.2064.2064.9-1.2.0...0...1c.1.64.psy-ab..29.1.2062.0..0.1799.7nYzlPRB6cM

END HERE!

SW

Have a Break, and answer these statements!

Encircle the letter of the answer. Choose the best answer.

1. Magma comes out to the surface through
 - a. opening formed by plate movements
 - b. ejection of hot gases from the earth
 - c. holes created on the surface of the earth
2. How are chains of volcanoes created?
 - a. hot spots
 - b. plate movements
 - c. collisions of plates
3. Where do volcanoes form?
 - a. plates that slip over each other
 - b. plates that destroy the other
 - c. plates that pushed each other downward
4. Volcanoes that are unlikely to erupt are called?
 - a. active
 - b. extinct
 - c. dormant

It sounds easy...



**Critical Thinking
Question:**

The archipelagic islands of the Philippines has quite a number of volcanoes, how could people make this advantageous?



References:

<https://www.csun.edu/~jao45194/volcano2.html>

https://www.youtube.com/watch?v=6Z4as_imJfM

www.nationalgeographic.com/environment/natural-disasters/volcanoes/

Answers in module 2.

1. B
2. B
3. A
4. B

Critical Question Rubrics:

Criteria	5 pts	4 pts	3 pt	0 pt
Organization of ideas	Ideas are well organized, stated, and consistent with the question asked	Ideas are organized, stated, and consistent with the question asked	Ideas are NOT organized and NOT consistent with the question asked	No answer

Learning Module 4

Types of Volcano

Time Frame: 3 h (two meetings)

Learning Objectives:

1. **Classify the different types of volcano.**
2. **Characterize the different types of volcano.**
3. **Classify the different volcanoes in the Philippines.**
4. **Show appreciation on the different types of volcano.**
5. **Construct model on the different types of volcano.**



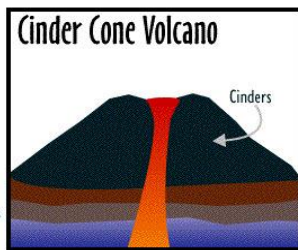
Science Idea

There are three main types of volcano

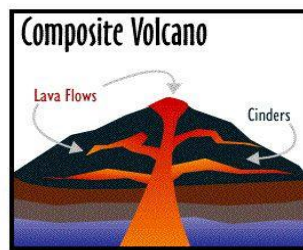
(www.zmescience.com/other/science-abc/types-of-volcano/)

Read

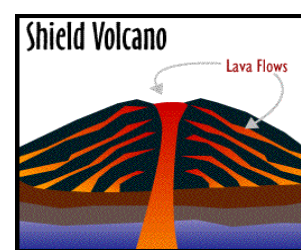
Types of Volcanoes and Its Characteristics



- the simplest type of volcano
- built from particles and blobs of congealed lava ejected from a single vent
- has a bowl-shaped crater at the summit and rarely rise more than a thousand feet or so above its surroundings
- also called scoria cones



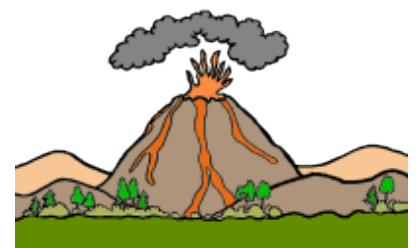
- sometimes called *stratovolcano*
- typically steep-sided, symmetrical cones of large dimension built of alternating layers of lava flows, volcanic ash, cinders, blocks, and bombs and may rise as much as 8,000 feet above its base
- a conduit system through which magma from a reservoir deep in the Earth's crust rises to the surface



- are built almost entirely of fluid lava flows
- gently sloping volcanoes built of very thin lava spreading out in all directions from a central vent
- have wide bases several miles in diameter with steeper middle slopes and a flatter summit
- largest volcanoes in the world

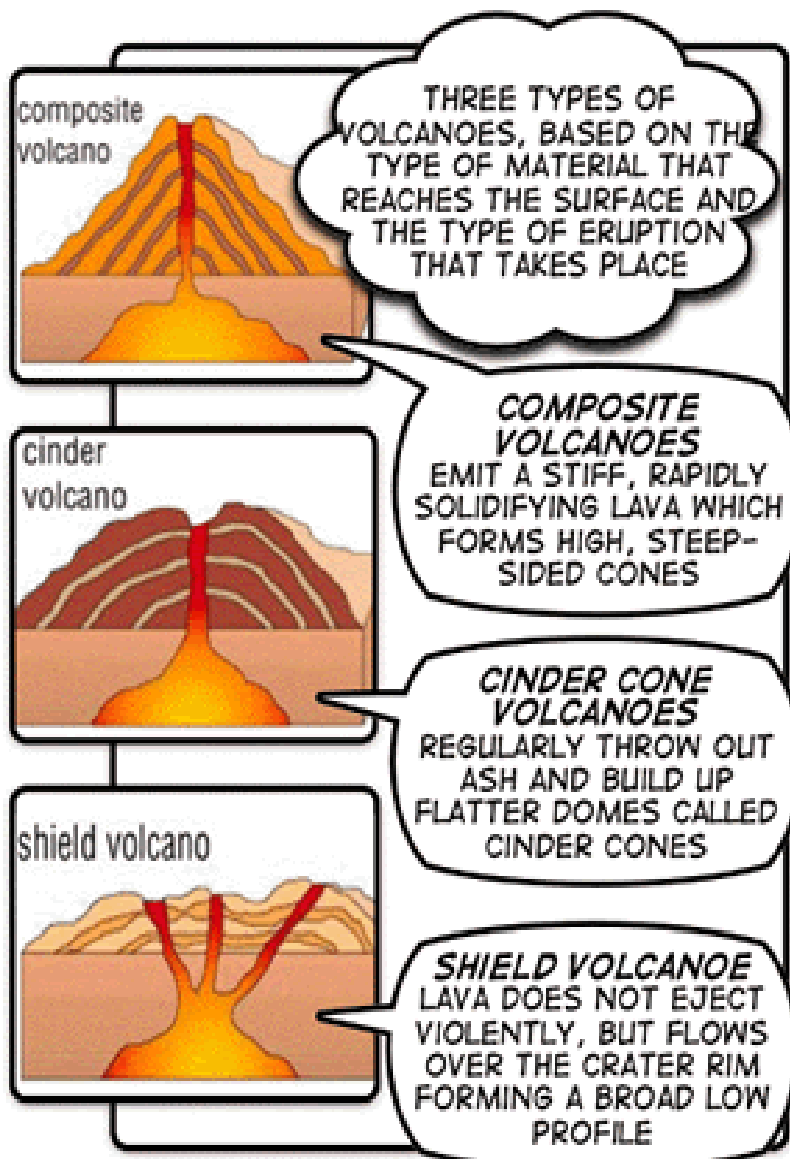
Source: https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=_E6oWu2hO8ao0AS3za6gCA&q=types+of+volcano&oq=types+of&gs

Have you seen the different types of volcano? How about me, what type of volcano do I belong?
Continue reading....



Read

...more on the types of volcano



Composite Volcano – Mt. Fuji of Japan



Cinder Cone Volcano – Holocene, Utah USA



Mt. Kanlaon is an active stratovolcano on the island of Negros, Philippines. It is the highest point in Visayas, with an elevation of 2,465 m above sea level.

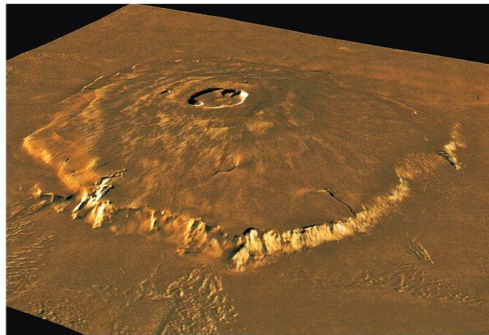


Can you now distinguish one from the other?

Read

Check this out!!!

Mother of all volcanoes: Olympus Mons



24 Kms high (3 times Mt. Everest), 600 Kms across (as big as Missouri)

Philippine volcanoes come in different types.

Source: <https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=jU-oWsHQC8GY0QS13p-ADg&q=olympus+mons&oq=olympus&gs>

**YOUR
ASSIGNMENT**

Module Output: (See Rubrics at the end page of this module)

Using discarded cardboard and recycled papers, construct models of the different types of volcanoes. (size: l = 1 ft; h = 4 inches; w = 1 ft)

End here!!!

SW

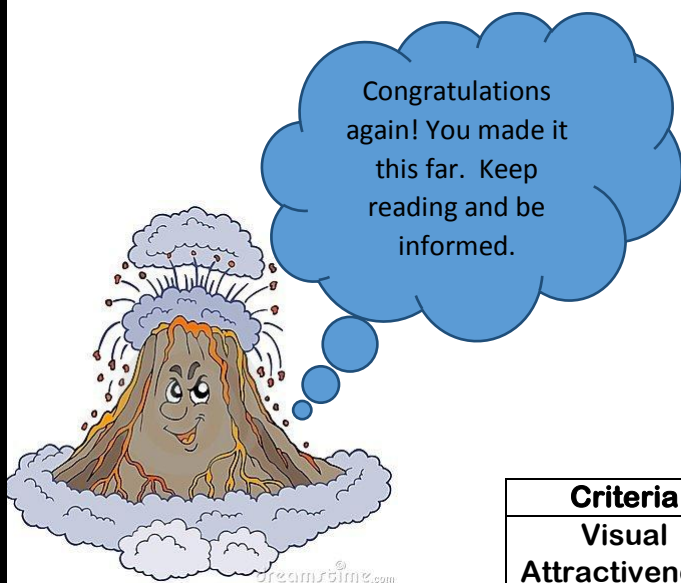
Check What You Learned:

Encircle the letter of the best answer:

1. Which type of volcano is commonly composed of basalt?
 - a. Cinder volcano
 - b. Shield volcano
 - c. Composite volcano
2. How is Mt. Mayon classified as a volcano?
 - a. Cinder volcano
 - b. Shield volcano
 - c. Composite volcano
3. This type of volcano has a gentle eruption with oozing lava flows
 - a. Cinder volcano
 - b. Shield volcano
 - c. Composite volcano

**Critical Thinking
Question:**

What do you consider
the most destructive
type of volcano?
Explain.



Answers in module 3:

1.A

2.B

3.C

References:

<http://www.zmescience.com/other/science-abc/types-of-volcano/>

<https://www.universetoday.com/27333/types-of-volcanoes/>

<https://www.factmonster.com/world/world-geography/types-volcanoes>

<https://pubs.usgs.gov/gip/volc/types.htm>

Rubrics for the Types of Volcanoes Model

Criteria	3 pts	2 pts	1 pt
Visual Attractiveness	Model is visually attractive and depicts the real volcano	Model depicts the real volcano	Model is not attractive and does not represent the real one
Craftmanship	Skillfully produced with artwork	Produced with skills	Model is hurriedly done and without working skills shown

Critical Thinking Rubric:

Criteria	3 pts	2 pts	1 pt	0 pt
Organization of ideas	Ideas are well organized, stated, and consistent with the question asked	Ideas are organized, stated, and consistent with the question asked	Ideas are NOT organized and NOT consistent with the question asked	No answer
Reasoning	Appropriate reasons using science ideas cited	With reasons and science ideas cited	Reasons not appropriate and without science idea cited	No answer

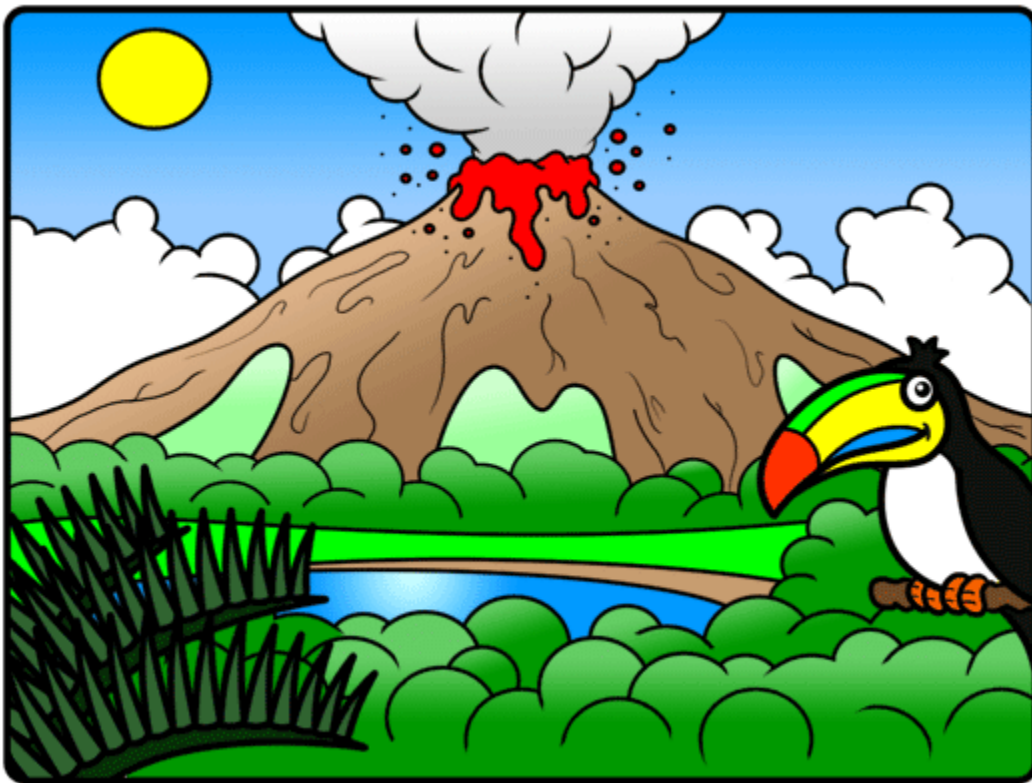
Learning Module 5

Volcanic Eruptions

Time Frame: 3 hrs (two meetings)

Learning Objectives:

1. Identify the different types of volcanic eruption.
2. Contrast the different types of volcanic eruptions and their effects.
3. Distinguish between non-explosive and explosive volcanic eruptions
4. Show concerns to people when a volcano erupts.
5. Draw a labelled Philippine volcano with its characteristics and
 - a) facts about the eruption;
 - b) causes of the eruption;
 - c) primary and secondary effects; and,
 - d) short-term and long-term responses

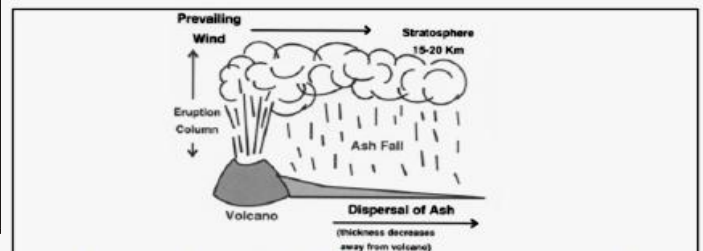
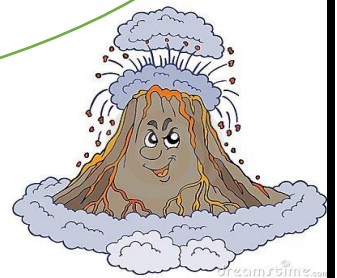
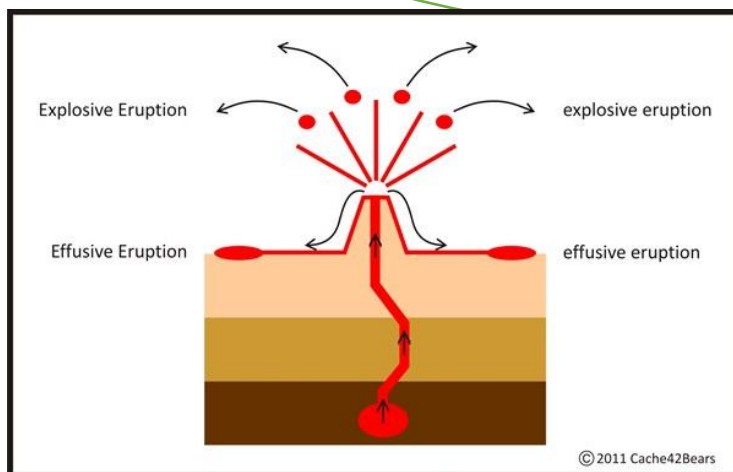


Science Idea

A volcanic eruption occurs when hot materials are thrown out of a volcano. Lava, rocks, dust, ash and gas compounds are some of these "ejecta"

Read

Volcanoes are frequently classified by their size and shape, but they can also be classified by their eruptive habits. Indeed, the type of volcanic eruption that occurs plays an important role in the evolution of a volcanic landform, thus forming a significant link between eruptive habit and volcanic structure. In general, eruptions can be categorized as either effusive or explosive. Effusive eruptions involve the outpouring of basaltic magma that is relatively low in viscosity and in gas content. Explosive eruptions generally involve magma that is more viscous and has a higher gas content. Such magma is often shattered into pyroclastic fragments by explosive gas expansion during an eruption (<https://www.britannica.com/science/volcano/Six-types-of-eruptions>)



- As pressure reduces, dissolved gases in the magma expand and explosively fragment the magma.
- This mixture of gas and magma blasts out of the volcano at high speed (up to 700 m/sec), producing an expanding eruption column.
- The eruption column can extend up into the stratosphere.
- The ash then falls to the ground, blanketing large areas with thick ash deposits.

Source: <https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=nFCoWqPoHYTQ0gSAvrr4Cw&q=types+of+volcanic+eruption&oq=types+of+volcanic+eruption&gs>



Dante's Peak

Lava and other volcanic matter are expelled in many distinctive ways. These ways were named after the manner in which some well-known volcanoes gave out lava. These are the following:

Read

TYPE OF VOLCANIC ERUPTION	CHARACTERISTICS
Hawaiian eruption	- throws out fluid basaltic lava into the air in jets from a vent or line of vents (a fissure) at the summit or on the flank of a volcano - builds hills called spatter cones - flows are very fluid, they can travel kilometres from their source before they cool and harden
Strombolian Eruption	- distinct bursts of fluid lava (usually basalt or basaltic andesite) from the mouth of a magma-filled summit conduit - can produce tephra; hardened globs of glassy lava, lava bombs, and small lava flows - one of the least violent of the explosive eruptions
Vulcanian Eruption	- short, violent, relatively small explosion of viscous magma (usually andesite, dacite, or rhyolite) - repetitive and can go on for days, months, or years, or may precede even larger explosive eruptions
Plinian Eruption	- largest and most violent of all the types of volcanic eruption - They release enormous amounts of energy and create eruption columns of gas and ash that can rise up to 50 km high at speeds of hundreds of meters per second - eruption columns are usually shaped like a mushroom (similar to a nuclear explosion) or an Italian pine tree - ash from an eruption column can drift or be blown hundreds or thousands of kilometres away from the volcano
Lava Dome	- forms when very viscous, rubbly lava (usually andesite, dacite or rhyolite) is squeezed out of a vent without exploding - may be rounded, pancake-shaped, or irregular piles of rock, depending on the type of lava they form from - dome-building eruption may go on for months or years, but is usually repetitive (meaning that a volcano will build and destroy several domes before the eruption ceases)
Surtseyan Eruption	- a kind of hydromagmatic eruption, where magma or lava interacts explosively with water - occur when an undersea volcano has finally grown large enough to break the water's surface - lavas created tends to be basalt, since most oceanic volcanoes are basaltic

Now that's a scholarly work. You may now check your learning.



Phenomenal
Fact!!!



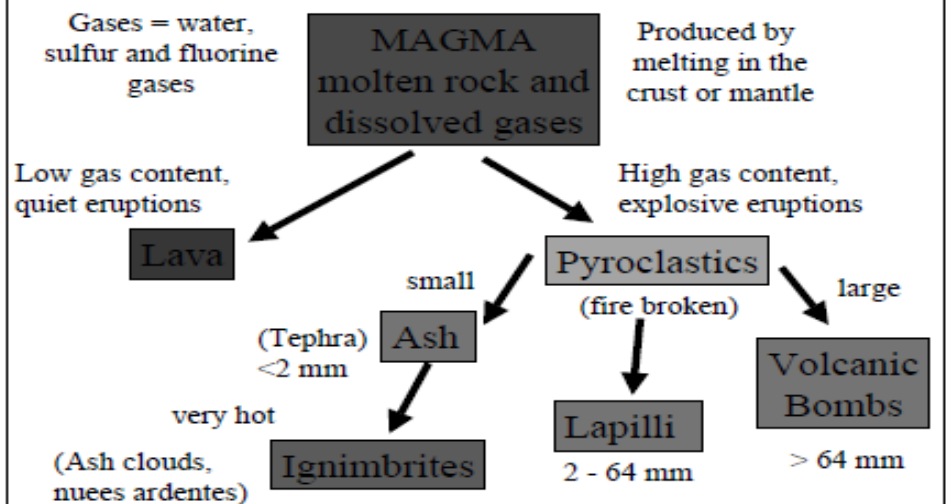
Read

Mt. Pinatubo eruption in 1992
resulted in a decrease in the
temperature worldwide over the
next few years.

Now, let me
tell you the
materials I
release!

Read

A Simple Guide to Volcanic Rocks



Let's take a Break!!!

SW

Check What You Have Learned:

- 1) Look at the pictures below. 2) Write your answer on the space provided. 3) Classify the type of volcanic eruption shown.



1. _____



4. _____



2. _____



5. _____



3. _____



6. _____

**YOUR
ASSIGNMENT**

Module Output:

In a 1/8 illustration board, draw/ sketch a Philippine volcano. Label its parts and features appropriately. Also, give the following information:

- a) facts about the eruption
- b) causes of the eruption
- c) primary & secondary effects
- d) short & long term responses



Do you
find it
easy?

Critical Thinking Question:

The eruption of Mt. Pinatubo in 1992 brought so much destructions and displacements to the people of Central Luzon. If you happen to be the local leader of the place, what will you do to lessen the destructive effects of Mt. Pinatubo eruption?

Once again you have made it. Congratulations! You only need one more module to finish this course on volcanology.



References:

https://en.wikipedia.org/wiki/Types_of_volcanic_eruptions
<https://www.higp.hawaii.edu/~scott/hwn.htm>
www.geology.sdsu.edu/how_volcanoes_work/Hawaiian.html
<https://pubs.usgs.gov/gip/volc/eruptions.html>

Answer in module 4:

1. Hawaiian
2. Plinian
3. Surtseyan
4. Vulcanian
5. Strombolian
6. Lava dome



Critical Thinking Question Rubric:

Criteria	3 pts	2 pts	1 pt	0 pt
Organization of ideas	Ideas are well organized, stated, and consistent with the question asked	Ideas are organized, stated, and consistent with the question asked	Ideas are NOT organized and NOT consistent with the question asked	No answer
Concrete examples given	Three (3) plausible examples are given	Two (2) plausible examples given.	One (1) plausible example given	No answer

Rubrics for the Module Output

Criteria	3 pts	2 pts	1 pt
Completeness of information	With complete information	Lacks 2 or more information	Absence of information
Visual Appeal	Work output is visually attractive and skilfully executed	Work output is visually attractive but not skilfully done	Work output is not visually attractive and not skilfully done

Learning Module 6

Volcanic Eruption Safety Management

Time Frame: 3 hrs (two meetings)

Learning Objectives:

- 1. Identify the different ways to mitigate destruction brought about by a volcanic eruption.**
- 2. Evaluate the given ways of mitigating destruction during a volcanic eruption.**
- 3. Design your own procedures, using the spoken dialect in your area, on how to lessen loss of lives during a volcanic eruption or evacuation plan.**
- 4. Recognize and show appreciation for the efforts done by the government to mitigate destruction during a volcanic eruption.**



Mt. Pinatubo Eruption in 1992

**Science
Idea**

Volcanoes can erupt explosively or voluminous release of magma for weeks or even years. Either way, they can be *cataclysmically (violent)* destructive.



When I get angry, you better prepare or be sorry. Find out how you can escape my fury and be saved.

Read

Here are some ways to mitigate destruction brought about by volcanic eruption.



Stay away from an active volcano.



If living near an active volcano, keep goggles and a mask in an emergency kit along with a flashlight and a working, battery-operated radio.

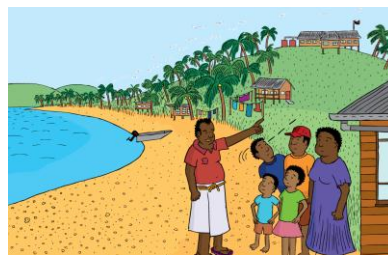


Prepare and know your evacuation plan.

IF A VOLCANO ERUPTS IN YOUR AREA



Evacuate only as recommended by authorities to stay clear of lava, mud flows, and flying rocks and debris.



Avoid river areas and low-lying regions.



Before you leave the house, change into long-sleeved shirts and long pants and use goggles or eyeglasses, not contacts. Wear an emergency mask or hold a damp cloth over your face.



If you are not evacuating, close windows and doors and block chimneys and other vents, to prevent ash from coming into the house.



Be aware that ash may put excess weight on your roof and need to be swept away. Wear protection during clean-up



Ash can damage engines and metal parts, so avoid driving. If you must drive, stay below 56 kilometres an hour

Source:

<https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=0FGoWspMMSr0gTvhoJA&q=safety+procedure+for+volcanic+eruption&oq=safety+procedure+for+volcanic+eruption&gs>



Now that's for your own safety. Are they difficult to follow?



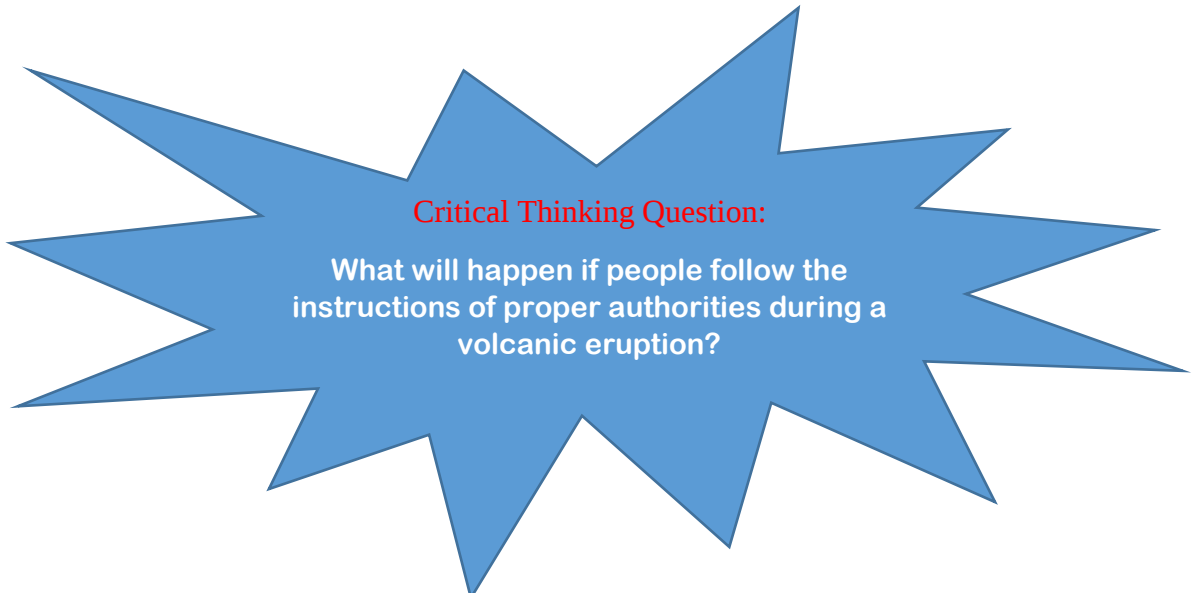
Check What You Have Learned:

Encircle the letter that corresponds to the best answer.

1. Which of the following should be included in your emergency kit during a volcanic eruption?
 - a. Flashlight
 - b. Jewelleries
 - c. Money
 - d. Pictures

2. In an event of volcanic eruption,
 - X. abide with the announcement of the local authorities; and,
 - Y. follow the suggestions of your neighbours
 - a. X only
 - b. Y only
 - c. both X & Y
 - d. neither X nor Y

3. Why should one wear long pants & sleeves, mask or goggles during a volcanic eruption?
 - a. To prevent skin damage caused by the radiation emitted by the volcano.
 - b. To prevent being burned caused by the materials ejected from the volcano.
 - c. To prevent body injuries produced by the materials released by the volcano.
 - d. To prevent people from scolding and giving reminders during a volcanic eruption.



Critical Thinking Question:

What will happen if people follow the instructions of proper authorities during a volcanic eruption?

**YOUR
ASSIGNMENT**

© Can Stock Photo



Module Output:

1. On the page of the paper, write your evaluation on the given ways to mitigate destructions in the event of a volcanic eruption. Evaluate in terms of the following:
 - a) appropriateness of the procedures
 - b) comprehensible (easy to understand)
 - c) ability to execute
2. Mitigating procedures and/or evacuation plan for volcanic eruption using the dialect spoken in your area.



References:

<http://www.nationalgeographic.com/environment/natural-disasters/volcano-safety-tips/vivaweb2.bosai.go.jp/v-hazard/pdf/12E.pdf>
[www.explorevolcanoes.com/volcanic%20hazard%20management.](http://www.explorevolcanoes.com/volcanic%20hazard%20management.html)

html

Answers to Module 5 “Check What You Have Learned.”

1. A and C
2. A
3. C

Critical Thinking Question Rubric:

Criteria	3 pts	2 pts	1 pt	0 pt
Organization of ideas	Ideas are well organized, stated, and consistent with the question asked	Ideas are organized, stated, and consistent with the question asked	Ideas are NOT organized and NOT consistent with the question asked	No answer

Module Output:

The faculty/teacher will assess and evaluate students’ works.



Learning Module 7

Earthquakes

Time Frame: 3 hrs (two meetings)

Learning Objectives:

- 1. Define an earthquake, as well as its epicentre and focus.**
- 2. Explain the occurrence of earthquakes according to elastic rebound theory.**
- 3. Explain the relationship between earthquakes and faults.**
- 4. Describe where (in a Plate Tectonic sense) different types of earthquakes are generated.**
- 5. Describe the process of locating earthquake epicentres using P and S waves.**
- 6. Describe the Richter magnitude scale for measuring the size of an earthquake.**
- 7. Recognize the role of modern science in studying the occurrence of an earthquake.**

Introduction to Earthquakes

What is an earthquake? **Earthquake** is the movement of Earth's crust resulting from the release of built up **potential energy** between two stuck tectonic plates!



The lithosphere is the outermost mechanical (physical) layer, which is made up of brittle, rigid solid materials. The lithosphere is about 100 kilometers thick. Since it is rigid and brittle, when stresses act on the lithosphere, breakdown happens. This is what we understand as an earthquake.

Earthquake is one creative way scientists learn about Earth's interior by looking at how the energy journey from the focus (the point where the earth breaks) of the earthquake. These are seismic waves. Seismic waves travel outward in all directions from the earthquake's focus. These waves are picked up by seismographs around the world. Two types of seismic waves are most useful for learning about Earth's interior. The P – wave and the S – wave. The third wave is the Surface wave which is the slowest.

Well then, we have labelled what is earthquake, then, let's get more specific and investigate the world of earthquakes!



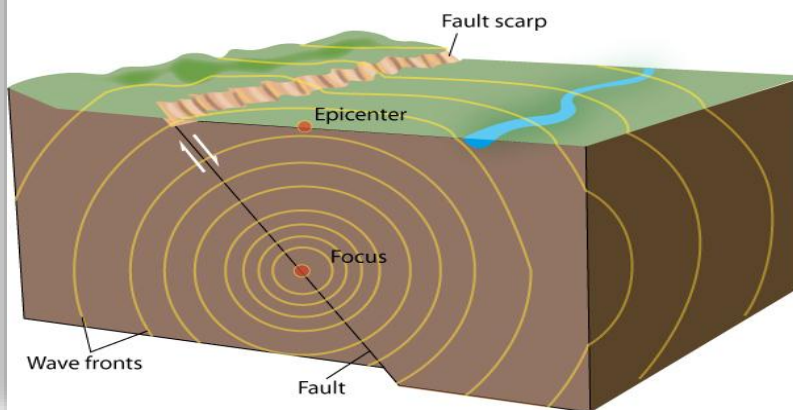
Earthquakes

Science Idea

Earthquakes are the vibrations caused by rocks breaking under stress. The underground surface along which the rock breaks and moves is called a fault plane.

Read

Seismic Waves Radiate from the Focus of an Earthquake



Earthquakes happen along plate margins (where plates meet). When plate moves past towards or away from each other the movement is jagged.

Friction causes the plates to get stuck and triggers the pressure to build up.

Earthquakes occur when this build-up of pressure is released.

Source: <https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=zFKoWoOPD8as0gT-95nICw&q=waves+from+an+earthquake&oq=waves+from+an+earthquake&gs>

Do  : (page 49)

FYI!!!



The 1990 Luzon **earthquake** occurred on July 16 at 4:26 p.m (DST/Daylight Savings Time). 3:26 pm Local time on the densely populated island of Luzon in the **Philippines**. The shock had a surface wave magnitude of 7.8 and produced a 125 km-long ground rupture that stretched from Dingalan, Aurora to Cuyapo, Nueva Ecija.

Seismic Waves

Now, when an Earthquake occurs, there is a transmission of energy from the Earth's interior to its surface in the form of seismic waves. Earthquakes are caused by the movement of geologic material in the Earth's interior. Seismic waves transfer the earthquakes mechanical energy to the surface.

The three general types of wave are: 1) **P –wave or Primary Wave**, 2) **S – wave or Secondary Wave** and 3) **Surface Wave**.

P – waves arrive first and move in a push-pull motion.

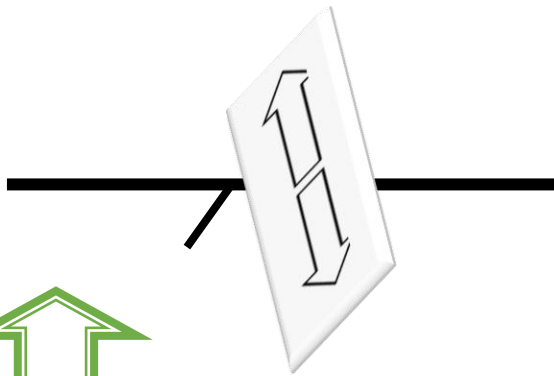
S –waves arrive second, hence the term and move in a side to side motion.

Surface waves are the last to arrive and are the slowest, cause most damage, and move in an up-down, side to side motion.

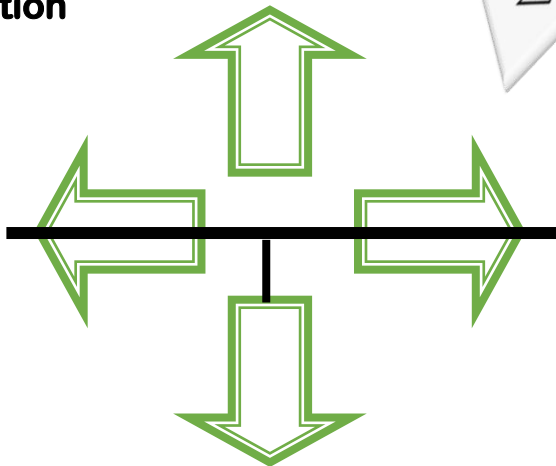
Primary wave Motion



Secondary Wave Motion



Surface Wave Motion





Why Do Earthquakes Happen?

Name: _____

Date: _____

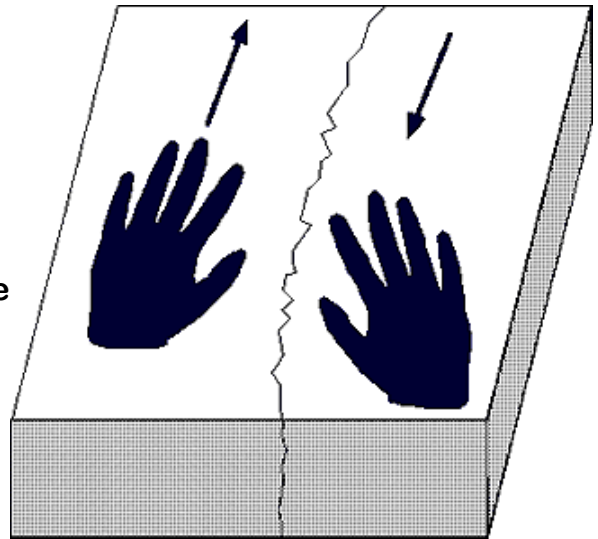
Materials You Need:

Styrofoam Block (1ft X 0.5 in X 0.5 ft)

Knife or cutter

Procedure:

1. Using a knife or cutter, break a block of foam rubber in half.
2. Put the pieces on a smooth table.
3. Put the rough edges of the foam rubber pieces together.
4. While pushing the two pieces together lightly, push one piece away from you along the table top while pulling the other piece toward you. See how they stick?
5. Keep pushing and pulling smoothly.



Questions:

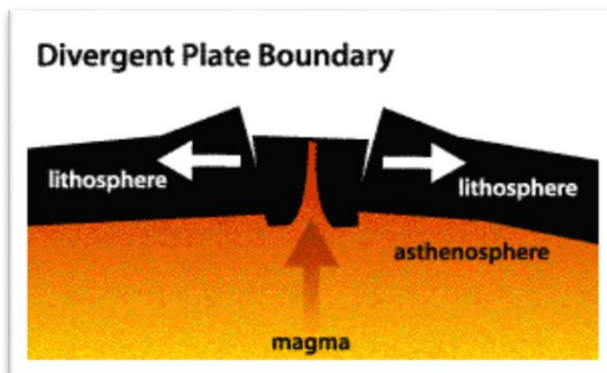
1. What did you observe as the broken blocks we moved past each other?

2. What will happen if plates of the earth move similar to the broken block of Styrofoam?

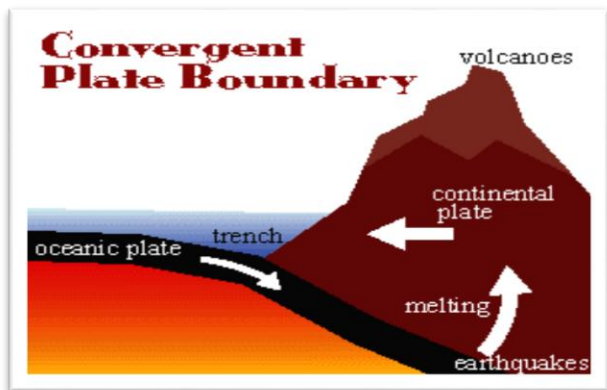
Conclusion:

Earthquakes can come in three forms, depending on the plate movements that occur beneath the earth's surface.

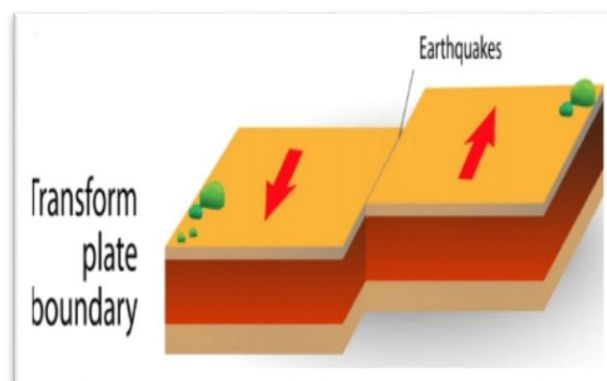
Earthquakes could occur in the different earth plate boundaries.



Plates are forced apart each other, usually forming a Rift Zone. This kind is common in ocean floors where new floors are created. An example is the Mid Atlantic Ridge.



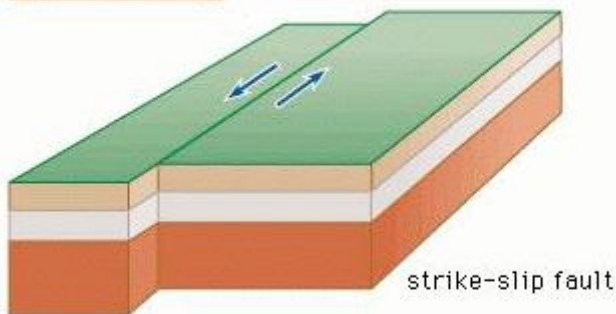
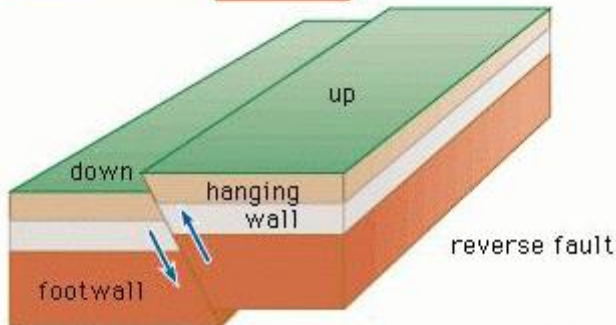
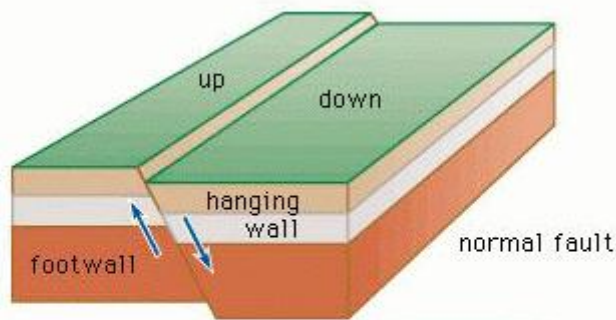
One plate is forced over another plate during movement creating a thrust fault.



The plates slip by each other, also called Strike-slip

What is a fault?

A fault is a region on Earth's surface that is broken into 2 pieces. There can be three types of movement (see figure below). In these diagrams, the term "hanging wall" is the side that moves up or down (<https://www.livescience.com/37052-types-of-faults.html>).



©1994 Encyclopaedia Britannica, Inc.

Normal fault - pulling apart

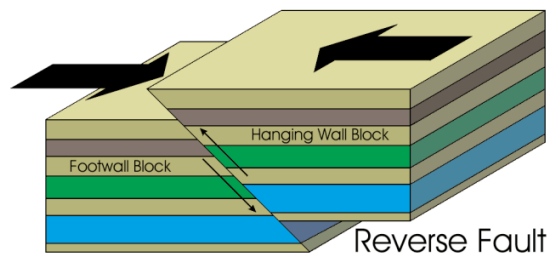
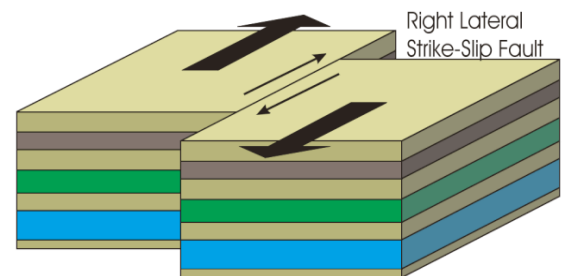
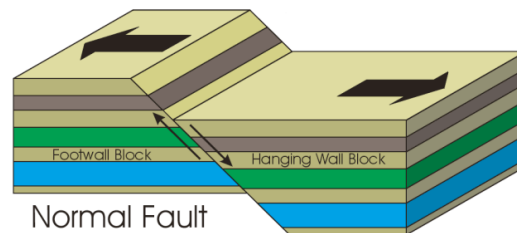
The hanging wall moves down the plate.

Reverse Fault

Here the hanging wall moves up the plate.

Strike-slip or Lateral

The land mass moves in separate direction, sideways.





Types of Earthquakes

Materials:

Block of Styrofoam

Water color

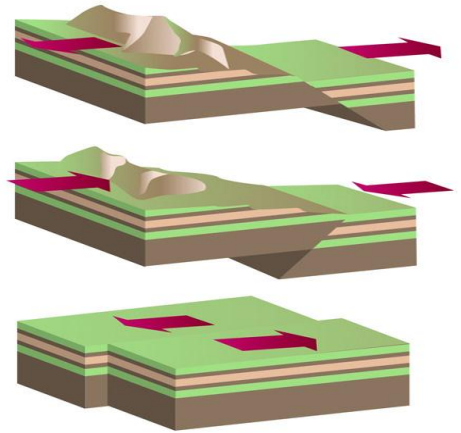
Illustrations of houses, trees, and people

Small sticks for stand

Knife

Procedure:

1. Prepare the materials above. With your group mates, design a landscape complete with its features.
2. Cut the prepared landscape into two.
3. Demonstrate by moving the Styrofoam blocks according to the type of earthquake assigned to the group.
4. Observe what happens.



Questions:

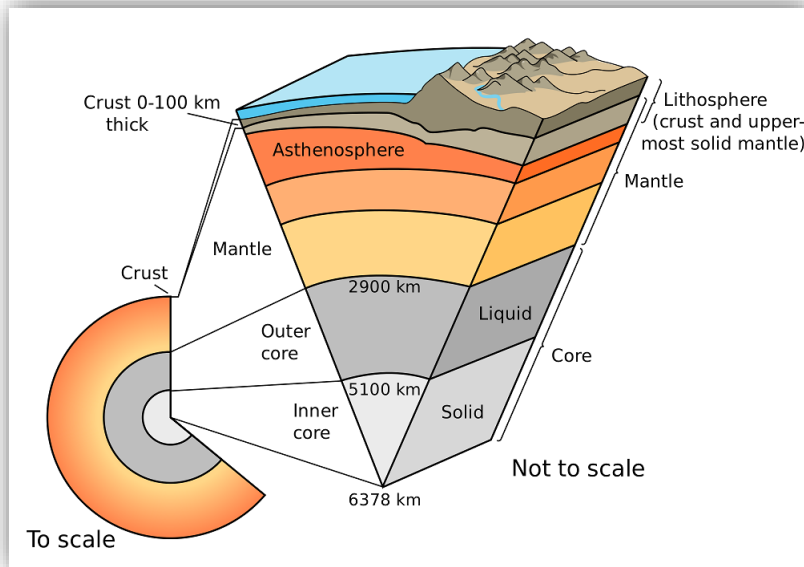
1. What happens to the houses, trees, and people (miniatures) as you move the Styrofoam plates?

2. If one of these movements happens, what should you do to avoid injury?

Conclusion:

Read

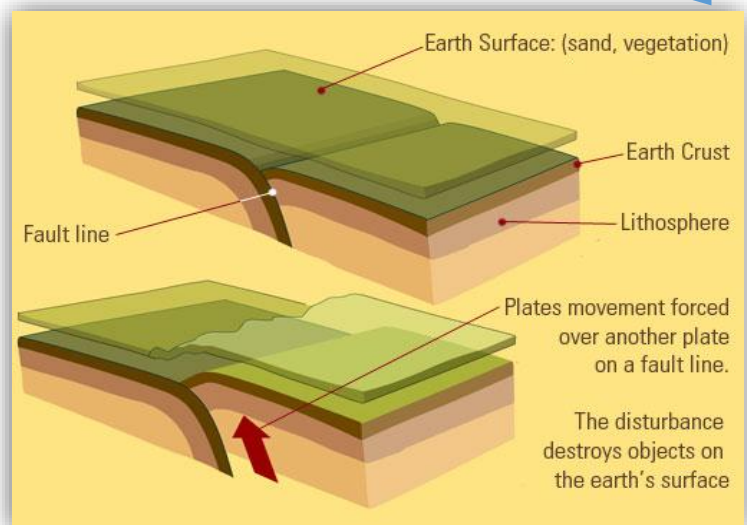
How do earthquakes form?



Earthquakes develop in the crust of the earth. The crust involves the earth's surface, submarine level, down to the ocean floors. The inner part of the earth contains massive energy. Some of this energy escapes through cracks and other volcanic activity, but the bulk of it is stored within the earth's inner part, contained in the crust.

The earth's outer crust is held in place like a jigsaw puzzle, with rough edges and lines. The energy stored here causes the pieces to slide, glide, knock and move around each piece. These pieces best describe what we call "Tectonic plates".

After a period of time, the built up energy and movement cause huge tension in the plates, and there is massive pressure on the fault line. This intense pressure resulting from energy build up causes the fault (*fault is a planar fracture or discontinuity in a volume of rock, across which there has been significant displacement as a result of rock-mass movement*) line to give way, and plates move over, against or apart from each other.



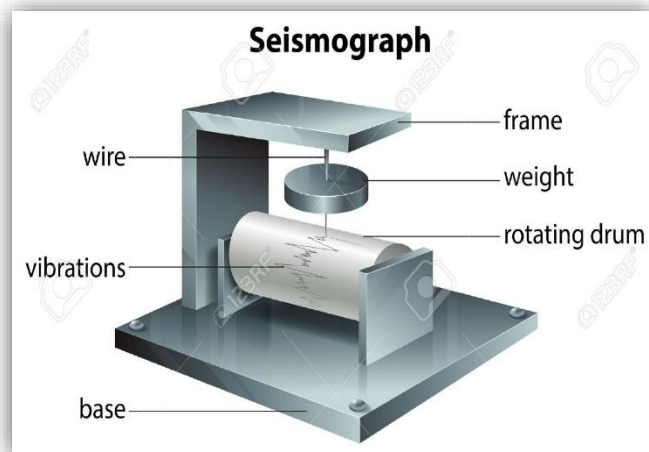
Source: <https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=3lOoWofELISW0gTt6I-wBQ&q=how+do+earthquakes+happen&oq>

Magnitude and Intensity of an Earthquake

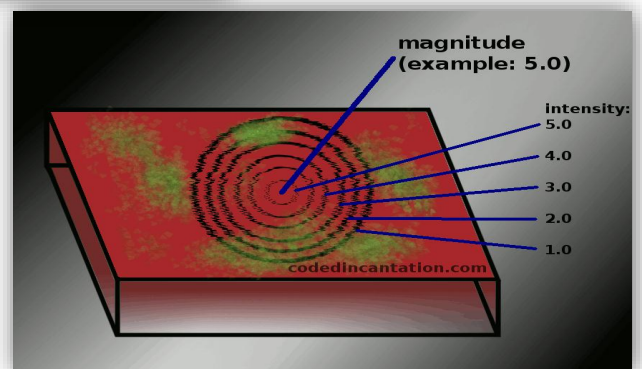
The magnitude of an earthquake is determined instrumentally. It measures the energy released at the source of the earthquake.

Intensity of an earthquake is a subjective parameter based on assessment of visible effects. It measures the strength of shaking produced by the earthquake at a certain location. Intensity is determined from effects on people, human structures, and the natural environment.

The **Richter magnitude scale** (also **Richter scale**) assigns a magnitude number to quantify the size of an earthquake. The Richter scale, developed in the 1930s, is a base-10 logarithmic scale, which defines magnitude as the logarithm of the ratio of the amplitude of the seismic waves to an arbitrary, minor amplitude, as recorded on a standardized seismograph at a standard distance (Wikipedia).

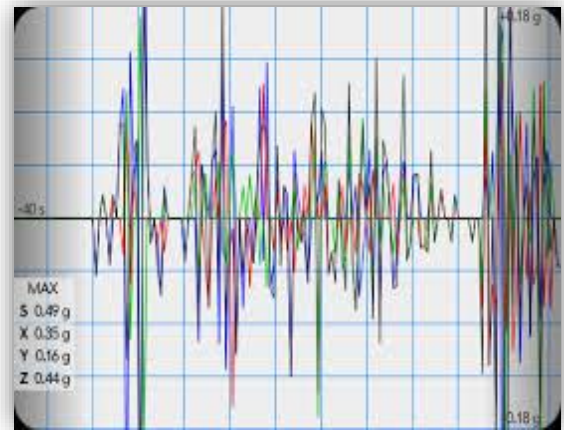


Source: https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=11SoWr_CiYmj0gSp7qMw&q=magnitude+and+intensity+of+earthquake&oq=magnitude+and+&gs



Read

Seismology has advanced since the historical stories where earthquakes were thought to be caused by restless gods or giant creatures slumbering beneath the Earth, but can we predict earthquakes?



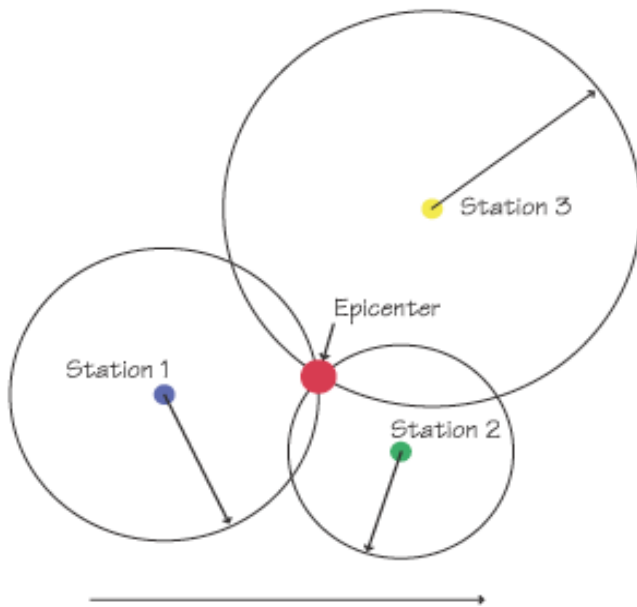
Magnitude	Earthquake Effects	Estimated Number Each Year
2.5 or less	Usually not felt, but can be recorded by seismograph.	900,000
2.5 to 5.4	Often felt, but only causes minor damage.	30,000
5.5 to 6.0	Slight damage to buildings and other structures.	500
6.1 to 6.9	May cause a lot of damage in very populated areas.	100



Locating an Epicenter

To define an epicenter of an earthquake, you need at least 3 seismic stations to detect an epicenter. The P and S waves help determine where the epicenter is located, and where all three circles meet is the location of the epicenter.

The distant you are from the epicenter,
the greater the S-P Interval (the time
between when the P wave hits and the S
wave hits.



*Distance from
epicentre is calculated
from delay between P-
wave and S-wave
arrivals*

Source:

https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=P1WoWsiEA8u_0ASK5LmwBg&q=locating+the+epicenter+of+an+earthquake&oq=locating+the+epicenter&gs

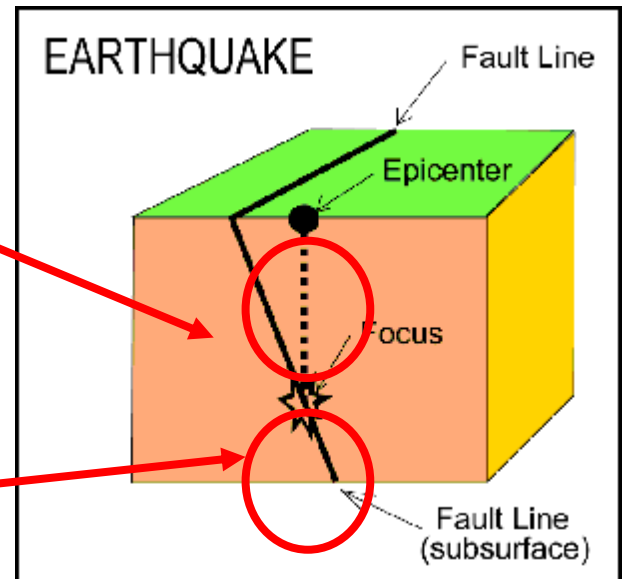
Read

What is an Epicenter?

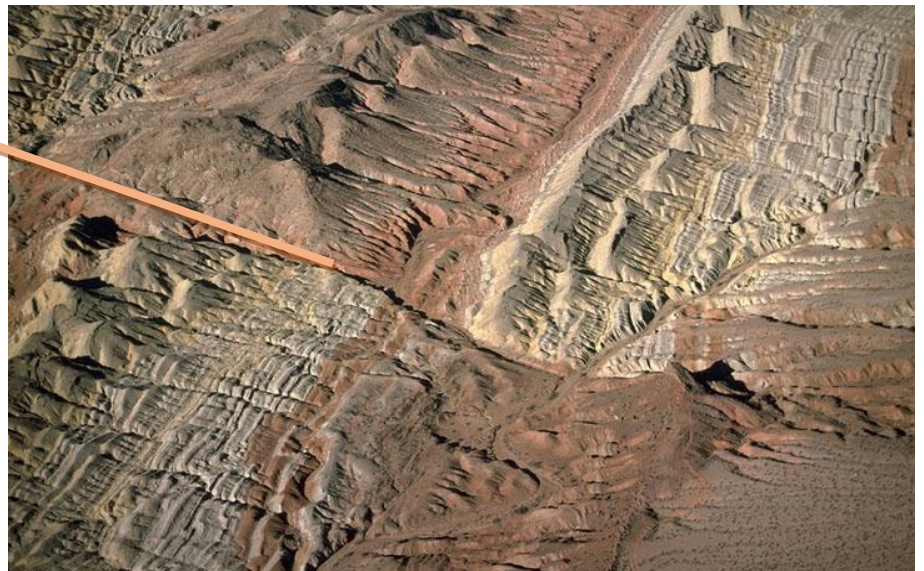
By its description: A point on Earth's surface that is directly above the focus of an earthquake, where the *shaking is strongest and most damage occurs*.

What is a Focus?

By definition: point below Earth's surface where the rock breaks along a *fault* and energy is released.



***Nevada
Fault
Line***



Source: <https://www.google.com.ph/search?biw=1366&bih=662&tbm=isch&sa=1&ei=uVWoWsWqEIqd0gTb-KiwBQ&q=epicenter+of+an+earthquake&oq=Epicenter+of+an+ea&gs>



Measure My Magnitude

Materials:

- Student desks (moveable)
- Plain white paper
- Non-permanent markers
- Transparency of the 'Seismographs' sheet
- Masking Tape

Set-Up (10 minutes)

Create a transparency of the 'Seismographs' sheet. Gather plain white paper for each student and enough markers for half the class (students will be paired and then share).

Procedure (25 minutes)

The italicized phrases are spoken suggestions for the instructor and those in parenthesis are possible answers that students might provide.

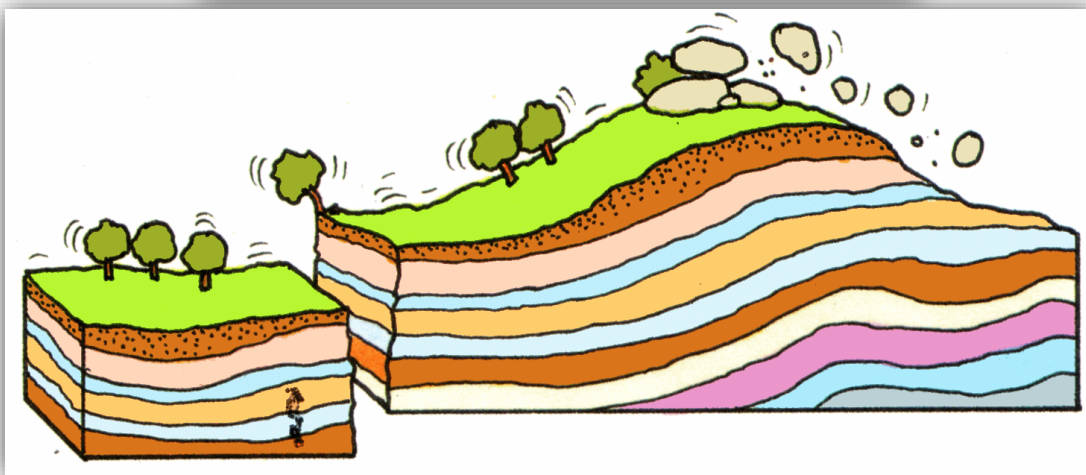
1. Introduce the topic of earthquake measurement. *Today, we will learn one method used to measure earthquakes. An earthquake's magnitude is a measurement of the amount of energy released by an earthquake. A seismograph is an instrument used to record the motion of earthquake waves.*
2. Show students the 'Seismographs' transparency. *Here we have three different seismographs. They each record the motion of earthquake waves with the wavy lines you see here. These wavy lines are called seismograms. Who has seen seismograms on the news after an earthquake? (Answers vary)*
3. Describe how to conduct the activity. You may wish to demonstrate with a volunteer partner.
 - a. *Before we begin, find a partner and stand beside a desk or table. (Have two sheets of paper and a marker ready at each desk). We are going to create our own seismograms by 'being' the earthquake using only a sheet of paper, this marker, and this desk.*
 - b. Place one of the sheets of paper on the desk. *I'm going to have (insert name) help me demonstrate.*
 - c. Have the student hold onto the marker so that it just touches the surface of the white paper. *While he/she is tightly holding onto the marker, I will "be" the earthquake.*
 - d. Lightly shake the desk and slowly pull it toward you. Make sure to stop before you run off the paper. This will leave seismograms on the white paper, representing the earthquake.
 - e. After you finish recording your seismograms, switch roles so that the student can "be" the earthquake as well. But this time ask him/her to shake the desk a little harder than the first time.
4. Let the students begin.
5. Compare the results. *Look at your seismograms. Which shaking produced bigger seismograms? (The second/harder shaking) So what does this mean? What can the size of the seismogram tell us about an earthquake? (The bigger the waves, the bigger an earthquake.) Scientists use the information collected in seismograms to determine the magnitude of earthquakes, which are the numbers you hear of after an earthquake, such as 5.4.*
6. Students arrange their seismograms. *Now we will arrange our seismograms by taping them on the board/wall from smallest to largest (wave amplitude).*

Questions:

1. What difficulty did you encounter as you performed the procedures of the experiment?

2. If you would be assigned to manipulate seismograph equipment, what things would you consider?

Conclusion:



Learning Module 8

Earthquake Risk Reduction Management

Time Frame: 3 hrs (two meetings)

Learning Objectives:

1. Identify the measures done by the government to lessen the destructive effects of an earthquake.
2. Demonstrate safety precautions during an earthquake.
3. Express familiarization of the different fault-lines in the Philippines.
4. Evaluate the different programs of the NDRRMC (National Disaster Risk Reduction Management Council) and PHILVOLCS on earthquake mitigation.
5. Show empathy to areas in the country displaced/destroyed by an earthquake.
6. Translate the earthquake safety precautions in the dialect spoken in your area.



**Be Prepared
Be Aware
Be Ready**

PREPARING FOR AN EARTHQUAKE

Predicting when an earthquake will strike is one thing that scientists have not figured out yet. Scientists know that it happens along fault lines and we know where these fault lines are. There are things we can do in preparation for an earthquake, and to make the response easier and quicker when it does.

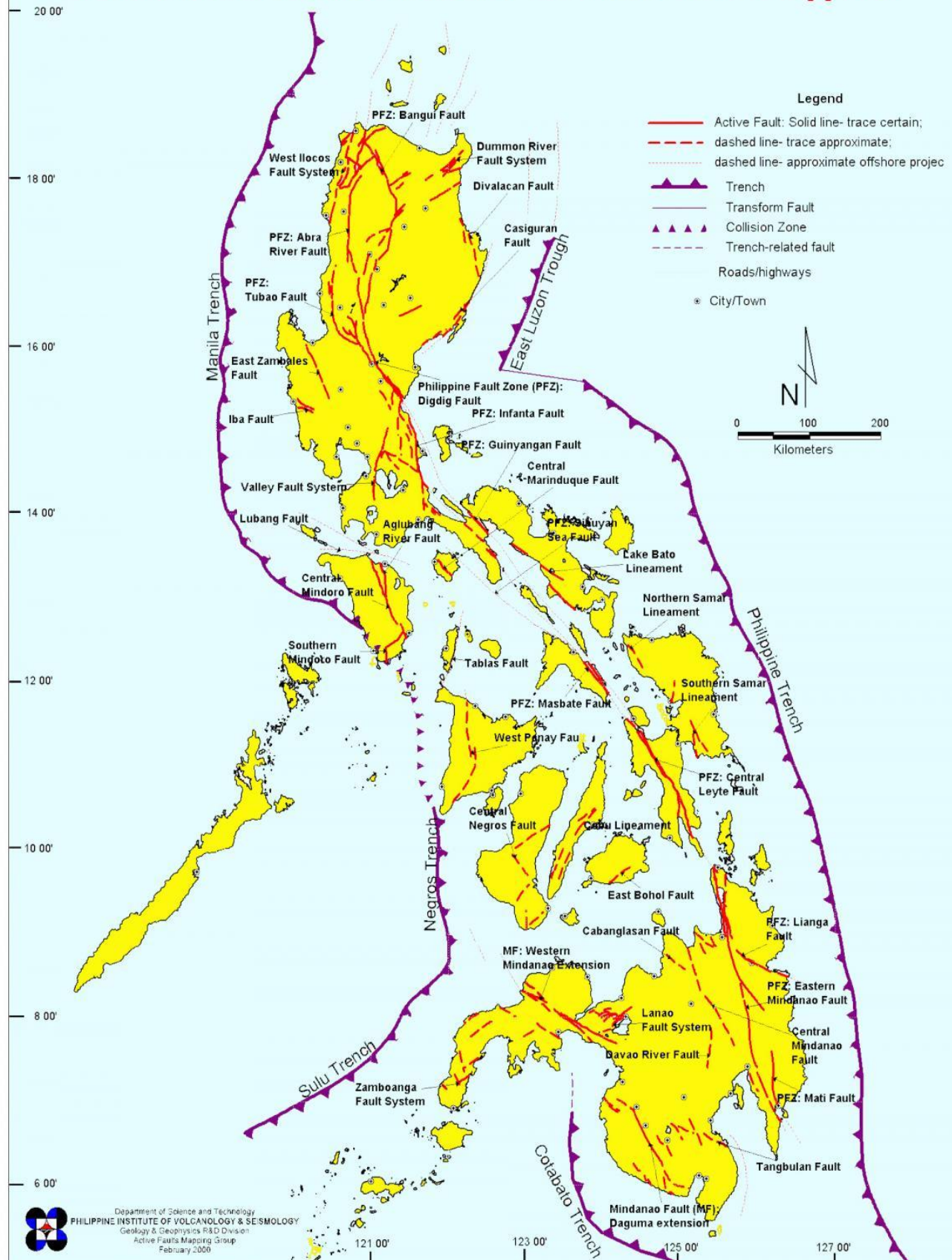
GOVERNMENT

- Authorities need to educate people about earthquake prone areas and fault lines in the country. People must also be educated on what earthquakes are and how to respond to them when they occur.
- Proper building permits and approvals must be given before people build in these areas. There are good engineering and architectural practices that can be engaged to put up earthquake-proof buildings.
- Government must ensure that facilities like fire and police stations, hospitals, schools and shelters, and emergency command posts are working well and prepared to deal with an emergency.

BE ALERT!!
EXPECT THE UNEXPECTED



Distribution of Active Faults and Trenches in the Philippines



FOR INDIVIDUALS

Read



FYI!

PHIVOLCS Programs and Projects

PHIVOLCS and DRR in Education: School-Based Preparedness (1)

Rapid Earthquake Damage Assessment System (REDAS) (1)

Development of National Earthquake Monitoring System (1)

Active Faults Mapping and Paleoseismology Program in the Philippines (1)

Ground Deformation Studies using GPS (1)

Establishment of a Cost-Effective Local Tsunami Early Warning System (TeWS) for Selected High-Risk Coastal Communities of the Philippines 2011-2013 (1)

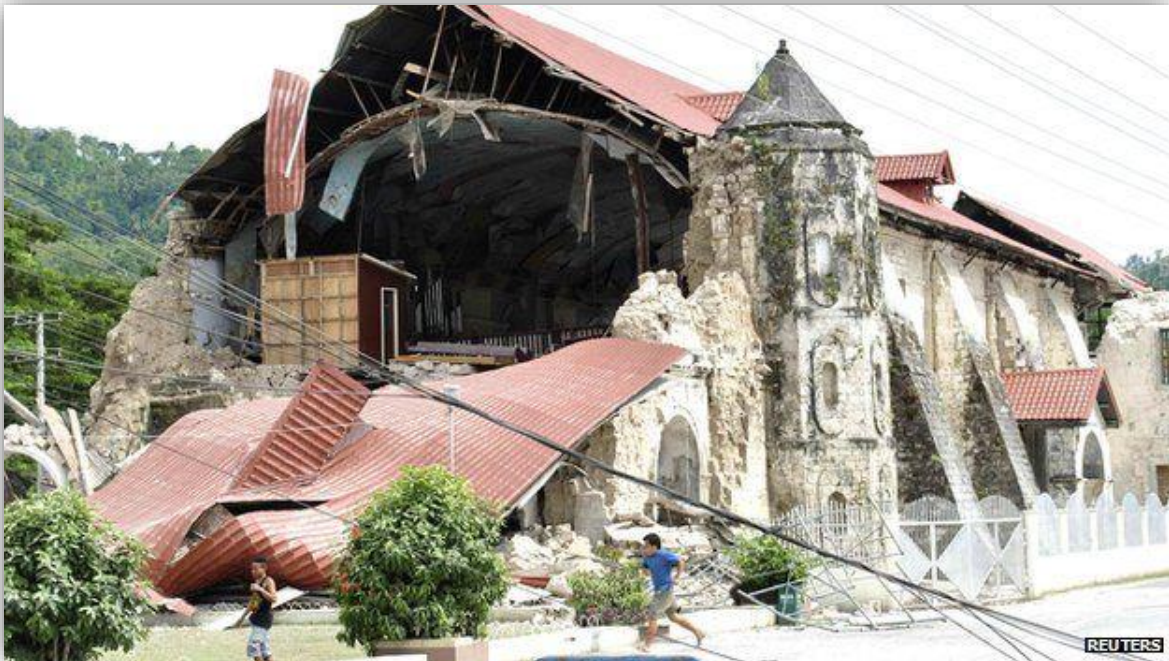
Enhancement of Earthquake and Volcano Monitoring and Effective Utilization of Disaster Mitigation Information in the Philippines - JICA-JST Project (2010-2014) (1)

Volcano Monitoring and Eruption Prediction (1)

Mitigate and Assess Risk From Volcanic Impact on Terrain and Human Activity (2009-2012) (1)



 **BE**
READY
MAKE A PLAN



Read

The 2013 Bohol earthquake occurred on 15 October at 8:12:32 PST in Bohol, an island province located in Central Visayas, Philippines. The magnitude of the earthquake was recorded at M_w 7.2, with its epicenter 6 kilometres (3.7 mi) S 24° W of Sagbayan, and its depth of focus was 12 kilometres (7.5 mi).

Module Output:

1. Download one program of NDRRMC/PHILVOLVC (as shown in the module) and evaluate according to the following:
 - a) appropriateness of the program
 - b) reflectiveness to the need of the people
 - c) process of implementation
2. Prepare leaflets on earthquake precautionary measures using the dialect spoken in your area/ mother tongue.



Check What You Have Learned:

Read each question carefully. Encircle the best answer.

1. The point where movement occurred which triggered the earthquake is the _____.
 - A. dip
 - B. epicenter
 - C. focus
 - D. strike
2. Which of the following sequences correctly lists the different arrivals from first to last?
 - A. P waves.....S waves Surface waves
 - B. Surface waves P waves S waves
 - C. P waves ... Surface waves S waves
 - D. S waves ... P waves ... Surface waves
3. Earthquakes can occur with _____ faulting.
 - A. Normal
 - B. Reverse
 - C. Thrust
 - D. All of these
4. Approximately what percentage of earthquake occurs at plate boundaries?
 - A. 10%
 - B. 40%
 - C. 70%
 - D. 90%
5. How often does magnitude 8 earthquake happen?
 - A. About once a year
 - B. About 5 to 10 years
 - C. About 50 to 100 years
 - D. About 5 to 10 times per year
6. In general, the most destructive earthquake waves are the
 - A. Q waves
 - B. P waves
 - C. S waves
 - D. Surface waves

7. Where is the focus with respect to the epicentre
- A. Directly below the epicentre
 - B. Directly above the epicentre
 - C. In the P waves shadow zone
 - D. In the S waves shadow zone
8. A family emergency plan should NOT include which of the following?
- A. Information about your children's school(s)
 - B. The name and phone number of an out-of-town contact person
 - C. A list of important phone numbers, including those of doctors and emergency services
 - D. Arrangements for each person in the family to be at a specific land line telephone at a specific time
9. When indoors during an earthquake, the safest place to be is
- A. under a sturdy piece of furniture
 - B. in the doorway
 - C. in a bedroom
 - D. inside the rest room
10. How much drinking water should you include in an emergency preparedness kit?
- A. One litre
 - B. One litre per person
 - C. One litre per person per day
 - D. It depends on your capacity to carry

References:

<http://www.bgs.ac.uk/discoveringGeology/hazards/earthquakes/>

<http://www.ga.gov.au/scientific-topics/hazards/earthquake/basics/what>

<https://earthquake.usgs.gov/learn/kids/eqscience.php>

http://www.shakeout.org/downloads/ShakeOut_ES2_MeasureMyMagnitude.pdf

<https://www.slideshare.net/jhaymz02/disaster-risk-reduction-and-management-and-earthquake-preparedness-davao>

<http://eschooltoday.com/natural-disasters/earthquakes/preparing-for-an-earthquake.html>

Ditan, Carolina, 2007; Elements of Physical Science., National Bookstore
Mandaluyong City



© Can Stock Photo - csp6495800

Answers to the Check What You Have Learned:

1. C	6. B
2. A	7. A
3. D	8. D
4. D	9. A
5. C	10. C

Module Output:

The faculty/teacher will assess and evaluate students' works.



www.shutterstock.com · 506244451



GLOSSARY

<i>Basaltic oceanic crust (n)</i>	about 6 km (4 miles) thick, it is composed of several layers, not including the overlying sediment. The topmost layer, about 500 metres (1,650 feet) thick, includes lavas made of basalt (that is, rock material consisting largely of plagioclase [feldspar] and pyroxene)
<i>Evacuation plan (n)</i>	lays out how to exit a building safely during an emergency
<i>Evolution (n)</i>	changes in the heritable characteristics of biological populations over successive generations
<i>Magnetic field (n)</i>	force field that is created by moving electric charges and magnetic dipoles, and exerts a force on other nearby moving charges and magnetic dipoles
<i>Mitigate (n)</i>	to make less severe, serious, or painful
<i>Mountain range (n)</i>	a line of mountains connected by high ground
<i>Natural satellite (n)</i>	a.k.a moon , in the most common usage:an astronomical body that orbits a planet or minor planet
<i>Ocean basin (n)</i>	anywhere on Earth that is covered by seawater but geologically ocean basins are large geologic basins that are below sea level
<i>Pacific Ring of Fire (n)</i>	a major area in the basin of the Pacific Ocean where a large number of earthquakes and volcanic eruptions occur
<i>PHILVOCS (n)</i>	Philippine Institute of Volcanology and Seismology (Filipino: Surian ng Pilipinas sa Bulkanolohiya at Sismolohiya) a Philippine national institution dedicated to provide information on the activities of volcanoes, earthquakes, and tsunamis, as well as other specialized information and services primarily for the protection of life and property and in support of economic, productivity, and sustainable development

Plate boundaries (n)

refers to the lines in the Earth's outer layer, the crust, and meet at certain point

Potential energy (n)

the energy possessed by a body by virtue of its position relative to others, stresses within itself, electric charge, and other factors

Seismology (n)

the branch of science concerned with earthquakes and related phenomena

Subduction (n)

the sideways and downward movement of the edge of a plate of the earth's crust into the mantle beneath another plate

Tephra (n)

rock fragments and particles ejected by a volcanic eruption

BIBLIOGRAPHY

Bayo-ong, Rolly B., Coronacion, Ma. Lourdes G., Jorda, Annamae T., Restubog, Anna Jamille., & Mocada, Maria Noemi M. Earth and life science for senior high school grade 11. Copyright 2016. ISBN: 978 – 971 – 8608 – 66 – 1. Education resources corporation, Cubao Q.C.

Ditan, Carolina (2007). Elements of Physical Science. Mandaluyong City: National Bookstore

Garrison, Tom. (2009). Essentials of oceanography. Brooks/Cole cengage learning, Belmont, CA USA. ISBN 13: 978 – 0 – 495 – 55531 – 5

Raven, Oeter H., Berg, Linda R., & Hassenzahl, David M.. Seveth edition environment. Copyright 2015. Booklore publishing. John Wiley & Sons Pte Ltd. ISBN: 978 – 981 – 25 – 3333 – 3.

Ross, Frederick., Enger, Eldon E. & Tillery, Bill W. (2013). Integrated science – 6th international edition. McGraw Hill International edition. ISBN: 978 – 1 – 259 – 01008 – 8.

Salandanan, Gloria G., Faltado, Ruben E. III., & Lopez, Merle B. Earth and life sciences for senior high school. Lorimar publishing, inc. Copyright 2016. ISBN: 978 – 621 – 8003 – 501 - 0

Tarback, Edward J., Tasa, Dennis., & Lutgens, Frederick K. Twelfth edition earth science. Copyright 2009 by Pearson Education, Inc. ISBN: 978 – 981 – 0697 – 43 – 3.

Tillery, Bill. Physical science – 9th edition. McGraw Hill International edition

Wilson, Jerry D., Higgins, Charles A. Jr., Shipman, James T. & Torres, Omar. (2013). An introduction to physical science – 14th edition. Rex Book Store Inc. Manila, Philippines. ISBN 978-23-7843-0

ibid , 2007; Elements of Physical Science

ibid, 2007; Elements of Physical Science., National Bookstore Mandaluyong City

http://earthquake.usgs.gov/learn/animations/animation.php?flash_title=Shadow+Zone&flash_file=shadowzone&flash_width=220&flash_height=320

<http://eschooltoday.com/natural-disasters/earthquakes/preparing-for-an-earthquake.html>

<http://eschooltoday.com/natural-disasters/earthquakes/preparing-for-an-earthquake.html>

<http://www.bgs.ac.uk/discoveringGeology/hazards/earthquakes/>

<http://www.ga.gov.au/scientific-topics/hazards/earthquake/basics/what>

<http://www.nationalgeographic.com/environment/natural-disasters/volcano-safety-tips/>

http://www.shakeout.org/downloads/ShakeOut_ES2_MeasureMyMagnitude.pdf

http://www.shakeout.org/downloads/ShakeOut_ES2_MeasureMyMagnitude.pdf

<http://www.zmescience.com/other/science-abc/types-of-volcano/>

<https://earthquake.usgs.gov/learn/kids/eqscience.php>
https://en.wikipedia.org/wiki/Types_of_volcanic_eruptions
<https://pubs.usgs.gov/gip/volc/eruptions.html>
<https://pubs.usgs.gov/gip/volc/types.htm>
<https://www.csun.edu/~jao45194/volcano2.html>
<https://www.factmonster.com/world/world-geography/types-volcanoes>
<https://www.higp.hawaii.edu/~scott/hwn.htm>
<https://www.slideshare.net/jhaymz02/disaster-risk-reduction-and-management-and-earthquake-preparedness-davao>
<https://www.slideshare.net/jhaymz02/disaster-risk-reduction-and-management-and-earthquake-Preparedness-davao>
<https://www.universetoday.com/27333/types-of-volcanoes/>
<https://www.universetoday.com/29125/parts-of-a-volcano/>
<https://www.universetoday.com/29125/parts-of-a-volcano/>
<https://www.volcanodiscovery.com/taal.html>
https://www.youtube.com/watch?v=6Z4as_imJfM
USBE-OER (2017). Earth Science 2017-2018. CK-12. Flexbook.
vivaweb2.bosai.go.jp/v-hazard/pdf/12E.pdf
www.ck12.org
www.explorevolcanoes.com/volcanic%20hazard%20management.html
www.geology.sdsu.edu/how_volcanoes_work/Hawaiian.html
www.nationalgeographic.com/environment/natural-disasters/volcanoes/

THANK
YOU!!!

Appendix C

Expert Assessment Tool for Module

EXPERT ASSESSMENT CHECKLIST

LEARNING MODULE IN PHYSICAL SCIENCE FOCUSED ON EARTH SCIENCE
EDUCATION FOR YEAR II NON-SCIENCE MAJORS AT THE EASTERN SAMAR
STATE UNIVERSITY, MAIN CAMPUS BORONGAN CITY, EASTERN SAMAR

Name: _____

Listed below are criteria for evaluating the different parts of a learning module in earth science. Please rate each item by encircling the corresponding equivalent in the 5-point scale (1-needs improvement; 2-below satisfactory; 3-satisfactory; 4- highly satisfactory; and 5-outstanding).

1. *CONTENT*

Objectives

1.1 are clearly stated	1	2	3	4	5
1.2 are attainable and measurable	1	2	3	4	5
1.3 include cognitive, affective, and psychomotor domain	1	2	3	4	5
1.4 include awareness of and concern for social issues and problems	1	2	3	4	5
1.5 include development of creative and critical thinking	1	2	3	4	5
1.6 contribute to the holistic development of the student	1	2	3	4	5
1.7 address the need to translate theory to practice, knowledge to action	1	2	3	4	5

Subject Matters/Topics

1.8 are accurate and up-to-date	1	2	3	4	5
1.9 are adequate to achieve the objectives	1	2	3	4	5

1.10	are not only confined to the present or the past but is also future oriented	1	2	3	4	5
1.11	are attuned to the Philippine conditions, environment, and society	1	2	3	4	5
1.12	are within the comprehension and interest of the students	1	2	3	4	5
1.13	use concepts, information that are universal and lasting	1	2	3	4	5
1.14.	use concepts of social relevance (present needs, problems and concern of people)	1	2	3	4	5
1.15	provide an integration of relevant knowledge and appropriate action	1	2	3	4	5

Values

1.16	avoid playing up customs that are not appropriate to current time or situation	1	2	3	4	5
1.17	are sensitive to the needs, traditions, and beliefs of different ethnic groups	1	2	3	4	5
1.18	develop respect for life of all kinds on planet earth	1	2	3	4	5
1.19	develop understanding, respect and appreciation of Philippine culture	1	2	3	4	5
1.20	develop national identity and pride	1	2	3	4	5
1.21	stress the need for kindness, compassion, honesty, self-reliance, and thrift	1	2	3	4	5
1.22	provide realistic and credible models with whom the students can identify	1	2	3	4	5
1.23	allow for understanding, appreciation, and practice of peace, justice, harmony, solidarity, and social responsibility	1	2	3	4	5

2. ORGANIZATION

2.1	unit goals/lesson objectives are clear	1	2	3	4	5
2.2	lessons are simple and easy to present to students	1	2	3	4	5
2.3	lessons can be adjusted in terms of time needed	1	2	3	4	5

2.4	flexibility in design; can be modified to be more effective for students' needs	1	2	3	4	5
2.5	activities are sufficient for development and skill enhancement	1	2	3	4	5
2.6	instructional materials are presented in an interesting ways	1	2	3	4	5
2.7	conceptual framework and unifying philosophy are present	1	2	3	4	5
2.8	accepted psychological and pedagogical principles are consistent	1	2	3	4	5
2.9	logical sequence and gradation of concepts are followed	1	2	3	4	5
2.10	study aids such as questions, problems, and explorations are adequately provided	1	2	3	4	5
2.11	strategies are used to develop problem solving skills	1	2	3	4	5
2.12	conventional and modern learning and teaching strategies were used	1	2	3	4	5

3. EFFECTIVITY

3.1	involve students in active learning through appropriate and sufficient activities and experiences	1	2	3	4	5
3.2	utilize practical applications and real life situations whenever possible	1	2	3	4	5
3.3	use strategies that allow for development of social skills such as cooperation, working harmoniously with others	1	2	3	4	5
3.4	use methods to develop higher cognitive skills, problem solving skills, and creativity	1	2	3	4	5
3.5	balance presentation of positive and negative aspects of argument/ issues/ theories	1	2	3	4	5
3.6	highly encourage discovery/ inquiry method of teaching-learning highly encouraged	1	2	3	4	5
3.7	generally allow the student to initiate the activity/exploration	1	2	3	4	5

3.8	encourage wider vision and inclination to social interaction	1	2	3	4	5
3.9	inspire respect for all form of life and peaceful processes	1	2	3	4	5
3.10	encourage learning to be extended outside the classroom	1	2	3	4	5

COMMENTS/SUGGESTIONS:

Evaluator: _____

Position: _____

School: _____

Address: _____

Appendix D

Assessment Questions – Earth Science

ASSESSMENT QUESTIONS IN EARTH SCIENCE

Name: _____

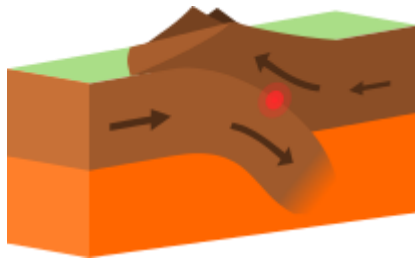
Score: _____

Date: _____

Read each statement carefully. Choose the best answer. Encircle the letter that corresponds to your answer.

1. Which of the following explains the occurrence of plate movements in the earth's crust?
 - A. Eruption of ocean volcanoes.
 - B. Transfer of heat from the core by thermal convection.
 - C. Expansion of the lithosphere as it absorbs heat from the sun.
 - D. Circular motion of the molten materials in the core layer of the earth.
2. What happens when divergent plate boundary befall?
 - A. A volcano is formed.
 - B. A rift valley is formed.
 - C. A plate move past the other.
 - D. Large mass of land arise from the ocean.
3. During the Stone Age, scientists theorized that reversal of the earth's magnetic field transpired. Which of the following is most likely to happen if this reversal takes place again?
 - A. The earth's magnetic field becomes weak.
 - B. The earth's magnetic field becomes stronger.
 - C. The earth's magnetic strength become concentrated to the south.
 - D. The earth's magnetic strength becomes concentrated to the north.

4.



Based on the illustration above, what kind of crust is formed by the plate activity?

- | | |
|-------------------|-----------------------------|
| A. Granitic crust | C. Crust made of magma |
| B. Basaltic crust | D. Crust made of limestones |

5. Which of the following is a manifestation of convergent boundary?

A.



C.



B.



D.



6. Which of the following is used by geologists to reconstruct the fit of the continents?

- A. The shoreline of the present
- B. The present edge of the continental shelf
- C. The shoreline at the time the continents were together
- D. The similarities of living organisms in the different continents

7.



The island found in the picture is a result of _____.

- A. hot spots
- B. divergent plate boundaries
- C. oceanic-oceanic plate boundaries
- D. oceanic-continental plate boundaries

8. About how fast do plates move?

- A. 3 cm per year
- B. 5 cm per year
- C. 10 cm per year
- D. 15 cm per year

9. Which of the following is a biological evidence that supports plate tectonic theory?
- A. Fossils of ferns from India and Australia
 - B. Fossils of brachiopods from India and Australia
 - C. Fossilized remains of a plant found in Northern America
 - D. Fossils remains of the reptile Mesosaurus found in the Philippines and South Africa
10. When does subduction happen?
- A. Hot spots
 - B. Convergent faulting
 - C. Divergent faulting
 - D. Transform faulting
11. Which of the following determines the relative size and shape of volcanoes?
- A. Type of volcano
 - B. Location of the volcano
 - C. Materials ejected during eruption
 - D. Both B & C
12. What type of volcano is shown in the picture below?



- A. Cinder volcano
- B. Composite volcano
- C. Perfect cone volcano
- D. Shield volcano

13.



What part of the volcano is being pointed to by the arrow?

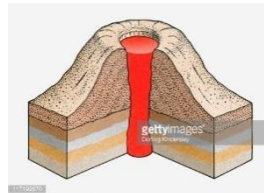
- A. Crater
- B. Magma chamber
- C. Primary vent
- D. Secondary vent

14. When Mt. Pinatubo erupted in 1990, the temperature of the surrounding dropped by about 2 degrees Celsius. What must have caused this phenomenon?

- A. The amount of materials ejected by the eruption
- B. The height of the ash produced by the eruption
- C. The ash materials that unclear the sky from the sun
- D. The distance of the ejected materials from the volcano



15.



The illustration above shows a lava dome. How are these structures formed?

- A. Abrupt eruptions of highly viscous lava
- B. Slow eruptions of highly viscous lava
- C. Rapid eruption of highly sticky lava
- D. Gradual ejection of viscous lava

16. Which of the following make up a felsic, a common volcanic rock?

- A. Aluminium & quartz
- B. Feldspar & quartz
- C. Silicon & feldspar
- D. Sodium & quartz

17. How does one prepare for an eventful volcanic eruption?

- A. Create a sheltering plan
- B. Develop an evacuation plan
- C. Prepare an emergency supply kit
- D. All of these

18. Which of the following is NOT to be included in a volcanic emergency supply kit?
- A. Water
 - B. Perishable food
 - C. Non-perishable food
 - D. Battery-powered radio & flashlight

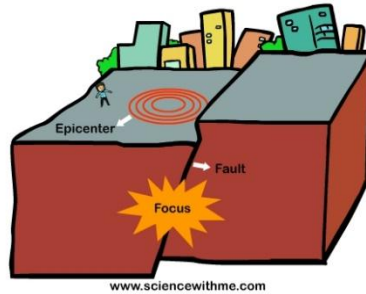
19.



Study the picture above. What could have caused this phenomenon?

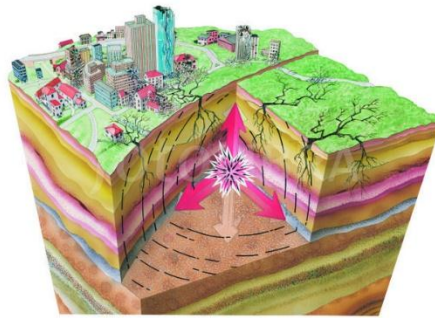
- A. Landslides
 - B. Chemical pollution
 - C. Uncontrolled fire
 - D. Volcanic ash fall
20. If you happen to live in the vicinity of an erupting volcano, what should you do to mitigate disaster?
- A. Wait for the rescue to arrive
 - B. Evacuate to the nearest safe place
 - C. Listen to the advice of the local government
 - D. Stay and secure your house with sturdy materials to prevent its collapse
21. What causes the occurrence of an earthquakes?
- A. Gradual movement of the earth's crust
 - B. Different types of pollutions created by people
 - C. Sudden release of energy in the earth's lithosphere
 - D. Movement of liquid materials from the inner layers of the earth

22.



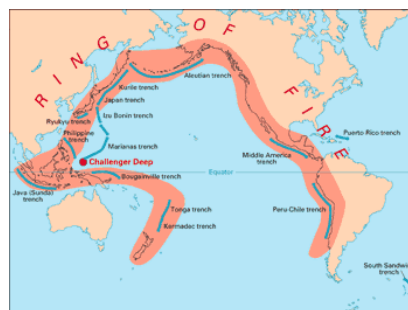
Study the illustration above. What type of fault could have caused the earthquake?

- | | |
|------------------|----------------------|
| A. Normal fault | C. Strike-slip fault |
| B. Reverse fault | D. Transform fault |



23. If an earthquake has occurred in an area, the point where the shaking originates is the

- | | |
|-------------------------|----------------------------|
| A. Earthquake focus | C. Earthquake wave fronts |
| B. Earthquake epicenter | D. Earthquake fault scraps |



24. The Philippines archipelago lies within the ring of fire, which of the following are highly expected to happen?

- | | |
|----------------------------------|-------------------------------|
| A. Stronger typhoons | C. Extreme weather conditions |
| B. Frequent shaking of the earth | D. More volcanoes formations |



25. From the picture above, what could have caused the movement of an overlying block with respect to the other?

- A. Fault scrap
- B. Normal fault
- C. Reverse fault
- D. Thrust fault

26. Seismologists believe the Earth's core is mostly made up of liquid materials because _____.

- A. the Earth vibrates on its axis
- B. it's the most logical generalization
- C. liquefied rocks erupt on the surface
- D. some seismic waves do not pass through the liquids phase

27. If an earthquake happens less than 30 km deep it is related with _____.

- A. Convergent plate boundaries
- B. Divergent plate boundaries
- C. Transform plate boundaries
- D. All of these

28. How many seismograph station readings are needed to locate the epicentre of an earthquake?

- A. 1
- B. 2
- C. 3
- D. 4

29. Which of the following sequences correctly lists the different arrivals from first to last?

- A. P waves – S waves – Surface waves
- B. P waves – Surface waves – S waves
- C. S waves – P waves – Surface waves
- D. Surface waves – P waves – S waves

30. How do rock particles move during the passage of a P wave through the crust?

- A. In rolling circular motion
- B. The particles do not move
- C. Back and forth parallel to the direction of wave travel
- D. Back and forth perpendicular to the direction of wave travel

31. Which of the following can be triggered by an earthquake?

- A. landslide
- B. Intense ground shaking
- C. Tsunami
- D. All of these

32. When indoors during an occurrence of earthquake, the safest place to be is

- A. Near the door
- B. In the bedroom
- C. In the restroom
- D. Under a sturdy table

33. If an earthquake hits while driving, you should

- A. Drive to the nearest hospital
- B. Stop or pull over and stay inside
- C. Stop and run to the nearest shelter
- D. Drive faster to move away from the earthquake

34. How much water should one include in an emergency preparedness kit?

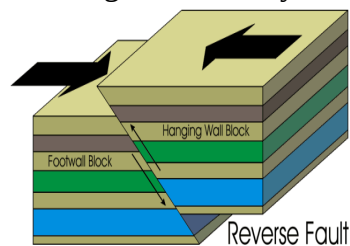
- A. 1 litre per person
- B. 2 litres per person
- C. 3 litres per person
- D. 4 litres per person

35. Which of the following will NOT improve safety factors during an earthquake?

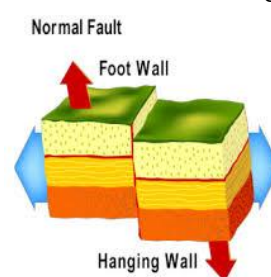
- A. Stand next to a window
- B. Studying earthquake's history in an area
- C. Removing heavy objects from high places
- D. Make sure that electric appliances are switched off

36. Which type of faulting is least likely to happen along the Mid-Atlantic ridge?

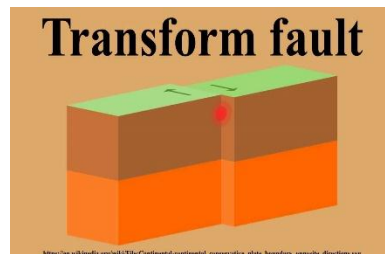
A.



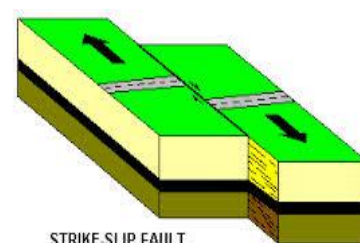
C.



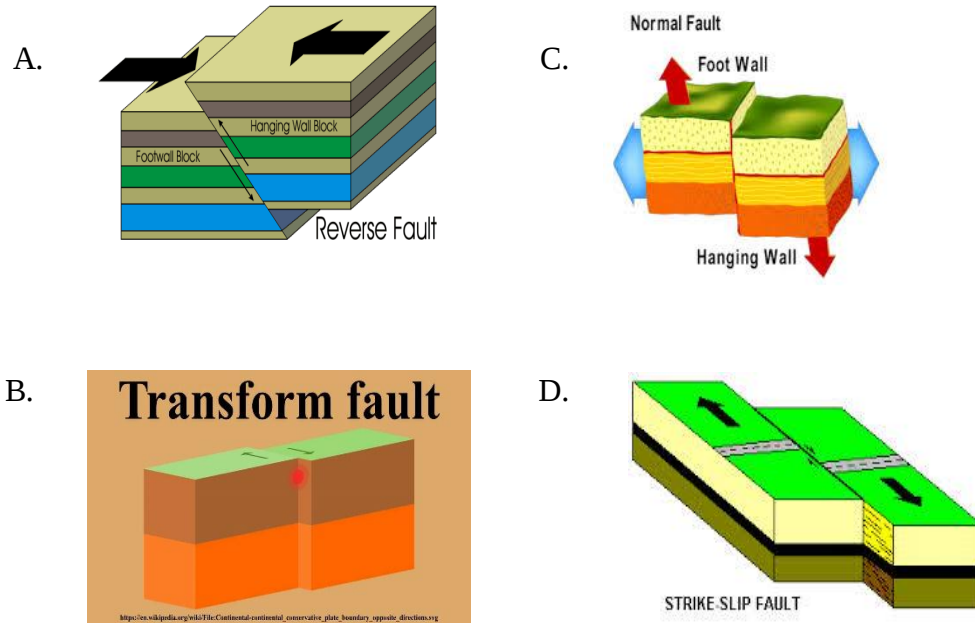
B.



D.



37. What type of faulting would be most likely to occur along transform faults?



38. Which of the following statements can best describe the state of earthquake prediction?

- A. Scientists can accurately predict when an earthquake will occur, but not where
- B. Scientists can accurately predict the time and location of almost all earthquakes
- C. Scientists can accurately predict the time and location of about 50 % of all earthquakes
- D. Scientists can characterize the seismic risk of an area, but cannot yet accurately predict most earthquakes

39. Which of the following measures an earthquake's intensity based on the observed effects on people and structures?

- A. Richter scale
- B. Centigrade scale
- C. Modified Mercalli scale
- D. Moment magnitude scale

40. Earthquake A has a Richter magnitude of 7 as compared with earthquake B's 6. Which amount of ground motion is a measure of earthquake intensity?

- A. A is 10X more intense than B
- B. A is 1000 more intense than B
- C. B is 0.01X as intense than A
- D. Richter magnitude does not measure intensity

41. When a volcano ejects acid lava, eruption is usually _____?

- A. light and less violent
- B. soft and less violent
- C. loud but less violent
- D. loud and more violent

42. Magma which is forced onto Earth's surface is known as _____?
- A. cone
 - B. lava
 - C. vent
 - D. magma chamber
43. Which of the following should be done before an imminent volcanic eruption?
- A. Building sturdy houses
 - B. Storing food & materials
 - C. Constructions of evacuation centers
 - D. Immediate evacuation of individuals
44. Why should lava flow be avoided?
- A. It is a great fire hazard
 - B. It produces extreme heat
 - C. It can destroy everything in their path
 - D. All of these
45. Who of the following is most likely affected by the acidic gas ejected by a volcanic eruption?
- A. Mostly males
 - B. Mostly females
 - C. Mostly infants
 - D. Mostly adults male & females
46. Which among the following should be done after a volcanic eruption?
- A. Go to a designated public shelter
 - B. Seek help from your neighbours
 - C. Listen to the people around and follow where they go
 - D. Immediately secure your house by opening its doors & windows
47. What should one do to prevent attack of respiratory ailment during an eruption of a volcano?
- A. Wear goggles always
 - B. Wear long-sleeves shirts
 - C. Use dust mask or damp cloth
 - D. Stay away from the windows



48. Look at the picture above. How does one classify this volcano?
- A. Quiet volcano
 - B. Fissure volcano
 - C. Explosive volcano
 - D. Intermediate volcano
49. What explains why the Philippines has quite a number of volcanoes?
- A. The Philippines is bounded by oceanic trenches
 - B. The Philippines is made up of many islands
 - C. The Philippines is located within the “ ring of fire “ zone
 - D. The Philippines is located near the deepest part of the ocean

50. How are intra-plate volcanoes formed?
- A. Convergent faulting
 - B. Divergent faulting
 - C. Stationary hot spots
 - D. Transform faulting

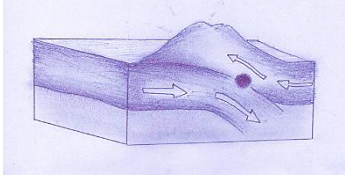
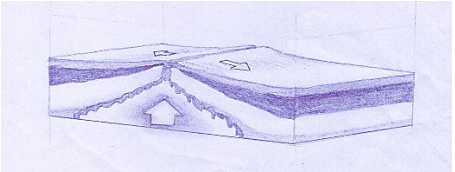
Appendix E

Table of Specification

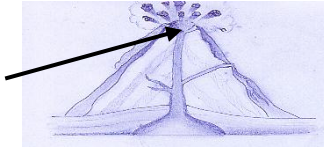
Assessment Questions – Earth Science

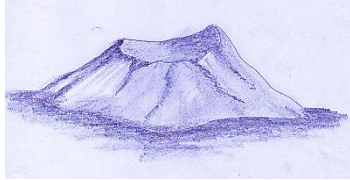
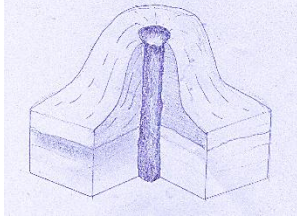
TOS – EARTH SCIENCE

			FORM A	FORM B
Topic	Objectives	Bloom's Cognitive Levels		
A. Plate Tectonic	1. Explain what plate tectonic is	Analysis & Application	#1. Which of the following will allow you to determine the absolute motion of plates? A. hot spots and their tracks B. magnetic reversals in the sea-floor crust C. mapping sediment thickness in the ocean basins D. age of the sediment directly above any portion of the ocean crust	#2. What finally convinced geologists that the continents did move? A. Paleomagnetism B. Mantle convection C. Dinosaur distribution D. <i>Lystrosaurus</i> in Antarctica
	2. Differentiate the different types of plates	Analysis & Evaluation	#3. Which of the following could happen if frequent earthquakes strike along a rift? A. Materials from the crust will be destroyed B. Molten magma materials will solidify and form new crust C. Superheated water will be ejected to the surface and form geysers D. New mountains and ridges will be formed in the earth's crust	#4. A Bell tower in Laoag, Ilocos Norte is said to be sinking, what could best explain the said phenomenon? A. The land where the tower was built is made up of soft materials B. The materials where the tower is made of is disintegrating C. The land topography is very unstable D. More solid materials are being added to the surroundings

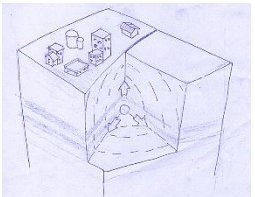
		Synthesis & Application	#5. If you are to agree with the idea of super continent by Wegener, what evidence will you look for to explain the Pangaea theory? A. Existence of land bridges B. Genetic makeup of human beings from different continents C. Presence of land-dwelling reptiles throughout scattered continents D. Ancient animals that were able to adapt in-order to survive	#6. Which of the following is used by geologists to reconstruct the fit of the continents? A. The shoreline of the present B. The present edge of the continental shelf C. The shoreline at the time the continents were together The similarities of living organisms in the different continents
	3. Characterize the different plate boundaries	Analysis & Creating	#7.  Based on the illustration above, what kind of crust is formed by the plate activity? A. Basaltic crust B. Granitic crust C. Crust made of magma D. Crust made of limestones	#8.  What would happen if the two adjacent plates move away from each other like the illustration above? A. Deep ridges will be formed B. A great valley will be created C. Volcanoes will be formed in the surface D. Molten materials will rise and eventually form the land

	4. Describe and explain how plates move	Analysis	#9. During the Stone Age, scientists theorized that reversal of the earth's magnetic field transpire. Which of the following is most likely to happen if this reversal take place again? A. The earth's magnetic field becomes weaker. B. The earth's magnetic field becomes stronger. C. The earth's magnetic strength becomes concentrated to the south. D. The earth's magnetic strength becomes concentrated to the north.	#10. What happens when a piece of continent reaches an ocean-bound subduction zone? A. subduction ceases B. the continent is subducted C. an island chain is quickly formed D. subduction switches to the other plate
		Synthesis & Analysis	#11. If two plates come together, I -powerful earthquakes will shake both areas II - oceanic crust will be created III - continental crust will be formed A. I only B. II only C. I & II D. II & III	#12. Which of the following will most likely be formed when less dense plate slides under the more dense plate? A. Hot spots B. Ridges C. Trenches D. Volcanoes
		Analysis & Creating	#13. Which of the following is responsible why plates of the earth move? A. rising and sinking of magma B. movement of hot magma to the surface	#14. What would happen if the hot molten magma inside the earth ceases to move? A. More volcanoes will be formed.

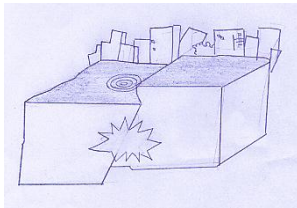
			C. convection current formed by the materials in the mantle D. pressure created by the molten materials in the mantle	B. Plates of the earth will be destroyed. C. New crustal plates will be created. D. Convection current will not be formed.
B. Volcanoes	1. Understand volcanos formation and types	Synthesis & Evaluation	#15. Which of the following determines the relative size and shape of volcanoes? A. Type of eruption B. Location of the volcano C. Materials ejected during eruption D. Both A & C	#16.  What type of volcano is shown by the figure above? A. Cinder B. Composite C. Perfect cone shaped D. Shield
		Application & Analysis	#17.  What part of the volcano is being pointed to by the arrow? A. Crater B. Primary vent C. Secondary vent D. Magma chamber	#18. Which of the following occurs when the magma chamber heats up nearby groundwater? A. More gas will be released by the chamber B. A destructive volcanic eruption will happen C. Carbon dioxide, SO₂, and H₂S will be ejected D. Hot steam will be released by the fumarole

			#19.  (Mt. Taal of Batangas) Look at the illustration above. How does one classify this volcano? A. Quiet volcano B. Intermediate volcano C. Explosive volcano D. Fissure volcano	#20. What explains why the Philippines has quite a number of volcanoes? A. The Philippines is bounded by oceanic trenches B. The Philippines is located within the “ ring of fire “ zone C. The Philippines is made up of many islands D. The Philippines is located near the deepest part of the ocean
	2. Identify key feature of volcanic activity	Synthesis	#21.  The illustration above shows a lava dome. How are these structures formed? A. Gradual ejection of viscous lava B. Slow eruptions of highly viscous lava C. Rapid eruption of highly sticky lava D. Abrupt eruptions of highly viscous lava	#22. During an explosive volcanic eruption pyroclastic materials flow to the nearby surroundings. Which of the following comprise pyroclastic flow? I- Volcanic ash II- Cinders and bombs III- Bombs and heated water IV- Cooled lava A. I & II B. II & III C. I,II, & III D. I,II, & IV

		Evaluation	#23.  Study the illustration above. What could have caused this phenomenon? A. Landslides B. Chemical pollution C. Volcanic ash fall D. Uncontrolled forest fire	#24. When Mt. Pinatubo erupted in 1990, the temperature of the surrounding dropped by about 2 degrees Celsius, what must have caused this phenomenon? A. Amount of materials ejected by the eruption B. The distance of the ejected materials from the volcano C. The height of the ash produced by the eruption D. The ash materials that unclear the sky from the sun
		Analysis & Application	#25. When a volcano ejects acid lava, eruption is usually A. light and less violent C. loud but less violent B. soft and less violent D. loud and more violent	#26. When a volcano erupts, lava flow should be avoided because it, I- is a great fire hazard II- produces extreme heat III- can destroy everything in their path A. I & II only B. II & III only C. I & III only D. I,II, & III
	3. Identify and recognize safety practices before, during, and after a volcanic eruption (DRRM)	Application	#27. How does one prepare for an eventful volcanic eruption? A. Create a sheltering plan B. Develop an evacuation plan C. Prepare an emergency supply kit	#28. Which of the following is NOT to be included in a volcanic emergency supply kit? A. Water B. Perishable food C. Non-perishable food

			D. Ask for assistance from the local government	D. Battery-powered radio & flashlight
		Creating	#29. If you happen to live in the vicinity of an erupting volcano, what should you do to mitigate disaster? A. Wait for the rescue to arrive B. Evacuate to the nearest safe place C. Listen to the advice of the local government D. Stay and secure your house with sturdy materials to prevent its collapse	#30. In Legaspi, Albay where Mt. Mayon is located there are several communities that settle within the danger zone. If you were the leader, what would you do to minimize clear and present danger of the volcano? A. Ask the people to leave the place. B. Together with the community members, build a wall around the community. C. Create a workable emergency plan for the community. D. Create a fund raising program that will provide the community with resources for an eventual event.
C. Earthquake	1. Define what an earthquake is	Analysis	#31. What causes the occurrence of an earthquake? A. Gradual movement of the earth's crust B. Different types of pollution created by people C. Sudden release of energy in the earth's lithosphere	#32. 

			D. Movement of liquid materials from the inner layers of the earth	If an earthquake has occurred in an area, the point where the shaking originates is the _____? A. Earthquake focus B. Earthquake epicenter C. Earthquake fault scrap D. Earthquake wave fronts
		Synthesis & Application	#33. Seismologists believe that the Earth's core is mostly made up of liquid materials because _____? A. the Earth vibrates on its axis B. it's the most logical generalization C. liquefied rocks erupt on the surface D. some seismic waves do not pass through the liquids phase	#34. Friction is created when crustal plates are stucked and earthquakes occur. What explains why this happens? A. Release of pressure B. Large of amount heat dissipated C. The destructive frictional force it produces. D. Convection current produced in the mantle
	2. Classify the different types of earthquake	Analysis & Application	#35. When does an earthquake caused transform plate boundary happen? A. Plates collide with each other B. One plate subducts another plate C. Plates strike slip over the other D. Two plates are being submerged	#36.  From the illustration above, what could have caused the movement of an overlying block with respect to the other?

				A. Fault scrap B. Normal fault C. Reverse fault D. Thrust fault
		Analysis & Synthesis	#37.  Study the illustration above. What type of fault could have caused the earthquake? A. Strike-slip fault B. Reverse fault C. Normal fault D. Transform fault	#38. Some phenomena happens as an effect of another event like earthquake. The following are triggered by an earthquake EXCEPT A. Flooding B. Massive erosion C. Landslide D. Tsunami
	3. Classify earthquake effects with different magnitudes		#39. Which of the following measures an earthquake's intensity based on the observed effects on people and structures? A. Richter scale B. Centigrade scale C. Modified Mercalli scale D. Moment magnitude scale	#40. The magnitude of an earthquake can be measured using an instrument. If an earthquake magnitude reading is between 5.5 to 6.0, what effect will it have on the surface? A. Big tsunami will be created B. All man-made structures will collapse. C. Major damage to buildings and other structures

				D. Slight damage to buildings and other structures
		Analysis & Synthesis	#41. When does a foreshock of an earthquake occur? A. Before a major earthquake B. After one major earthquake C. Before a series of large earthquakes D. After a series of large earthquakes	#42. Can you imagine what life would be after a major earthquake in a largely populated area like Metro Manila? I – more people will be affected II– major transportations will be disrupted III– major businesses will be forced to shut down A. I, II, & III will most likely happen B. I & II will most likely happen C. II & III will most likely happen D. I & III will most likely happen
		Analysis	#43. Which of the following sequences correctly lists the different arrivals from first to last? A. P waves – S waves – Surface waves B. P waves – Surface waves – S waves C. S waves – P waves – Surface waves D. Surface waves – P waves – S waves	#44. How do rock particles move during the passage of a P wave through the crust? A. In rolling circular motion B. The particles do not move C. Back and forth parallel to the direction of wave travel D. Back and forth perpendicular to the direction of wave travel

	4. Identify and demonstrate things to be done before, during, and after an earthquake	Application	#45. When indoors during an occurrence of earthquake, the safest place to be is _____? A. Near the door B. In the bedroom C. In the restroom D. Under a sturdy table	#46. If an earthquake hits while driving, you should _____? A. Drive to the nearest hospital B. Stop or pull over and stay inside C. Stop and run to the nearest shelter D. Drive faster to move away from the earthquake
		Evaluation & Application	#47. How much water should one include in an emergency preparedness kit for an earthquake? A. 1 litre per person B. 2 litres per person C. 3 litres per person D. 4 litres per person	#48. A family emergency plan should NOT include which of the following? A. Information about your children's school(s) B. The name and phone number of an out-of-town contact person C. A list of important phone numbers, including those of doctors and emergency services D. Arrangements for each person in the family to be at a specific land line telephone at a specific time
			#49. Government and private institutions regularly conduct the earthquake drill to improve survival capacity of the people. Is this program effective?	#50. Earthquakes may happen anytime and anywhere. Some structures are built not designed to withstand strong earthquake. If you were an engineer assigned to assess structures in your area, what

		Creating & Evaluation	I. Yes, because it prepares the people on what to do when an earthquake happens II. Yes, because it minimizes the fear of people on an earthquake III. No, because working hours is sacrificed and it decreases the productivity of the people A. I only B. II only C. III only D. I & II	recommendation/s would you consider? I. Ask non-earthquake proof structures to be abandoned. II. Endorse non-earthquake proof structures for immediate repair III. Demolish non-earthquake proof structures. IV. Penalize the owner of the non-earthquake proof structures. A. I & II B. II & III C. III & IV D. I, II, & III
--	--	-----------------------	---	---

Prepared by:

Delbert A. Dala

Appendix F

Checklist for Evaluating Assessment Questions

Checklist for Evaluating Achievement Tests

Adopted from Duad,C.B.(2016). Development of a Strategic Intervention Material (SIM) for Grade 10 Science: Chemical Equations and Reactions. Manuscript submitted for publication

Evaluator _____

Educational Attainment _____

Position _____

Institution _____

Instructions: Listed below are the criteria for evaluating the Achievement Test. Please rate each facet by writing the corresponding equivalent on a four-point scale.

Outstanding 4

Highly Satisfactory 3

Satisfactory 2

Needs Improvement 1

I. Table Specification

_____1. Test specifications describe the nature and limits of the achievement domain to be measured

_____2. The intended learning outcomes stated in performance (measurable) terms

_____3. Test specifications indicate the nature and distribution of items to be included in the test

II. Test Format and Directions

_____1. Item arrangement contributes to ease of reading and responding.

_____2. Items of the same type are placed together in the test.

_____3. Items are arranged in order of increasing difficulty within each section of the test.

- _____4. The method of answering and the location of the answer space contribute to efficient test taking.
- _____5. Items are numbered in consecutive order throughout the test.
- _____6. There is a balanced proportion of correct answers.
- _____7. The sequence of answers is free from patterns.
- _____8. Directions provided for the test, as a whole and for separate sections, are clear and concise.
- _____9. Final copy of the test is satisfactory in terms of spacing, legibility, and freedom from errors.

III. Test Items

A. General

- _____1. Each test items is relevant to an important learning outcome.
- _____2. Each item type is appropriate for the particular learning outcome to be mastered.
- _____3. Each item presents a clearly formulated task.
- _____4. Each item is stated in simple, clear language, and free of non-functional material.
- _____5. Each item is free of extraneous clues.
- _____6. The difficulty of each item is appropriate for the task and for the use to be made of the results.
- _____7. The answer to each item is one that would be agreed upon by experts.
- _____8. There is an adequate number of items for each interpretation to be made.
- _____9. The items are sufficiently independent that one item does not aid in answering.
- _____10. The items are free from ethnic, racial, ideological, religious, and sexual bias.

B. Multiple Choice

- _____1. The stem of each item presents a single clearly formulated problem.
- _____2. The stem of each item is stated in simple, readable language.
- _____3. The stem of each item is worded so that there is no repetition of material in the alternatives.
- _____4. The stem of each item is stated in positive form, whether possible.
- _____5. If negative wording is used in the stem, it is emphasized by capitalization, italic, or underlining.
- _____6. The intended answer is correct or clearly best.
- _____7. All alternatives are grammatically consistent with the stem and parallel in form.
- _____8. The alternatives are free from verbal clues to the correct answer.
- _____9. The distracter are plausible and attractive to the uninformed.
- _____10. The relative length of the correct answer varies to eliminate length as a clue.
- _____11. The alternative “all of the above“ has been avoided and “none of the above” used sparingly.
- _____12. The position of the correct answers varies so that there is no detectable pattern.

Appendix G

Consent Form

Title of the Study : **Strategic Intervention Materials (SIMs) on Earth Science: Its Effects on the Academic Performance, Problem Solving and Critical Thinking Skills of Year 2 BSBA Students of the Eastern Samar State University**

Informed Consent Form

Name of Researcher: DELBERT A. DALA

Contact Number: 0912-7784845

Department of Natural Sciences, College of Arts & Sciences Eastern Samar State University

PURPOSE OF THE STUDY

You are being invited to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what your participation will involve. Please read the following information carefully and feel free to ask the researcher if there is anything that is not clear or if you need more information.

The purpose of the study is to determine the level of academic performance, critical thinking and problem-solving skills of the non-science major students taking up Earth Science after they are exposed to a material (SIM) that will make their study easier and enjoyable. This class is considered in the study because the researcher happens to be the teacher who will handle the subject.

STUDY PROCEDURES

The study will be simultaneously conducted as the teacher delivers the lessons in Earth Science as provided in the course syllabus for the course. The participants will be asked to participate in the different activities similar to the activities conducted in a normal classroom environment. There will be pre-test and post-test. After the administration of the pre-test, an intervention material will be used that will be provided by the teacher. Questions in the tests will be objective type and all will follow the format of multiple choice. The questions will be focused on the topics discussed in Earth Science only.

DURATION

Based on the course guide provided by the teacher, the study will be conducted only in the allotted time. Extension will be carried out only upon the request and needs of the participants and will be considered only after the researcher finds the importance of the said extension.

RISKS

The participation of the students will be free from any risk in any form. All activities to be performed will ensure the physical and emotional safety of the participants.

BENEFITS

There will be no direct benefit the participants will be acquiring. However, the participants are expected to gain insights from the different activities to be conducted. Results of the research will be used only for the purpose of improving the delivery of the lessons in Earth Science, and for planning future activities that will ensure greater learning

for the students. No financial benefits or similar remuneration will be considered in the duration of the study.

CONFIDENTIALITY

Your responses in this research will be anonymous. Every effort will be made by the researcher to preserve your confidentiality, including the following:

1. *Numbers will be assigned for participants that will be used on all research notes and documents.*
2. *Keeping notes, test results, and any other personal identifiers in a locked cabinet that only the researchers will have access to or will be disposed using the shredder.*

CONTACT INFORMATION

If you have any questions at any time about this study, or if you experience any non-normative sensations as a result of participation, you may contact the researcher whose contact information is on the first page.

CONSENT

I have read the provided information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have answered to my satisfaction. I understand that I will be given a copy of this form, and the researcher will keep another copy on file. I voluntarily consent to be a participant in this study.

Print Name of Participant_____

Signature of Participant _____

Date _____
Day/month/year

Print Name of Researcher_____

Signature of Researcher _____

Date _____
Day/month/year

Appendix H

Answer Sheet

ASSESSMENT IN EARTH SCIENCE

Answer Sheet

Examinee #: _____

Score: _____

Date: _____

1.	11.	21.	31.	41.
2.	12.	22.	32.	42.
3.	13.	23.	33.	43.
4.	14.	24.	34.	44.
5.	15.	25.	35.	45.
6.	16.	26.	36.	46.
7.	17.	27.	37.	47.
8.	18.	28.	38.	48.
9.	19.	29.	39.	49.
10.	20.	30.	40.	50.

Appendix I

Authenticity Result



AUTHENTICITY RESULT

Date of Release: May 02, 2018
Result Code: 2018-0420
Submission ID: 957463710
Title of Output: Strategic Intervention Material (Sim) on Earth Science: It's Effects on the Academic Performance, Critical Thinking Skills, and Problem Solving Skills of Year II Bseba Students of the Eastern Samar State University

Author (s): Delbert A. Dala

Authenticity Report:

Similarity Report: 20%

- Interpretation: A similarity of 20% means that 20% of the entire paper is similar to sources in Turnitin's (authenticity software) online repository. The colored bibliographical references denote the sources of similarity to previously published work which maybe from internet sources (17%) publications (8%), and student papers 12%) for the remaining similarity percentage.
- Highlighted text in the Manuscript:
 - Red marks and highlights are set of texts directly or exactly copied from online sources.
 - Other color marks and highlights are set of text exactly copied from other sources (student papers and publications).

Marie Paz E. Morales, Ph.D.
Director

Appendix J

Language Editor Certification

This certifies that the undersigned has served as the language editor of
MR. DELBERT A. DALA, an *M.A. Science Teaching* student of the Philippine Normal University,
who worked on the paper, "The Development of SIMS (Strategic Intervention Materials) on
Earth Science for Students of Eastern Samar State University".


PROF. MARIA FATIMA D. NOLASCO
Faculty of Arts and Languages