Integrating Problem – Based Learning Worksheets as Supplemental Materials with Modular instruction: Its Effect on Learner's Critical Thinking Skills on Earthquakes in Grade 8 Earth and Space

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ABSTRACT

The poor performance of Philippines' students as one of the participating countries in the TIMMS 2019 as supported by PISA 2018 coupled with the challenges of learning at home amidst the pandemic: this action research aimed to assist learners through the provision of problem – based learning worksheets as supplemental materials together with the prescribed modular approach. Specifically, it aims to determine the effect of integrating problem – based learning worksheets as supplemental materials with modular instruction on the performance of Grade 8 students on learning competencies focusing on earthquakes in Earth and Space. The participants of the study were 50 Grade 8 students of Lambunao National High School for the S.Y. 2020-2021. Researcher–made problem – based learning worksheets as supplemental materials together with the DepEd - prescribed modules were provided to the experimental groups while the control group solely received DepEd provided modules. Mean, Paired Samples t-test, and Independent Samples t-test were used as statistical tools in this study. Findings showed that the modular approach significantly improved the performance of both groups by comparing their pretest and posttest results. Significant differences were observed when comparing the posttest results of both the control and experimental group with the experimental group (incorporated problem – based learning worksheets with DepEd - prescribed modules) obtaining the higher mean scores. These findings led to the conclusion that the use of problem – based learning worksheets improved the academic performance of students in Grade 8 – Earth and Space on earthquake learning competencies. Recommendations include the incorporation of problem – based learning worksheets as supplemental materials together with DepEd prescribed modules as tools in learning Science.

Keywords: modular learning, supplementary learning materials

INTRODUCTION

To further improve the quality of education and increase the global competitiveness of its graduates, the Philippines introduced the K- 12 Program mandated from the Republic Act (RA) No. 10533 known as the Enhanced Basic Education Act of 2013. This covers Kindergarten and 12 years of basic education with six years of primary, four years of junior high school and two years of senior high school education with six salient features aimed to develop students and prepare them for tertiary education and employment in the future (Philippine Congress, 2013).

The Philippines had unsatisfactory performances on both the TIMSS (Trends in International Mathematics and Science Study) 2019 examination and PISA (Program for International Student Assessment) 2018. The TIMSS 2019 results revealed that the Philippines ranked the lowest both in Science and Math among 58 participating countries for the Grade 4 learners (Bernardo, 2020). This is further proven by the recent PISA 2018 results wherein Philippines was also ranked last among 78 participating countries in Science and Math. Possible causes of these subpar performances include budget allocation per student, illiteracy or poor language skills, socio-economic constraints, bullying, and fear of failure (Organization for Economic Co-

operation and Development, 2019). At present times in the public-school setting, these are further compounded with the adjustments required and the level of preparedness of learners, teachers, and parents on education in the new normal, which is a hybrid approach to education that combines traditional classroom education with distance learning.

Among these concerns, the researcher has chosen to address the adjustments that the learners and teachers have to make in the current education setting which involves incorporating distance learning as the new way to continue education. In Lambunao National High School, all the learners opted for modular learning as their most preferred learning delivery due to the lack of electronic devices and internet connection needed for other modes of learning like online education. The modules were written and had undergone quality assurance from the Department of Education Division personnel and were printed and distributed by the school on scheduled dates.

The content of these Deped – prescribed modules, though focused on the learners' higher order thinking skills and are conceptualized, still require the learner to do additional research to answer the different areas of their activity sheets. Coupled with the huge number of printed modules from at least eight core subjects received in a weekly basis from the school, these gave the students a limited time in accomplishing the various activity sheets and pushed them to do additional research (with online sources as the most viable option) which posed a challenge of its own due to the unavailability of stable internet connection and electronic devices when needed. Another problem with this is that students had limited ideas on discerning the most reliable sources of answers from online sources and trained them to be overly reliant on the internet without even understanding the questions or actually performing the assigned activities on their modules, turning them into passive learners. With this in mind, the researcher proposed the integration of problem – based learning worksheets as supplemental materials to address this.

Innovation, Intervention, and Strategy

The researcher proposed the addition of printed problem – based learning worksheets together with the DepEd – provided learning modules to deal with the challenges of learning amidst the new normal, focusing on the selected Most Essential Learning Competencies (MELCs) on earthquake in Grade 8 Earth and Space. These problem – based learning worksheets as supplemental materials were used to extend and complement the existing learning resources made available to the students. Its purpose is not to be the main source of instruction but serve to support the existing learning materials as enrichment resources (Bien, 2020).

In the 2nd grading period, the K-12 Grade 8 Science curriculum focuses on the field of Earth & Space with earthquake as one of its topics. Learning solely from their printed DepEd – prescribed modules promoted an inadequate learning experience especially since the modules should be accomplished on the assigned date for submission and checking and the perilous nature of the COVID – 19 transmission which highlighted the importance of staying at home and avoiding crowds, limiting the options of the students to access other educational resources outside of their homes (or even access a steady stream of online sources). This fact additionally emphasized the importance of having additional sources of learning available at home which were provided by the problem – based learning worksheets as supplemental materials integrated in this research.

Action Research Questions

This study aimed to determine the effect of integrating problem – based learning worksheets as supplemental materials with DepEd – prescribed modular instruction on the critical thinking skills of students on earthquakes in Grade 8 Earth and Space.

Specifically, the study sought answers to the following questions:

1. What is the level of performance improvement, as measured by the difference between the pre-test mean score and post-test mean score of grade eight students in the control group (DepEd – prescribed module only)?
2. What is the level of performance improvement, as measured by the difference between the pre-test mean score and posttest mean score of grade eight students in the experimental group (Dep-Ed prescribed module with problem – based learning worksheets as supplementary materials)?
3. There is no significant difference in the pretest and post-test mean scores of grade eight students in both control and experimental groups.
4. There is no significant difference in the posttest mean scores of grade eight students in the control and experimental groups.
5. What is the plan of action after determining the effect of integrating problem – based learning worksheets as supplemental materials with DepEd – prescribed modular instruction on the critical thinking skills of learners on earthquakes in Grade 8 Earth and Space?

EMPIRICAL REVIEW

The International Landscape of Science Education

In 2020, science education internationally faced significant challenges and transformations due to the COVID-19 pandemic, which led to widespread school closures and a rapid shift to online learning. Key trends and issues that characterized science education include disruption of traditional learning and the shift to online and remote learning, inequities in access to education, and the focus on mental health and well-being.

The pandemic caused the largest disruption of education systems in history, affecting nearly 1.6 billion students across more than 190 countries. School closures impacted 94% of the world's student population, with up to 99% affected in low and lower-middle-income countries. This disruption hindered students' access to quality science education, particularly in regions with limited resources and infrastructure (Idin, 2020). To address this, schools have transitioned to online learning and educational technology became crucial. Platforms for eLearning gained prominence, enabling teachers to deliver science lessons remotely. This shift highlighted the importance of digital literacy and access to technology, as many students faced challenges due to a lack of devices or reliable internet connections. The need for effective online science education resources became apparent, emphasizing interactive and engaging content to maintain student interest (Bui, 2021).

The crisis brought by the pandemic also exacerbated existing inequalities in education. Students from disadvantaged backgrounds faced greater challenges in accessing online learning resources, leading to increased educational disparities. The United Nations highlighted that many students, particularly in poorer regions, were unable to access the education they needed during the pandemic, raising concerns about long-term impacts on learning outcomes (Idin, 2020). Students' mental health became a significant concern as educators recognized the importance of supporting students' emotional well-being alongside their academic learning. Science education began to incorporate discussions on mental health, resilience, and coping strategies as part of the curriculum (Idin, 2020).

Science Education in the Philippines during the Pandemic

Just like in the international setting, Science education in the Philippines faced significant challenges during the COVID-19 pandemic, but also presented opportunities for innovation and growth. Traditional learning was halted as the pandemic caused widespread school closures, affecting nearly 1.6 billion students across the Philippines. Schools transitioned to flexible learning delivery, moving away from the default face-to-face model (Arrieta, 2020). Online learning platforms became a means for teaching though many students faced challenges due to lack of devices or reliable internet connections, highlighting the digital divide (Bonito,

2022). The most significant challenge for students was their home learning environment. Many lacked a conducive space for studying, which affected their concentration and overall learning experience. This was compounded by the absence of face-to-face interactions with teachers and peers, leading to feelings of isolation and disengagement from the learning process (Barrot et al., 2021). While technological literacy was not a major concern, access to necessary devices and stable internet connectivity was critical. Many students did not have adequate gadgets, such as laptops or tablets, which hindered their ability to participate in online classes. Reports indicated that only 64% of students had access to smartphones, and 55% had access to laptops or desktop computers. Local government initiatives, like providing tablets, were implemented, but these were not universally available, and connectivity issues persisted, especially in rural areas (Ignacio, 2021). The pandemic also exacerbated mental health issues among students. The stress of adapting to online learning, coupled with the isolation from traditional classroom settings, contributed to anxiety and other mental health challenges. The disruption in education led to what has been termed "learning poverty," with a significant increase in the percentage of children unable to read by age ten, rising from 69.5% pre-pandemic to 91% in 2021 (Lu, 2023).

Modular Distance Learning as an Alternative Learning Delivery Modality

During the COVID-19 pandemic, the Philippines implemented modular distance learning as a primary mode of education to provide flexibility and to ensure continuity despite school closures, as mandated in DepEd order 12, series of 2020. This included both printed and digital modules, allowing students to learn independently at home. The approach was particularly beneficial for students in rural areas with limited internet access. The modular system encompassed various modalities, including printed modules, digital modules, online learning, and radio-based instruction. This diversity aimed to cater to different learning environments and resources available to students, though printed modules became a main modality amongst the other forms (Tria et al., 2022). However, the reliance on printed modules and self-directed learning often led to superficial understanding rather than fostering critical thinking. Without direct interaction with teachers or peers, students missed opportunities for discussion and exploration of complex concepts, which are essential for developing critical thinking skills (Tria et al., 2022). Some modules also lacked depth and did not encourage higher-order thinking skills. Poorly designed assessments and activities often focused on rote memorization rather than analytical or evaluative skills, which are crucial for critical thinking development (Talimodao and Madrigal, 2021).

Additionally, it has also brought its own share of challenges to the learners. Many students faced difficulties accessing learning materials. While some benefited from printed modules, others struggled due to a lack of resources, such as textbooks and technology. Roque (2022) stated that for students relying on digital modules, online learning, or printed modules into which some still required additional research, poor internet connectivity was a significant barrier. Many students reported unstable connections, making it difficult to engage with lessons or submit assignments effectively.

While the Department of Education aimed to provide quality modular learning materials, many teachers reported challenges in creating effective content. Issues included unclear instructions, poorly designed assessments, and a lack of alignment with learning objectives (Roque, 2022). These shortcomings hindered students' ability to grasp key concepts and complete their assignments effectively. Reports also indicated low submission rates for assignments and modules, with some studies showing that many students struggled to comply with learning tasks. Factors contributing to this included overloaded remote learning tasks, difficulty understanding module content, and poor learning environments at home. This lack of engagement highlighted the need for better instructional supervision and support systems (Bustillo & Aguilos, 2022). Talimodao and Madrigal (2021) also discussed that the need for parental support also increased, as many younger students required assistance in navigating their modules. However, parents often lacked the knowledge or time to help their children, leading to inconsistent learning outcomes. These concerns impacted students' motivation and mental health. Many students reported feelings of isolation, struggled with time management, and the inability to access reliable responses in their worksheets, leading to increased

stress and anxiety and also diminishing students' cognitive engagement, making it difficult for them to apply critical thinking skills effectively (Sacramento R. & Sacramento N., 2023).These experiences on modular approach pushed for better ways of integrating supplemental learning materials that are accessible to the learners and are geared to develop their critical thinking skills and conceptual understanding of the subject matter.

Integration of Problem – based Learning Worksheets as Supplemental Materials

Problem-Based Learning (PBL) is an instructional method that emphasizes student-centered learning through the exploration of complex, real-world problems. This method encourages self-directed learning and critical thinking rather than passive absorption of information through lectures(University of Florida, n.d.). PBL encourages students to analyze, evaluate, and create solutions to complex problems, thereby developing their critical thinking abilities. This is essential for success in both academic and real-world scenarios. It also empowers students to take charge of their learning by identifying knowledge gaps and seeking out resources to fill those gaps. This autonomy helps develop lifelong learning skills (Cornell University, n.d.). Engaging with material through problem-solving helps students retain information longer than traditional rote memorization methods. The active involvement in learning is expected to lead to a deeper understanding of concepts. Results from the study conducted by Ostby (2022) indicated that students improved their critical thinking abilities and peer interactions when engaged in PBL activities, highlighting the effectiveness of this approach in fostering essential skills for academic success. Another research effort highlighted the application of PBL in elementary education, addressing the educational equity gap in PBL research, emphasizing that it can effectively engage young learners and develop critical skills by presenting them with real-world problems to solve collaboratively (Reed et al., 2021). Nettleton's study (2019) which focused on high school students found that PBL significantly increased student engagement and motivation. Students reported higher satisfaction levels and a greater sense of ownership over their learning process when participating in PBL activities, which encouraged them to take initiative and responsibility for their educational outcome.

These studies, coupled with the existing gaps on the modules prescribed for the learners, became the motivation in the construction of problem – based worksheets which aim to address the demands on the learners' continuous education and development of critical thinking skills and conceptual understanding in the safety of their homes.

ACTION RESEARCH METHODS

This action research utilized the quasi-experimental design, specifically a Pretest Posttest Control Group Design to determine the effect of integrating problem – based learning worksheets as supplemental materials with modular instruction on the performance of Grade 8 learners on earthquakes in Earth and Space.Quasi-experimental research designs, as the name suggests, uses nonexperimental(or non-researcher-induced) variation in the main independent variable of interest, essentially mimicking experimental conditions in which some subjects are exposed totreatment and others are not on a random basis (Gopalan et al., 2020, p. 220).

Participants and sources of data and information

The participants of the study were the 50 Grade 8 students of Lambunao National High School. These learners were officially enrolled during the school year 2020-2021 and have Science 8 as one of their subjects. The participants were divided into two groups, the control (utilized the DepEd – provided modules only) and the experimental group (used the DepEd – provided modules with the researcher – made supplementary materials). The participants were matched-paired (matching–only design) based on their pre-test results by ranking them using Microsoft Excel. After the match–pairing (rank 1 with 2, 3 with 4, etc.), the selection of the participants who were assigned to the control and experimental groups was done using a coin toss (e.g. heads – control group, tails – experimental group) with 25 participants per group.

Data Gathering Methods

This study gathered the pretest and posttest scores of Grade 8 students using 35 multiple – choice researcher – made test instruments.

Two equivalent sets of 35-item multiple-choice researcher-made tests were prepared by the researcher. This included the following contents in the second quarter: a) Using models or illustrations, explain how movements along faults generate earthquakes, b). Differentiate the epicenter of an earthquake from its focus; the intensity of an earthquake from its magnitude; active and inactive faults, and c) Explain how earthquake waves provide information about the interior of the earth.

This test was validated by three Science teachers of Lambunao National High School. The test was pilot-tested to Grade 8 students who did not participate in the study. Kuder-Richardson Formula (KR-20) was used to test the reliability into which the test instrument generated a reliability value of 0.817.

This study was conducted during the second quarter of the school year 2020-2021. The pretest was conducted before the conduct of the study. The posttest was administered after the intervention.

Data Analysis Plan

The following statistical tools were used to analyze the data collected:

Mean: It was used to determine the level of performance of Grade 8 learners in Earth & Space before and after the intervention.

The level of performance in Earth and Space was determined using the following scale which was validated by three Science teachers at the researcher's school:

Scale	Description
28.00 - 35.00	Outstanding
21.00 - 27.99	Very Satisfactory
14.00 - 20.99	Satisfactory
7.00 - 13.99	Fairly Satisfactory
0.00 - 6.99	Did not meet expectation

Paired Samples t – test: This was used to determine the significant difference between the pretest and posttest scores of learners in Grade 8 Earth and Space in both the control and experimental groups.

Independent Samples t – test: This was used to determine the significant difference in the posttest scores of learners in Grade 9 Earth and Space between the control and experimental groups.

The alpha was set at .05.

All statistical computation was availed of via Jamovi version 2.5.3 software.

Ethical Issues

Before the pre – test data collection, permission from the school head of Lambunao National High School for the approval of the conduct of the study was solicited. Likewise, consent from the adviser and the subject teacher was also secured. Parents' consent was secured from the participants by giving each of them directly of a uniform copy of informed consent during module retrieval as part of the alternative learning delivery modality due to the pandemic. All data that were collected before and after the intervention were treated with

the utmost confidentiality through the data privacy act of 2012 included in the pre-test and post-test questionnaier. The respondents of the study were oriented and informed before the conduct of the study through a group chat. Incentives for participation such as a souvenir or snack were also given to the participants through their parents during module retrieval at school. Proper protocols on the precautionary measures on Covid -19 were practiced throughout the conduct of the study.

RESULTS AND DISCUSSION

Level of Performance based on the Pretest and Post Test Mean Scores of Grade 8 Learners in Earth and Space

Table 1 showed the pretest score ($\bar{X}$= 12.20, s = 4.18) of the Control Group (DepEd – provided modules only) with a "fairly satisfactory" level of performance while their posttest score ($\bar{X}$ = 15.60, s = 4.28) had a "satisfactory "level of performance. The low pretest scores of the Control coincide with the findings of Sadiq and Zamir (2014) as cited by Valencia (2020) wherein students may not have been equipped with the knowledge and skills in answering the questions given to them.

Table 1: Pretest and Posttest Mean Scores of Grade 8 Learners in Earth and Space belonging to the Control Group

Test	Mean ($\bar{X}$)	Standard Deviation ($s_{\bar{X}}$)
Pretest	12.2	4.18
Posttest	15.6	4.28

Note. $\bar{X}$= sample mean; s = sample standard deviation

Table 2 showed the pretest score ($\bar{X}$= 12.40, s = 4.12) of the Experimental

Group (DepEd – provided modules with a researcher – modified supplementary learning materials) also had a "fairly satisfactory" level of performance while their posttest score ($\bar{X}$= 21.1, s = 6.37) had a "very satisfactory "level of performance. These results indicate that the posttest scores of the participants belonging to both groups improved after introducing the printed modules. The results in Table 2 showed that there was an improvement of the students' performance in the posttest. This finding of the study is supported by Guido (2014) who found that the use of self-instructional materials is particularly beneficial to students.

Table 2: Pretest and Posttest Mean Scores of Grade 8 Learners in Earth and Space belonging to the Experimental Group

Test	Mean ($\bar{X}$)	Standard Error ($s_{\bar{X}}$)	Standard Deviation (s)
Pretest	12.4	4.12	-
Posttest	21.1	6.37	-

Note. $\bar{X}$= sample mean; s = sample standard deviation

Significant Difference in the Pretest and Post Test Scores of Grade 8 Learners in Earth and Space

Results show that significant differences occur between Pre – Test and Post Scores of those who utilized DepEd – prescribed modules (Z = -7.87, p =<.001) and those who used these modules with supplementary learning materials (Z = -12.8, p = <.001) as shown in Tables 3 and 4 respectively. These data agree with Valencia (2020) as he explained in his study how modular teaching significantly improves the performance of students in learning science concepts based on the measured competencies. Cua (2020) also cites

additional advantages for the modular approach such as the efficiency of using one's time as students can set their schedules in accomplishing their tasks and has flexibility on the location wherein students can do their tasks almost anywhere. They can be comfortable with their setting and can pause and resume their work with the utmost freedom. A modular approach may not be convenient for all learners, but its strengths are undeniable when used as a learning delivery system.

Table 3: Significant Difference in the Pretest and Posttest Scores of Grade 8 Learners in Earth and Space belonging to the Control Group

Statistic	Z-value	p-value
Test	-7.78	<.001

Note. p – value shows the level of significance (significant at p = < 0.05)

Table 4: Significant Difference in the Pre – test and Post – test Scores of Grade 8 Learners in Earth and Space belonging to the Experimental Group

Statistic	Z-value	p-value
Test	-12.8	<.001

Note. p – value shows the level of significance (significant at p = < 0.05)

Table 5 presents a significant difference between the post – test scores of the control group and experimental groups (Z = -3.76, p = <.001), pointing out a significant improvement in the test scores of those who studied the DepEd – prescribed modules with supplementary learning materials than that of the participants who solely relied with the DepEd – issued modules. This is supported by Marces (2020) as the developed learning materials can improve the performance of the students in learning Science. In their study on Modular distance learning implementation in the Philippine Secondary Public Schools, Dangle and Sumaoang (2020) presented their results wherein 90 % of 30 participants had a hard time answering their modules while 50% of them do not have enough time to finish their modules within a week, citing internet connection as one of the main problems. The concerns on internet connection is further supported by Salac and Kim (2016) in their study on internet speed among developed countries in Asia wherein Philippines is ranked 104th among 160 countries with a meager average internet speed of 2.8 Mbps. Coupled with problems of distributing learning modules to students and some modules requiring checking out online links, the provision of supplementary learning materials can aid in improving student's performance and understanding of the targeted Science competencies.

Table 5: Significant Difference in the Post – test Scores of Grade 8 Learners in Earth and Space between the Control Group and Experimental Group

Statistic	Z-value	p-value
Test	-3.57	<.001
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Note. p – value shows the level of significance (significant at p = < 0.05)

SUMMARY

This research aimed to determine the effect of integrating problem – based worksheets supplemental materials with modular instruction on the performance of Grade 8 learners in Earth and Space of Lambunao National High School. This study employed a quasi- experimental research design, specifically a Pre – test

Post – test Control Group design with researcher – made problem – based worksheets supplementary learning materials as intervention and researcher – made instrument to assess the academic performance of Grade 8 Earth and Space learners.

The following were the salient findings of the study:

1. The post – test scores of Grade 8 learners on Earthquakes in Earth and Space were higher than their pre – test scores for both the control (modular approach only) and the experimental group (modular approach with problem – based worksheets).
2. There is a significant difference between the pre – test and post – test scores of both the control group and experimental group of Grade 8 learners in Earth and Space.
3. There is a significant difference between the post – test scores of the control group and experimental group of Grade 8 learners in Earth and Space.

CONCLUSION

This action research focused on determining the effect of integrating problem – based worksheets as supplemental materials with modular instruction on the performance of Grade 8 learners on Earthquakes in Earth and Space. The results have shown that the use of modular approach increased the post test scores of the learners. Furthermore, learners using the modular approach with problem – based worksheets as supplementary learning materials also had significantly higher post test scores than learners who used the modular approach only, showing how these materials can be used to improve the performance of learners on earthquakes in Grade 8 Earth and Space. Modular approach offers a lot of benefits as a mode of learning delivery: flexibility in terms of the setting, accessibility to learners, and promotion of self or independent learning. Still, the disadvantages due to the lack of face – to- face interaction with teachers and problems with unstable and/ or unavailable internet connection pose threats on the efficiency of the modular approach. Introduction of supplemental learning materials can alleviate this concern due to the inclusion of simplified and enriched discussion coupled with guide questions to ascertain the learners' understanding. Transitioning to self – learning modules embedded with supplemental materials can be the key in improving the modular approach as one of the learning delivery systems.

RECOMMENDATIONS

Use modular approach with problem - based worksheets as supplementary learning materials which can help improve their academic performance and understanding of Science concepts.

Suggestions for further studies

1. Conduct further studies on using supplementary learning materials in teaching the other subject areas.

2. Conduct further studies on various approaches, formats and selection of content to improve the supplementary learning materials

Research Limitation

The limitations of the study included the prior knowledge of the students, lack of assurances that they were the ones who answered the worksheets, stability of internet connection, potential for outside interference. Thought the pre-test was used to gauge the learners' prior understanding, the assurance that they were the ones who took the exam can be put into question. This concern was shared with the validity of students' responses in the worksheets since the researcher was not able to check if the learners performed them individually or with outside help, leading to the difficulty in gauging students' understanding. Stability of internet connection couple with possibility of securing a mobile device made communication with the learners an additional challenge. Outside interference like household chores, distractions from siblings and

family members as well as leisurely use of gadgets could have also affected the reliability of the obtained responses

Plans for Dissemination and Utilization

The result of the study was presented during the School Learning Action Cell (SLAC) last July - August 2021 and In-Service Training for teachers on the incoming school year. The findings were presented to other science teachers and interested teachers in other subject areas so that they can also incorporate this strategy in improving their student's performance and motivation to learn as well as find ways to modify and improve this technique.

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APPENDIX

APPENDIX A

Letter of Approval

Department of Education

Region VI - Western Visayas

Division of Iloilo

LAMBUNAO NATIONAL HIGH SCHOOL

Lambunao, Iloilo

December 7, 2020

LUDA G. AHUMADA, PhD

Principal III

Lambunao National High School

Lambunao, Iloilo

Madam:

Greetings of love and peace!

I would like to inform your good office that we are presently conducting our action research entitled "Integrating Supplemental Learning Materials with Modular Instruction: Its effect on Learners' Performance in Grade 8 Earth and Space".

In this connection, we would like to seek permission from your good office to allow us to conduct our intervention to Grade 8 learners during the 2nd quarter for the school year 2020-2021.
Hoping for your positive response.

Thank you very much and God Bless.

Respectfully yours,

DHANIEL MARC F. LAYAWON

Researcher

Approved:

(Sgd.) **LUDA G. AHUMADA, PhD**

Principal III

APPENDIX B

Research Instrument

Name:	Date:
Year & Section:	Score:

EARTH & SPACE 8

Type of Exam: Multiple Choice

Direction: Select the letter of the best answer among the given choices. Write your answers on the spaces provided before each number.

1) An earthquake is the shaking of the ground caused by the movement along faults.

This statement is considered to be:

A. True B. False C. Either A or B D. Depends on the situation

2) Which of the following terms are breaks or fissures along the walls, ceilings or the ground which show that significant movement has taken place?

A. Focus B. Seismology C. Faults D. Earthquakes

3) PHIVOLCS is a Philippine national institution dedicated to provide information on the activities of volcanoes, earthquakes, and tsunamis and issues warnings as necessary. The acronym PHIVOLCS stands

for:

A. Philippine International Volcanic System

B. Provincial Integrated Volcanic Studies

C. Philippine Institute of Volcanology and Seismic Activity

D. Philippine Institute of Volcanology and Seismology

4) Locations far from the epicenter of an earthquake often sustain _____ damage than those that are closer.

A. More B. Lesser C. Similar D. Greater

5) A tsunami is a series of waves caused by earthquakes or undersea volcanic eruptions. This is caused by a sudden push from an underwater fault caused by its horizontal movement along the sea floor.

Which among the following statements is considered to be true?

A) The first statement is true while the second statement is false

B) The first statement is false while the second statement is true

C) Both statements are true

D) Both statements are false

6) Intensity and magnitude are importance scales used as measurements during an earthquake. Which among the following statements correctly differentiates one from the other?

A. Intensity measures the energy released at the source of the earthquake while Magnitude is determined from the effects of an earthquake on people, human structures and the natural environment

B. Magnitude is expressed in a Hindu – Arabic format (ex. 1,2,3) while Intensity is shown in a Roman numeral format (I, II, III)

C. Intensity is often measured before an earthquake occurs while magnitude is measured after.

D. Intensity is used for tsunamis while magnitude is solely used for earthquakes

7) What is the flat surface between two pieces of the ground that move past each other when there is fault movement?

A. Fault line B. Fissure C. Seismic field D. Fault plane

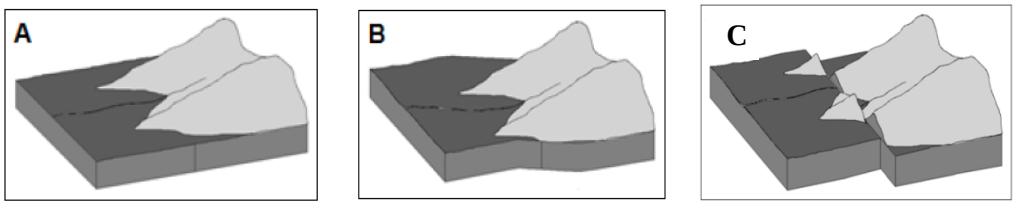
8) Fill-in the blanks with the correct answers:

The study of earthquakes is called _____ while volcanoes are studied under the science of _____

A. Seismology; Volcanology C. Seismism; Volcanism

B. Seismicity; Volcanicity D. Seimic; Volcanic

9) Which of the following observations correctly describes the images shown below?



A. The energy from inside the earth makes the rock bend. When too much bending occurs and the limit is reached, the rocks suddenly snap causing an earthquake

B. The presence of a mountainous region on both sides of the fault line causes a massive disturbance on the surface of the ground. This causes its movement which then becomes an earthquake

C. Earthquakes mostly occur on regions with uneven surfaces, causing bending of the ground on one side which then transfers the stored energy to the other region

D. Faults are formed when earthquakes move the ground from one area to another. These are often seen on mountainous regions more than valleys or plains due to the difference in the weight of the ground beneath them

10) Which of the following is known as the origin or the exact place where an earthquake starts?

A. Epicenter B. Fault line C. Fault D. Focus

11) Complete the following statement: The higher the number registered in the intensity and magnitude scale, the _____ an earthquake is.

A. Stronger B. Weaker C. Slower D. Farther

12) An earthquake's epicenter is found directly _____ its focus.

A. Below B. On C. Above D. Perpendicular

13) The Philippines is an earthquake – prone country, registering an average of 20 earthquakes a day and 100 to 150 earthquakes are felt per year. This level of activity is also observed in countries forming an arc around the Pacific ocean. This arc is famously referred to as:

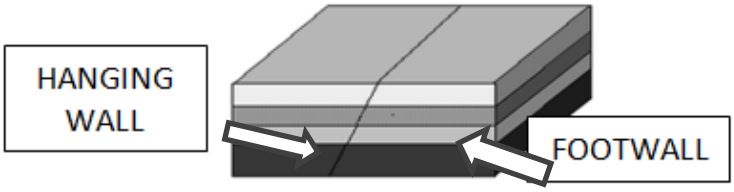
A. Pacific Tectonic Region C. Pacific Quake-prone Area

B. Pacific Ring of Fire D. Pacific Seismologic Territory

14) Every fault movement beneath the sea will form a tsunami. This statement is considered to be:

A. True B. False C. Either A or B D. No fault movement is involved

15) Which of the following statements are evident on the illustration found below?



I. Hanging wall and foot wall are rarely found on inactive faults

II. The hanging wall occurs above the fault plane and the footwall occurs below the fault.

III. Tsunamis are formed due to the movement of the hanging wall and foot wall

A. I and II only B. II and III only C. I only D. II only

For numbers 16 – 18, choose which level on the PHIVOLCS Earthquake Intensity Scale (PEIS) is most likely described in the given scenarios:

16) Gina is drinking a glass of milk tea at the upper floor of a mall in Iloilo city when she noticed her drink kept on moving though she had placed it on the table for quite some time. She then felt a vibration of a passing light truck which eventually madeher fell nauseous.

A. III B. V C. VII D. X

17) Raymond is driving his motorcycle when he suddenly felt as if it had flat tires. On his way home, he noticed how the trees were swaying even though there was still air outside as some people kept on losing their balance on the sidewalk.

A. III B. IV C. V D. VII

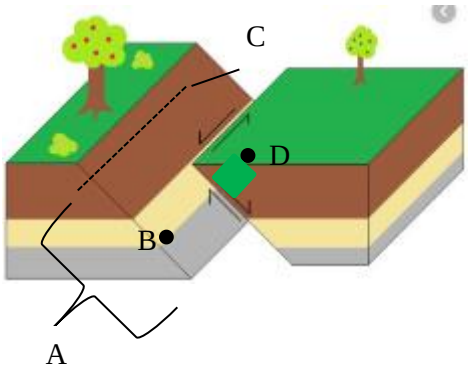
18) Maddie was cleaning their living room and noticed how the chandelier swung slightly. The still water that she poured on the flower vase a while ago moved noticeably.

A. II B. III C. V D. IX

19) The potential energy stored on the ground, when released, makes it move. There is no movement at first because of a type of force present between two surfaces that are trying to slide across each other. Which force is referred to in the previous statement?

A. Kinetic B. Static C. Friction D. Tension

For numbers 20 – 23, properly label the parts of the fault model based on the following illustration:



20) Focus 22) Epicenter

21) Fault plane 23) Fault line

24) A dip-slip fault forms when the rock layers on opposite sides of a fault slide past each other vertically. Which of the following dip-slip faults are formed as a result of compression wherein the hanging wall moves upward in relation to the footwall?

A. Normal fault C. Left –lateral fault

B. Reverse fault D. Transverse fault

25) During a visit on a neighboring town, Joanna noticed how a huge fracture on the road caused by the earthquake last month. Remembering her lessons in Earth and Space, she took a picture of this and classified it as a _____ fault.

A. Right lateral strike -slip fault C. Transverse fault

B. Left lateral strike -slip fault D. Oblique slip fault

26) While attending their classes, the Grade 8 students of Lambunao National High School experienced an earthquake. Who among these students made the best action?

A. Jane ran outside and shouted, “Earthquake!” to inform everyone.

B. Marcus dropped down, covered his head with his bag, and sat under the long table.

C. Bea stayed near the window to check if help is coming.

D. Vincent continued to read his book while eating his snacks.

27) Seismic waves (waves involved in earthquakes) behave in different ways depending on what they encounter along the way. Which of the following seismic waves cannot pass through and disappear when they come in contact with liquid matter?

A. P- waves B. L – waves C. S- waves D. R – waves

28) What is the relationship between earthquakes and faults?

A. Fault movements may not cause earthquakes

B. Movements in the faults cause earthquakes

C. Earthquakes and faults are not related to each other

D. All faults produce earthquakes

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29) How do movements along faults generate earthquakes? Arrange the events below in proper order.

I. The rocks along the fault do not move immediately because of a force that holds them in place

II. The vibrations travel in all directions producing and earthquake

III. When the energy that holds them together is overcome, the rocks suddenly snap and vibrate

IV. Energy from inside the Earth makes the rocks along the fault bend

A. I, II, III, IV B. IV, III, II, I C. I, III, IV, II D. IV, I, III, II

30) When scientists note the effect of earthquake on people, structure and surroundings, they are referring to the _____ of the earthquake

A. Magnitude B. Intensity C. Pressure D. Force

31) What area could be at risk of an earthquake when the West Panay Fault moves?

A. Palawan B. Antique C. Tarlac D. Siquijor

32) Which of the following describes the active fault?

A. An active fault is one that has not moved in the past and is not expected to move in the future

B. An active fault is one that has not moved in the past and has invisible cracks on the surface

C. An active fault is one that has not moved in the past and is expected to move again

D. An active fault is one that has visible cracks on the surface

33) How do we know what the core of the Earth is made of?

A. Deep bore holes allow us to sample all but the inner 10% of the Earth

B. Using sound waves projected to the ground

C. Seismic waves give information about the kind of material through which they pass

D. Volcanoes bring up material directly from the core

34) Which describes tsunami waves when they are far from shore?

A. They are low and fast C. They are high and slow

B. They are low and slow D. They are high and fast

35) As seismic waves travel deeper into the crust, they speed up.

That means that at a depth, the rocks are denser.

A) The first statement is true while the second statement is false

B) The first statement is false while the second statement is true

C) Both statements are true

D) Both statements are false

--- END ---

DHANIEL MARC F. LAYAWON
Proponent

APPENDIX C

Statistical Computation

Paired Samples t – test for the Control Group					
			statistic	**df**	**p**
Control Pretest	Control Posttest	Student's t	-7.87	24.0	< .001
Note. H_a $\mu_{\text{Measure 1 - Measure 2}} \neq 0$					

Descriptives for the Experimental Group					
	N	**Mean**	**Median**	**SD**	**SE**
Experimental Pretest	25	12.4	12	4.12	0.825
Experimental Posttest	25	21.1	22	6.37	1.274

Paired Samples t-test for the Experimental Group					
			statistic	**df**	**p**
Experimental Pretest	Experimental Posttest	Student's t	-12.8	24.0	< .001
Note. H_a $\mu_{\text{Measure 1 - Measure 2}} \neq 0$					

Group Descriptives for the Posttests of the Control Group and Experimental Group						
	Group	**N**	**Mean**	**Median**	**SD**	**SE**
Posttest results of Control and Experimental Groups	Control	25	15.6	16.0	4.28	0.856
	Experimental	25	21.1	22.0	6.37	1.27

Independent Samples T-Test for the Posttests of the Control Group and Experimental Group				
		Statistic	**df**	**p**
Posttest results of Control and Experimental Groups	Student's t	-3.57	48.0	< .001
Note. H_a $\mu_1 \neq \mu_2$				

APPENDIX D

Activity Sheets in Earth and Space 8

Quarter No. 2	**Subject: Science 8**
Lesson No. 1	**Topic: Earthquakes and Faults**
Name:	**Section:**

Time to Learn!

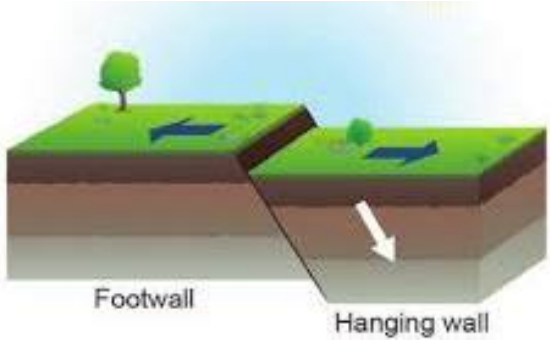
FAULT

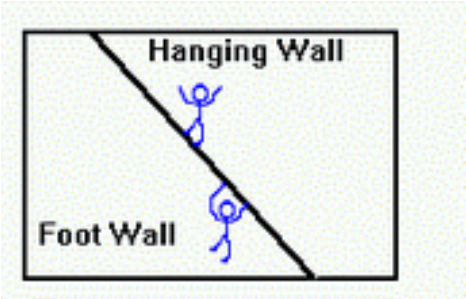
- A **fault** is a fracture on the Earth's crust that causes the rock layers or the flat surface (**fault plane**) on either side to break and slide past each other. It is a crack in the crust of the earth caused by the movement of the rocks on either side of it.

- The two sides of a non-vertical fault are known as the **hanging wall** and **footwall**.

  - The **hanging wall** occurs **above** the fault plane and the **footwall** occurs **below** the fault.

  - This terminology comes from mining: the miner stands with the footwall under his feet and with the hanging wall hanging above him when passing through a dug area underground



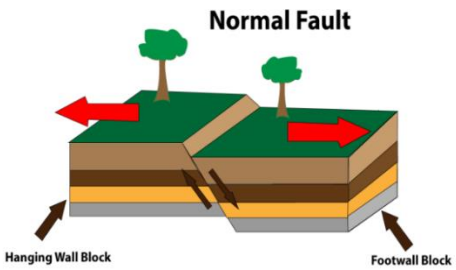


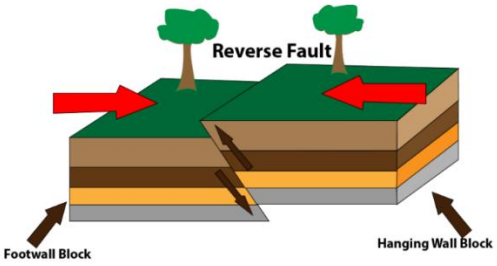
KINDS OF FAULTS

❖ **Dip-slip faults** can occur either as "reverse" or as "normal" faults.

○ A **normal fault** forms as a result of tension. The rock layers in the Earth's crust are pulled apart, and gravity causes the hanging wall to move **downward** in relation to the footwall.

○ A **reverse fault** forms as a result of compression. The rock layers in the Earth's crust are squeezed together, and the force pushes the hanging wall **upward** in relation to the footwall.

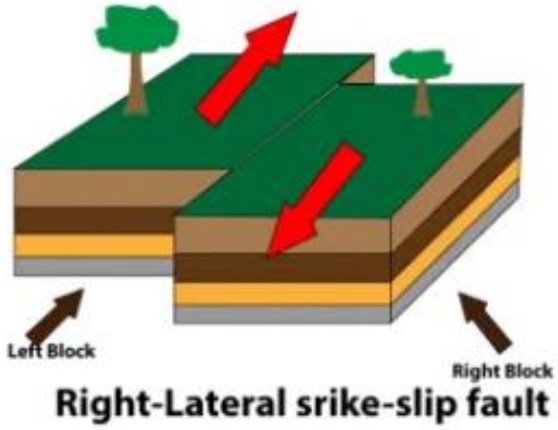




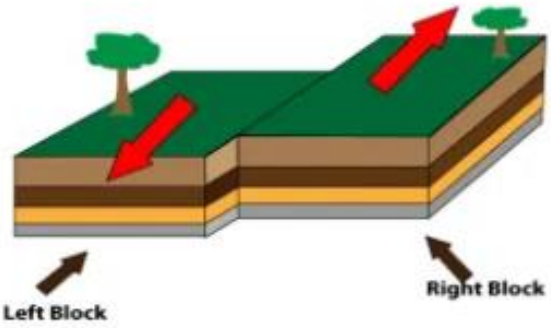
❖ A **strike-slip fault** forms when the rock layers on opposite sides of a fault slide past each other horizontally.

○ When one left block moves in the forward direction and right block in the backward direction then that type of fault is known as a **left-lateral strike-slip fault**

○ When one right block moves in the forward direction and left block in the backward direction, then that type of fault is known as a **right-lateral strike-slip fault.**

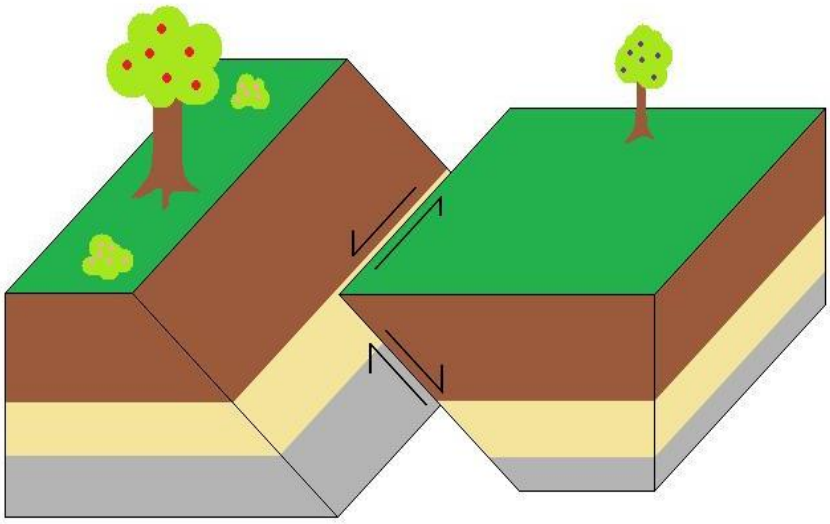


Right-Lateral srike-slip fault



Left-Lateral Strike-Slip Block

❖ A fault which has a component of dip-slip and a component of strike-slip is termed an **oblique-slip fault.**



Let's Answer This! (Answers should be written in an extra sheet of bond paper)

1. Have you seen any of these faults in your neighborhood? Which one?

Ans: _____

2. What do you think is the reason behind fault formation?

Ans: _____

3. Imagine that you are an emergency responder or municipal disaster risk officer, how would you address a situation where in there are fault formations in your community?

Ans: _____

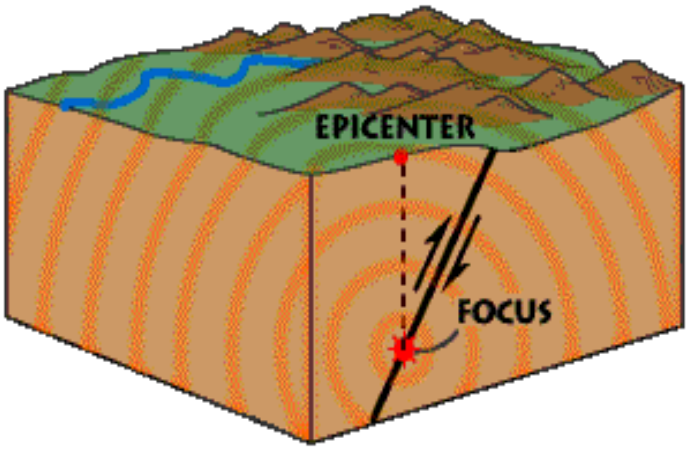
Quarter No. 2	**Subject: Science 8**
Lesson No. 2	**Topic: Other Facts about Earthquakes**
Name:	**Section:**

Time to Learn!

Epicenter vs. Focus

Focus- also known as the hypocenter, is the location inside the Earth where an earthquake begins

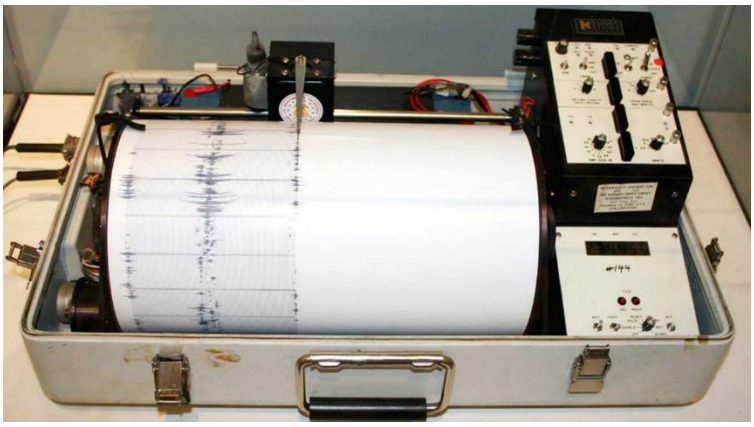
Epicenter– is the point at the Earth's surface directly above the focus where the strongest shaking occurs during an earthquake. Sometimes the ground surface breaks along the fault. Sometimes the movement is deep underground and the surface does not break.



Intensity of an Earthquake vs. Magnitude of an Earthquake

Intensity- measures the strength of shaking produced by the earthquake at a certain location. It is determined from effects on people, human structures, and the natural environment.

Magnitude – measures the energy released at the source of the earthquake. Magnitude is determined from measurements on **seismographs**.



Modified Mercalli Earthquake intensity scale – is the most commonly used earthquake intensity scale and is written in **Roman numeral system** (e.g. I, II, III).

Abbreviated Modified Mercalli Intensity Scale	
Intensity Scale	**Description**
I	Not felt except by a very few under especially favorable conditions.
II	Felt only by a few persons at rest, especially on upper floors of buildings.

	Hanging objects swing slightly. Still water in containers oscillates noticeably.
III	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a light truck. Duration estimated.
IV	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Some people lose their balance. Motorists feel like driving in flat tires. Damage slight.
VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI	Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII	Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Richter magnitude scale - also known as the **Local magnitude (M) scale**, assigns a number (**Hindu – Arabic format**) to quantify the amount of seismic energy released by an earthquake.

Magnitude	**Earthquake Effects**
Less than 2.5	Usually not felt but can be recorded by seismograph.
2.5 to 5.4	Often felt, but only causes minor damage.
5.5 to 6.0	Slight damage to buildings and other structures.
6.1 to 6.9	May cause a lot of damage in very populated areas.
7.0 to 7.9	Major earthquake. Serious damage.
8.0 or greater	Great earthquake. Can totally destroy communities near the epicenter.

The **Philippine Institute of Volcanology and Seismology (PHIVOLCS)** is a service institute of the Department of Science and Technology (DOST) that is principally mandated to mitigate disasters that may arise from volcanic eruptions, earthquakes, tsunami and other related geotectonic phenomena.

BEFORE, DURING, AND AFTER AN EARTHQUAKE

There are many things you can do to help yourself in the event of an earthquake. Generally, an earthquake is divided into three stages: before, during, and after. Know what to do in each stage.Hear are some of them:

Before

1. Develop a family earthquake plan. Prepare yourself and your home by completing the activities on this checklist.

2. Decide how and where your family will reunite if separated.

3. Know the safe spots in each room: under sturdy tables, desks, or against inside walls

and the danger spots: windows, mirrors, hanging objects, and tall, unsecured furniture.

4. Conduct practice drills. Physically place yourself in safe locations.

5. Learn first aid and CPR (cardiopulmonary resuscitation).

6. Keep a list of emergency phone numbers.

7. Maintain emergency food, water and other supplies, including a flashlight, a portable battery-operated radio, extra batteries, medicines, first aid kit and clothing.

During

1. If indoors, stay there and take cover under a table, desk, or other sturdy furniture.

2. Face away from windows and glass doors.

3. Lie, kneel or sit near a structurally sound interior wall or corner away from windows, brick fireplaces, glass walls, etc.

4. Practice **Drop, Cover and Hold. DROP** where you are, onto your hands and knees. **COVER** your head and neck with one arm and hand or any hard, sturdy object. **HOLD ON** until shaking stops. Remain where you are until shaking stops. Think out your plan of action first, then move.

5. Know exit routes if in a commercial building. Take cover and don't move until the shaking stops.

6. If outside, get into an open area away from trees, buildings, walls and power lines.Get to the best available shelter if there is no open area available.

Stay below window level in your vehicle.

After

1. Check for injuries. Render first aid. Do not move seriously injured victims unless they are in immediate danger. Do not use the telephone immediately unless there is a serious injury, fire or other emergency. Hunt for hazards.

2. Use gloves, wear heavy shoes, and have appropriate clothing available.

3. Check building for cracks and damage, including roof, chimneys, and foundation.

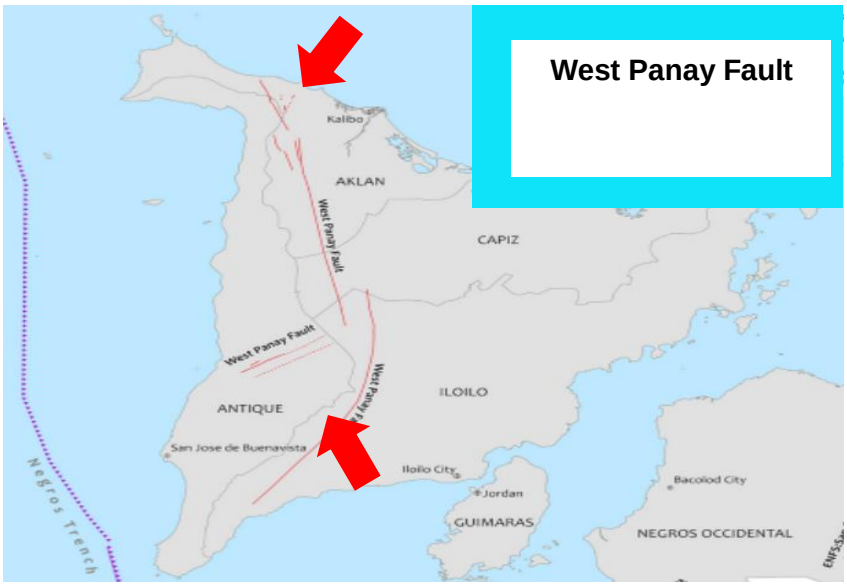
4. Check food and water supplies.

5. Turn on the radio and listen for emergency broadcasts/announcements, news reports, and instructions. Cooperate with public safety officials.

6. Be prepared for aftershocks. Plan for evacuation in case events make this necessary. Leave written messages for other family members or searchers.

Active vs. Inactive Faults

Active Fault- isa fault that is likely to have another earthquake sometime in the future. Faults are commonly considered to be active if they have moved one or more times in the last 10,000 years. The closest active fault here is the **West Panay Fault** which runs along the border of Antique and its nearby provinces in the island of Panay.



Inactive Fault – is a fault that is unlikely to cause an earthquake and has not move for a long, long time.

Let's Answer This! (Answers should be written in an extra sheet of bond paper)

A) Give two real life examples of the negative effects of an earthquake.

B) Imagine if you are a structural engineer tasked by your municipality to design a quake – proof evacuation area in case of a strong earthquake (magnitude of 5 and above). Enumerate the details on how you would plan its structure and explain the purpose of each design.

Quarter No. 2	**Subject: Science 8**
Lesson No. 3	**Topic: Earthquake Waves**
Name:	**Section:**

Time to Learn!

Earthquake Waves

Seismic waves- (or earthquake waves) are the waves of energy caused by the sudden breaking of rock within the earth or an explosion. They are the energy that travels through the earth and is recorded on **seismographs**. The study of earthquakes is known as **seismology** while **volcanology** is for volcanoes**.**

Two Major Types of Earthquake Waves

1. **Body wave** - can travel into the Earth's inner layers. There are two type of body wave, the **Primary wave** and the **Secondary wave**.

Two Types of Body Wave	
a. Primary wave (P – wave)	- Vibration is parallel to the direction they are travelling in a push-pull motion with a velocity of 4-6 km/sec - P-wave can travel in solid, liquid, and in gas. It can travel to the different layers of the earth Interior surfaces. - It is form of a **compression wave**.
b. Secondary wave (S – wave)	- Vibration is perpendicular (Up and Down) to their direction of travel with a velocity of 3-4 km/sec. - S-wave can only travel in solid but not in Liquid and gas. - It is a form of **transverse wave**

2. **Surface wave** - can only travel into the surface of the earth/ It has two types, the **Love wave** and the **Rayleigh wave.**

Two Types of Body Wave	
a. Love wave	- Moves on the surface of the ground from side to side motion with a velocity of about 4 km/sec - It is a form of a transverse wave - Moves only in the ground surface in back and forth path.
b. Rayleigh wave	- Moves on the surface of the ground slower than the Love wave in a circular motion. - The shaking that we felt during an earthquake is caused by Rayleigh wave. - Moves only in the surface of the ground in circular motion.

Earthquake and Tsunami

Tsunami- is a form of wave produce from a sudden push of underwater fault. Itis much powerful than other form of wave that involves the whole dept of the sea from the seafloor to the surface of water. Tsunami travels at the speed of a jet plane. When the tsunami reaches the shore, it slows down but it grows in height.

When a fault suddenly moves on land, you get an earthquake. But if a fault suddenly moves in or near a body of water, you may get a tsunami in addition to the earthquake.

Importance of Earthquake Waves.

It helps scientist to;

1. Predict earthquakes and tsunamis.

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2. Picture the earth's interior part.

For example, as seismic waves travel deeper into the crust, they speed up. That means that at depth the rocks are denser. In the upper part of the mantle, the waves slow down. That means the rocks there are partially molten.

As the waves reach the core, one kind of seismic wave (s-waves) disappears. That means that the outer core is liquid. At certain depths, the waves are reflected and refracted (bent). That means the Earth must be layered.

The Four Interior Layers of the Earth

Crust- is the thinnest and brittle layer of the Earth's Interior. It comprises The continent and the ocean basins. The crust composed mainly of aluminum silicates.

Mantle- is divided into two parts, the upper mantle and the lower mantle. It is adense and hot semi-solid rock layer, composed mainly of Ferro-magnesium Silicate. It is where most of the internal heat of the earth is located

Core- makes up one third (1/3) of the mass of the earth. Made up of two distinct parts;

a. **Outer Core** is the thick liquid layer made up of iron and of very dense. Thicker than the inner core.

b. **Inner Core** is solid is made up of solid iron and nickel. Many scientists believe that it keeps in solid states due to the extreme pressure from the other layers. It is the innermost layer of the earth.

Let's Answer This! (Answers should be written in an extra sheet of bond paper)

1. Imagine that you are a PHIVOLCS officer assigned in a coastal area. For people living near the sea / ocean, what precautionary measures can they do to prevent loss of lives in an impending tsunami? Write down the step – by - step plan on how to address this situation.

2. Give an example of an object in real – life that resembles the earth and its layers. Draw, paste or print – out this object and label it based on the earth's layers.