	School:		**Grade Level:**	**7**
	Teacher:		**Learning Area:**	**Science**
	Teaching Dates and Time:		**Quarter:**	**Fourth**
			Week:	**Week 3-Day 2**

I. CONTENT, STANDARDS AND LEARNING COMPETENCIES		***ANNOTATIONS***
A. CONTENT STANDARDS	The learners learn that the damage or effects on communities depend on the magnitude of and distance from an earthquake.	
B. PERFORMANCE STANDARDS	By the end of the Quarter, learners will appreciate the value of using systems to analyze and explain natural phenomena and demonstrate their understanding of the dynamics of faults and earthquakes. They are confident in identifying and assessing the earthquake risk for their local communities using authentic and reliable secondary data. They use the country's disaster awareness and risk reduction management plans to identify and explain to others what to do in the event of an earthquake. Learners explain the cause and effects of secondary impacts that some coastal communities may experience should a tsunami be produced by either local or distant earthquake activity. Learners use reliable scientific information to identify and explain how solar energy influences the atmosphere and weather systems of the Earth and use such information to appreciate and explain the dominant processes that influence the climate of the Philippines.	
C. LEARNING COMPETENCIES	**Learning Competencies**: Explain how earthquakes result in tsunamis that devastate shoreline communities	
D. LEARNING OBJECTIVES	**Learning Objectives:** 1. Identify the different types of seismic waves;	

	2. Explain how earthquakes result in tsunamis; and 3. Realize how tsunamis devastate shoreline communities.	
I. CONTENT		
Earthquake Scenarios and Tsunami		
II. LEARNING RESOURCES		
A. REFERENCES	● Tsunami | Run-up and Inundation, tidal wave, sea level & inundation. (n.d.). https://www.sms-tsunami-warning.com/pages/runup- Inundation ● Libretexts. (2022, May 6). 8.3: Seismic waves. Geosciences LibreTexts. https://geo.libretexts.org/Bookshelves/Geology/Fundamentals_of_Geology_(Schulte)/08%3A_Earthquakes/8.03%3A_Seismic_Waves ● Bhuyan, S. (2020, April 11). Seismic Waves: Definition, Types, Examples, and diagram. Science Facts. https://www.sciencefacts.net/seismic-waves.html ● Tsunamis. (n.d.). Environment. https://www.nationalgeographic.com/environment/article/tsunamis	
B. OTHER LEARNING RESOURCES		
III. TEACHING AND LEARNING PROCEDURE		
BEFORE/PRE-LESSON PROPER		
ACTIVATING PRIOR KNOWLEDGE	**Short Review** **Review on Earthquakes**	

	Earthquakes are natural events that occur when energy is suddenly released from the Earth's crust, causing the ground to shake. They can be mild tremors or destructive disasters, depending on their intensity and location. **Terms Related to Earthquakes:** ● **Epicenter** – The point on the Earth's surface directly above the focus. ● **Focus (Hypocenter)** – The underground location where an earthquake starts. ● **Seismic Waves** – Energy waves that travel through the Earth during an earthquake. ● **Magnitude** – The measurement of the energy released by an earthquake (measured using the Richter Scale). ● **Intensity** – The strength of shaking felt at different locations. ● **Fault Line** – A crack in the Earth's crust where movement occurs. ● **Aftershocks** – Smaller earthquakes that follow the main earthquake. **Causes of Earthquakes:** 1. **Surface Causes (Dynamic Agencies Operation)** – Activities like mining, dam construction, and explosions can create small earthquakes. 2. **Volcanic Causes** – Movement of magma inside a volcano can trigger earthquakes, often before an eruption. 3. **Tectonic Causes** – The most common type, caused by the movement of tectonic plates along faults. **Theory of Plate Tectonics:** The Earth's outer shell is divided into large plates that float on the semi-fluid mantle. Their movement causes earthquakes. There are three types of plate boundaries:	

	• **Convergent Boundary** – Plates collide, causing strong earthquakes and mountain formation. • **Divergent Boundary** – Plates move apart, creating new crust. • **Transform Boundary** – Plates slide past each other, often causing violent earthquakes. **Impact of Earthquakes:** • Destruction of buildings and infrastructure • Loss of lives and injuries • Landslides and ground fissures • Tsunamis (if undersea earthquakes occur) Understanding earthquakes and their causes helps in preparedness and reducing risks. Scientists study seismic activity to predict potential hazards and protect communities.	
LESSON PURPOSE/INTENTION	**Lesson Purpose** The purpose of this lesson is to help understand the different types of seismic waves, their characteristics, and how they travel through the Earth during an earthquake. By the end of the lesson, should be able to: 1. **Define seismic waves** and explain their role in earthquakes. 2. **Identify and differentiate** the two main types of seismic waves: **Body Waves** and **Surface Waves**. 3. **Describe the characteristics** of **P-waves (Primary waves), S-waves (Secondary waves), Love waves, and Rayleigh waves**. 4. **Understand how seismic waves help scientists study the Earth's**	

	interior and detect earthquake activity. 5. **Recognize the impact of seismic waves** on buildings, landscapes, and human safety. This lesson will include interactive discussions, visual demonstrations, and simple hands-on activities to deepen understanding of seismic waves and their effects.	
LESSON LANGUAGE PRACTICE	**Unlocking Content Vocabulary** **Directions:** Unscramble the words below to form the correct vocabulary term related to seismic waves. Then, match each term with its correct definition.	**Answer Key:** 1. Seismic Waves – Vibrations that travel through the Earth caused by an earthquake. 2. Body Waves – Seismic waves that travel through the Earth's interior. 3. Surface Waves – Seismic waves that move along the Earth's surface and cause the most damage. 4. Primary Waves (P-Waves) – The fastest seismic waves that travel through solids, liquids, and gases. 5. Secondary Waves (S-Waves) – Slower seismic waves that travel only through solids. 6. Love Waves – Surface waves that move the ground side to side. 7. Rayleigh Waves – Surface waves that make the ground move in a rolling motion.

Scrambled Word	Definition
Micseis vseaw	Vibrations that travel through the Earth caused by an earthquake.
bdyo avwse	Seismic waves that travel through the Earth's interior.
safrceu aevws	Seismic waves that move along the Earth's surface and cause the most damage.
imrayrp svaew	The fastest seismic waves that travel through solids, liquids, and gases.
nayrdoesc svaew	Slower seismic waves that travel only through solids.
oevl aevws	Surface waves that move the

	ground side to side.
llyiegarh svaew	Surface waves that make the ground move in a rolling motion.

DURING/LESSON PROPER

READING THE KEY IDEA/STEM

Seismic waves

- Seismic waves are the waves of energy caused by the sudden breaking of rock within the earth or an explosion.
- Response of material to the arrival of energy fronts released by rupture.
- Energy that travels through the earth and is recorded on seismographs.

Seismic waves defined by:

- Where they move-Earth's interior vs. Surface
- How they move -vertically vs. Horizontally
- How fast they move -meters per second

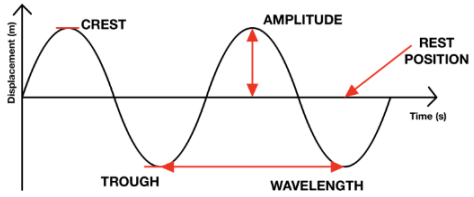
History

Around 132 AD, Chinese scientist Chang Heng invented the first seismoscope, an instrument that could register the occurrence of an earthquake.

What is wave...?

- A wave can be described as a disturbance that travels through a medium from one location to another location.

Diagram of wave



How they create?

• Seismic 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.

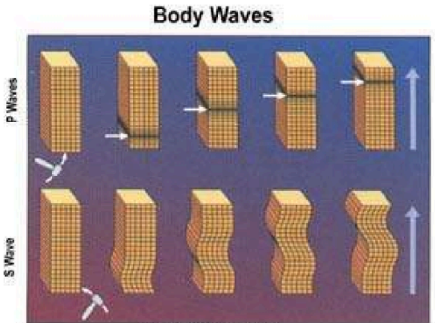
• There are several different kinds of seismic waves, and they all move in different ways. The two main types of waves are **body waves** and **surface waves.**

Types of seismic Waves

1. Body waves
   - Primary waves
   - Secondary waves
2. Surface waves
   - Love waves
   - Rayleigh waves

Body waves

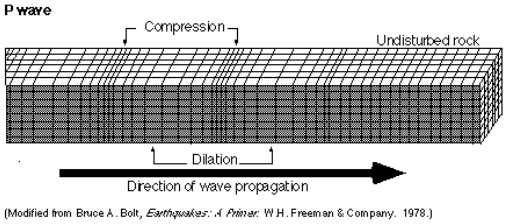
- Body waves are those waves which travels through the interior of the earth.



Body Waves

►P Waves (compression wave)

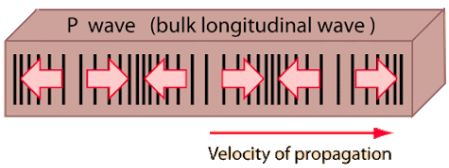
The first kind of body wave is the P wave or primary wave. This is the fastest kind of seismic wave. The P wave can move through solid rock and fluids, like water or the liquid layers of the earth. It pushes and pulls the rock it moves through just like sound waves push and pull the air.



(Modified from Bruce A. Bolt, *Earthquakes: A Primer*. W.H. Freeman & Company. 1978.)

Movement of p-waves

P-waves are the fastest waves created by an earthquake. They travel through the Earth's interior and can pass through both solid and molten rock. They shake the ground back and forth like a Slinky - in their travel direction, but do-little damage as they only move buildings up and down.



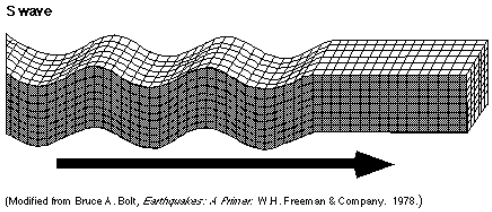
SPEED OF THE PRIMARY WAVES

→ In air, they take the form of sound waves, hence they travel at the **speed of sound**. Typical speeds are 330 m/s in air, 1450 m/s in water and about 5000 m/s in **granite**.

→ Primary waves (P-waves) are compressional waves that are **longitudinal** in nature. P waves are pressure waves that travel faster than other waves through the earth to arrive at seismograph stations first hence the name "Primary". These waves can travel through any type of material, including fluids, and can travel at nearly twice the speed of S waves

► S wave (transverse wave)

- The second type of body wave is the S wave or secondary wave, which is the second wave you feel in an earthquake. An S wave is slower than a P wave and can only move through solid rock. This wave moves rock up and down, or side-to-side.



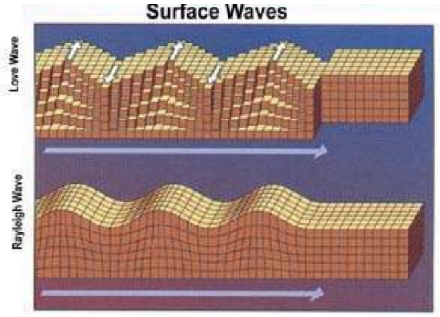
(Modified from Bruce A. Bolt, *Earthquakes: A Primer*. W.H. Freeman & Company. 1978.)

Secondary (shear) waves

▸ S-waves lag behind P-waves as they travel 1.7 times slower and can only pass through solid rock. However, they do more damage because they're bigger and shake the ground vertically and horizontally.

Surface waves

Surface waves are those waves which travels through the surface of the earth.

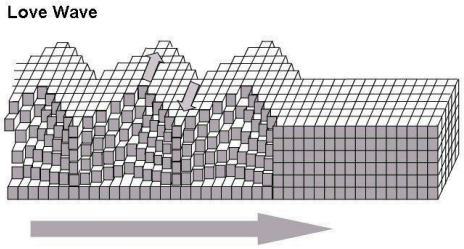


Surface waves

1. **Love waves**

‣ A type of seismic surface wave in which particles move with a side-to-side motion perpendicular to the main propagation of the earthquake. The amplitude of this motion decreases with depth. Love waves cause the rocks they pass through to change in shape. They travel faster than Rayleigh waves.

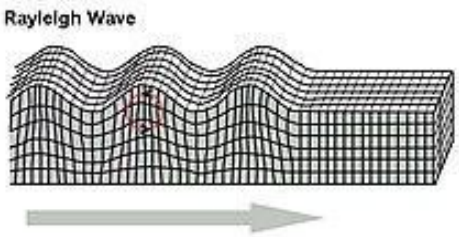
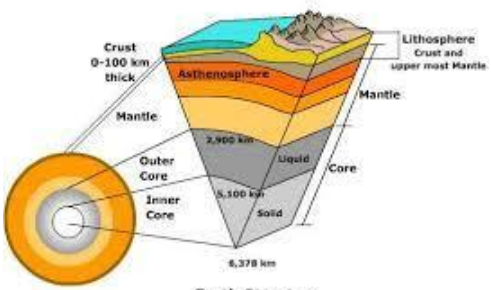
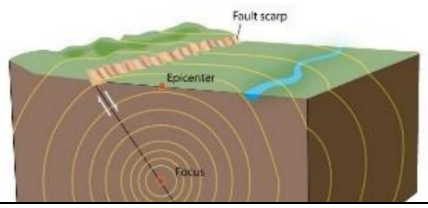
‣ the Love waves at about 3.5 km/s

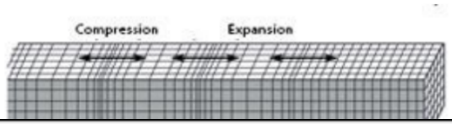
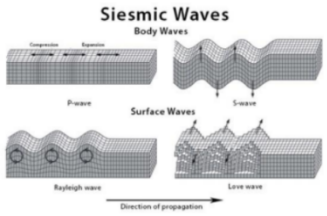


2.

Rayleigh waves

‣ A type of seismic surface wave that moves with a rolling motion that consists of a combination of particle motion perpendicular and parallel to the main direction of wave propagation. The amplitude of this motion decreases with depth. Like primary waves, Rayleigh waves are alternatingly compressional and extensional (they cause changes in the volume of the rocks they pass through).

	Rayleigh waves travel slower than Love waves. ▸ the Rayleigh waves at 3.0 km/s  **How they travel?** ▸ The Rayleigh waves "roll" along the surface, described as "up and over backwards roll." These surface waves do most of the damage to structures. The Love waves shake us from side to side and the Rayleigh waves shake us up and down Uses of seismic waves ▸ On the basis of seismic waves we differentiate different layers of earth ▸ On the basis of seismic waves we sub classified the layers.  Earth Structure (Not to Scale)	
DEVELOPING and DEEPENING UNDERSTANDING OF THE KEY IDEA/STEM	**SUB-TOPIC 1: Types of Seismic Waves** **1. Explicitation** Ask a learner to recall what they learned from the previous lesson on the anatomy of an earthquake and how it is generated.  	Let the learners recall what they learned about the anatomy of an earthquake. This diagram will lead them to the idea that seismic waves radiate from the focus of an earthquake. If the learners cannot present the idea on their own, you may remove the label and ask them leading questions such as:

	2. Worked Example Learners will try to match the description with the correct figure.  The motion of Love wave particles forms a horizontal line that is perpendicular to the propagation direction. The energy of Love waves radiates in two directions rather than three. P waves are compressional waves that travel through solids, liquids, and gases. They propagate through a substance by compressing and expanding it alternately. The motion of Rayleigh wave is a mix of longitudinal, compressional, and dilatation. As a result, the particles travel elliptically in the vertical plane. S-waves (Secondary waves): They are also known as shear waves, and they can only propagate in hard, solid materials by vibrating particles in a direction perpendicular to the propagation. **3. Lesson Activity** **I. Activity No. 3.1:** Seismic Wave Simulation **II. Objective(s):** At the end of the activity, you should be able to classify the different types of seismic waves through a hands-on simulation. **III. Materials Needed:** Slinky, and large flat surface (such as a table or floor)	1) Where can you find the: a. focus? b. epicenter? 2) Where did the waves originated? 3) How earthquakes occur? 

	IV. Instructions: Read the description of each type of seismic wave. **Types of Seismic Waves** a) Body Waves - travel through the interior of the Earth and have a frequency higher than the surface wave. • P-waves (Primary waves): also known as pressure waves, may travel through both solid and liquid materials. They move quickly and are the first to reach the seismograph. They propagate through a substance by compressing and expanding it alternately. The particles' velocity is parallel to the direction of wave transmission. • S-waves (Secondary waves): They are also known as shear waves, and they can only propagate in hard, solid materials by vibrating particles in a direction perpendicular to the propagation. As a result, they cannot spread across a liquid. Seismologists could verify the existence of a liquid outer core of the Earth by investigating the paths of S waves. b) Surface Waves – are waves that flow along the Earth's surface-air boundary, or into the crust. They have lower frequency than body waves. They are easily identified and are responsible for earthquake-related damage and devastation. Surface waves have particles that move in a circular or elliptical pattern. The strength of surface waves decreases as they go deeper below the surface. • Rayleigh waves - are named after the British scientist Lord Rayleigh, who predicted their existence. Their motion is a mix of longitudinal, compressional, and dilatation. As a result, the particles travel elliptically in the vertical plane. These waves are dispersive, and their amplitudes often decline exponentially with depth in the earth.	If slinky is not available, you may use a rope.

	• Love Waves - named after British mathematician A. E. H. Love, according to him, the particles of Love waves jerk back and forth perpendicular to the direction of wave transmission, much like S-waves. The motion of Love wave particles forms a horizontal line that is perpendicular to the propagation direction. The energy of Love waves radiates in two directions rather than three. The amplitude often diminishes significantly with depth. Love waves move quicker than Rayleigh waves. **Simulation** 1. Place the slinky on a flat surface with enough space. Observe and describe the motion of the slinky for each wave type. 2. Use the slinky to simulate how each waves move. Set-up A. Hold one end of the slinky and shake it side to side horizontally. Set-up B. Hold one end of the slinky and quickly push and pull it back and forth horizontally. Set-up C. Push the slinky horizontally along its length, causing it to compress and stretch sideways. Set-up D. Hold one end of the slinky firmly in place. Using your other hand, move the end of the slinky up and down vertically while also moving it side to side horizontally in a circular motion. Guide Questions: 1. Which type of seismic waves is represented by: Set-up A? _____ _	

Set-up B?

_____
_

Set-up C?

_____
_

Set-up D?

_____
_

2. How do the waves might impact structures and communities during an

earthquake?

_____
_____
__

3. Which among the types of waves can cause the most damage and why?

_____
_

Rubric or Score Guide

Advanced (5 points)	Proficient (4)	Nearly Proficient (3)	Emerging (2)	Needs Improvement (1)
All of the required fields were answered, and the answers to guide	All of the required fields were answered, and the answers were well-	Some of the required fields were answered, and the answers were somewhat	Some of the required fields were answered, but the answers were not	Few of the required fields were answered, and the answers were not

Answer:

Set-up A: S-wave

Set-up B: P-wave

Set-up C: Love wave

Set-up D: Rayleigh wave

2. Seismic waves can have significant and wide-ranging impacts on structures and communities during an earthquake, including structural damage, infrastructure failure, loss of life and injury, and psychological and social consequences.

3. Surface waves are the most damaging during an earthquake due to their concentrated energy, large amplitudes, frequency content, effect on buildings, and long duration of shaking.

Understanding the characteristics and behavior of surface waves is essential for assessing seismic hazards, designing resilient structures, and implementing effective mitigation measures to reduce the risk of damage and loss during earthquakes.

	questions were well-organized and completely explained in detail.	organized and completely explained, but not in detail.	organized and explained but not in detail.	organized and not explained in detail.	organized and not explained in detail.		

AFTER AFTER/POST-LESSON		
MAKING GENERALIZATIONS AND ABSTRACTIONS	Worksheet Synthesis/Extended What you have learned In a one sheet of paper write something you understand about the lesson we discussed today.	
EVALUATING LEARNING	**Directions:** Read each question carefully and choose the best answer. Write the letter of your answer on the space provided. **1. What are the two main types of seismic waves?** A. Body Waves and Surface Waves B. Sound Waves and Light Waves C. Primary Waves and Secondary Waves D. Water Waves and Shock Waves **2. Which type of seismic wave is the fastest and can travel through solids, liquids, and gases?** A. S-Waves (Secondary Waves) B. Love Waves C. P-Waves (Primary Waves) D. Rayleigh Waves	**Answer:** 1. A. Body Waves and Surface Waves 2. C. P-Waves (Primary Waves) 3. B. Rayleigh Waves 4. B. They move the ground up and down and side to side. 5. A. Love Waves

	3. Which type of wave moves in a rolling motion, similar to ocean waves? A. P-Waves B. Rayleigh Waves C. Love Waves D. S-Waves **4. Why do S-Waves (Secondary Waves) cause more damage than P-Waves?** A. They travel faster than P-Waves. B. They move the ground up and down and side to side. C. They pass through both solids and liquids. D. They only travel underground. **5. Which seismic wave only travels along the Earth's surface and moves the ground from side to side?** A. Love Waves B. P-Waves C. S-Waves D. Body Waves	
ADDITIONAL ACTIVITIES FOR APPLICATION OR REMEDIATION (IF APPLICABLE)		
REMARKS		
REFLECTION		

Prepared by:

_____

Subject Teacher

Reviewed by:

_____

Master Teacher/Head Teacher