

Lesson Exemplars for Earth and Space Science 1

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Lesson Exemplar for Earth and Space 1

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Every care has been taken to ensure the accuracy of the information provided in this material. For queries or clarifications, you may contact the Bureau of Learning Resources – Office of the Director at blr.od@deped.gov.ph or via telephone at (02) 8634-1072. If you have feedback on the LE, please complete this form, which may be accessed through the following link: <https://bit.ly/sshsfeedbackform>.

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Lesson Title/Topic	The Historical Development of Theories on the Origin of the Universe	Lesson Exemplar	1
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I. OBJECTIVES	
A. Content Standard	The learners learn that the objects making up the universe have distinct characteristics.
B. Performance Standard	By the end of the quarter, learners describe the origin of the solar system and Earth's historical evolution. They relate Earth's unique position in the solar system to its composition, structure, and the dynamic nature of its outer layers. Learners explain how scientists determine the nature of Earth's interior. They also collaboratively create detailed models and scientific analyses and use evidence-based findings to illustrate the nature and composition of the Earth.
C. Learning Competencies	The learners describe the historical development of theories that explain the origin of the universe.
II. REFERENCES and MATERIALS <i>(Selecting Resources and Materials)</i>	<ul style="list-style-type: none"> • Anthroholic. "Theory of Special Creation or Divine Creation." April 7, 2023. Accessed [March 11, 2026]. https://anthroholic.com/theory-of-special-creation-or-divine-creation?srsId=AfmBOoorhdrIiyhftTGUj8cUJDXCiB88czwfbIjptCVoXLYF15pMQ1u5. • BYJU'S. "Steady-State Theory - Universe, FAQs." Accessed March 12, 2026. https://byjus.com/physics/steady-state-theory/. • May, Andrew. "What Is the Big Bang Theory?" Space.com, July 27, 2023. Accessed [March 12, 2026]. https://www.space.com/25126-big-bang-theory.html. • Physicsoftheuniverse.com. "Cosmological Theories through History – The Physics of the Universe." 2002. Accessed [March 12, 2026]. https://www.physicsoftheuniverse.com/cosmological.html. • Simplified In Short. "The Big Bang Theory Explained." YouTube video, 8:15. August 9, 2024. https://www.youtube.com/watch?v=pnRiowLkTME.
	The Historical Development of Theories on the Origin of the Universe
	<ol style="list-style-type: none"> 1. Identify early religious and philosophical explanations about the origin of the universe. 2. Describe the main ideas of the modern scientific theories explaining the origin of the universe. 3. Construct a simple, chronological timeline of the historical development of theories explaining the origin of the universe.
III. CONTENT <i>(Sequencing Content)</i>	
IV. OBJECTIVES <i>(Setting Clear Objectives and Analyzing the Tasks)</i>	

ANNOTATIONS

V. PROCEDURES

(Selecting Strategies, Making Meaningful Content, Delivering Lessons, and Assessing Learning)

**Instruction to the teacher on how to facilitate the activities.*

**In the Annotation, explicitly explain how the IDF is applied in each part of the lesson*

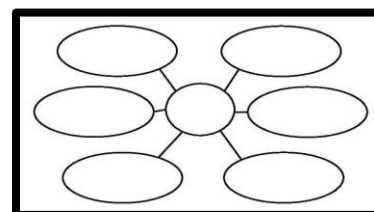
A. Activating Prior Knowledge

1. Activating Prior Knowledge

Option 1: Bubble Mapping the Universe

Procedures:

1. Create a central graphic organizer with the main term "Universe" in the center. A sample illustration is shown.
2. Learners should provide words in the outer nodes of the map using descriptions, scientific terms, or phrases based on what they already know.
3. Divide the class into groups of five and give each learner a number from 1 to 5.
4. Be prepared to discuss your bubble map because a random number will be called, and members need to stand and present.
5. After the presentations, give immediate feedback to learners about their bubble maps.



Option 2: Think – Pair – Share

Procedures:

1. Self-organize in pairs to create a learning unit.

Note to the teacher:

Draw a large circle on the board and write "Universe" at the center. Ask learners to add related terms around it. As they work in groups of five, move around to guide them. Then, call a random number (1–5); selected learners stand and share their answers. Responses may be written on Manila paper or pad paper.

IDF Application:

A blank peripheral map enables learners to incorporate their own context, thereby enhancing flexibility in learning. Random selection maintains engagement and fosters inclusion among all participants. Teacher feedback addresses misconceptions, while graphic organizers accommodate diverse learning needs and reinforce differentiated instruction.

Note to the teacher:

After pairing and receiving the question, give learners 2 minutes to think quietly. Move around to ensure engagement, then listen as pairs

2. Ask the main question: "Where do you think the universe came from?" You can present this using PowerPoint, Canva, or by writing it on the board.
3. Give two minutes for individual thinking.
4. Organize and summarize your findings into a short, bullet-point outline on a piece of paper. This will guide the discussion.
5. Briefly share your findings with the class in pairs.
6. Clear up any misconceptions, ensuring a solid scientific understanding of the concept.

2. Establishing the Purpose of the Lesson

Fact Verification Analysis

Procedures:

1. Present five statements about ideas, explanations, and theories on the origin of the universe.
2. Give each learner a card with "FACT" on one side and "BLUFF" on the other.
3. Allow learners five seconds to think about each statement.
4. Have all learners raise their cards to show whether they think the statement is a fact or a bluff.
5. Call on individual learners to explain their choice.
6. After each explanation, provide the correct answer along with feedback and reasoning for better understanding.
7. The following statements are to be presented:

Statements	Answer
1. The Theory of Divine Creation asserts that the transcendental, divine, or creator - that is, God - is the one who created life.	<p>Fact</p> <p>Rationalization:</p>

discuss and note any misconceptions. When they share, write key ideas on the board to recognize responses.

IDF Relevance:

*The **Think-Pair-Share** activity is grounded in learner-centered constructivism. By asking, "Where do you think the universe came from?", the teacher activates learners' prior knowledge and uses it to build new understanding.*

Note to the teacher:

Prepare the "Bluff" or "Fact" cards. Stand at the front of the room and hold up the "Fact" and "Bluff" cards to set the stage and give directions. Present each statement about theories of the origin of the universe one at a time. Count down, "3... 2... 1... Cards Up!" and have learners raise their "Fact" or "Bluff" cards. Instead of saying the correct answer right away, call on a learner to explain their choice. After the learner responds, provide the correct answer along with feedback and reasoning. Repeat this for all five statements. Once the fact verification activity is done, ask the learners, "Why do we need to study the different ideas and theories of the origin of the universe?" Collect and discuss their answers until they understand that these ideas, explanations, and theories reflect humanity's ongoing efforts to

			The statement correctly describes the Theory of Divine Creation.	<p><i>explain our existence, and that our beliefs on these ideas, explanations, or theories change over time.</i></p> <p><i>Please emphasize also that religion and science represent fundamentally different approaches to understanding reality. Religion is based on faith and subjective insight, whereas science relies on observation and empirical evidence. The Theory of Divine Creation constitutes a historical account within religious tradition regarding the origin of the universe. However, it does not qualify as a scientific explanation, as it depends on supernatural intervention. Clarifying this distinction is essential to prevent misconceptions or confusion among the learners.</i></p> <p><i>Verify the concepts used in the activity through the following links:</i></p> <ul style="list-style-type: none"> • https://anthroholi.com/theory-of-special-creation-or-divine-creation?srsltid=AfmBOoorhdrIiyhftTGUj8cUJDXCiB88czwfbIjptCvoXLYf15pMQ1u5 • https://www.physicsoftheuniverse.com/cosmological.html <p>IDF Application: <i>The activity "Fact" or "Bluff" requires every learner to respond physically. This supports the goal of Inclusive Education by preventing any learner from being a passive participant. The</i></p>
	2. The Aristotelian Universe is a cosmological theory that holds that the Sun is the center of the universe.	Bluff	Rationalization: The Aristotelian Universe It is a cosmological theory believing that the Earth is the center of the universe, not the Sun. This affirms the geocentric model of the universe.	
	3. The Steady State Theory proposes that roughly 13.8 billion years ago, the entire cosmos was compressed into a singular point of extreme density and heat, and that singularity underwent a rapid expansion.	Bluff	Rationalization: The statement describes the Big Bang Theory, not the Steady State Theory.	
	4. The Big Bang Theory is considered a famous theory of ancient times.	Bluff	Rationalization: The Big Bang Theory was developed in the 20 th century.	
	5. Cosmic Egg, also known as Brahmanda, believes that the universe was composed of atoms.	Bluff	Rationalization: The Cosmic Egg originated in India and describes the universe as cyclical or oscillating, not composed of atoms.	

	<ol style="list-style-type: none"> Once the fact verification activity is complete, ask learners: “Why do we need to study the different beliefs and theories about the origin of the universe?” Gather and discuss their responses, connecting them to the importance of the new lesson. Finally, present the learning objectives to set clear expectations for the session. 	<p><i>framework emphasizes that assessment should support learning, not just evaluate it.</i></p>
B. Instituting New Knowledge	<p>1. Presenting Examples</p> <p>Option 1: The Cosmic Origin Video</p> <p>Procedures:</p> <ol style="list-style-type: none"> Play a short, engaging video that explains the leading scientific theory on the origin of the universe, known as the Big Bang Theory. The video is 2 minutes and 57 seconds long. Use the provided link below: https://www.youtube.com/watch?v=pnRiowLkTME Before playing the video, ask the learners these questions to guide their focus: <ol style="list-style-type: none"> What theory is discussed in the video? In your own words, describe the theory presented. List the pieces of evidence supporting the theory. After watching, give learners 3 minutes to organize their responses. Then, have the learners share their answers with the class. <p>Option 2: Garter ng Kalawakan</p> <p>Procedures:</p> <ol style="list-style-type: none"> Divide the class into groups of five. For each group, complete the following steps: <ol style="list-style-type: none"> Begin by marking the “Galaxies.” Place the garter flat on the table without stretching it. Draw six dots in a straight line, each spaced exactly 2 cm apart. Label these dots A, B, C, D, E, and F. 	<p>Note to the teacher:</p> <p><i>Write the three guide questions on the board before playing the video to focus learners’ attention. As it plays, move around to ensure note-taking and briefly highlight key terms like “Singularity.” Afterward, give 3 minutes for discussion, then have learners explain the theory in their own words and write their ideas on the board. Conclude by noting that this is just one of several origin theories to be discussed later.</i></p> <p>IDF Application:</p> <p><i>The video serves as a key resource for exploration rather than simple definition. Guide questions progress from recall to deeper analysis, while using YouTube supports ICT integration and helps learners develop effective use of digital resources.</i></p> <p>Note to the teacher:</p> <p><i>Start the activity by giving learners garters and markers. Move the groups around to ensure that “Point A” is held securely at the zero mark. Remind those stretching the garter to do it slowly. They should imitate the</i></p>

- b. Measure the distance from Point A to each of the other points, and write these measurements in the Start Column of your provided table.
- c. Learner 1 should hold Point A firmly at the 0 cm mark.
- d. Learner 2 will slowly stretch the garter until Point B reaches the 4 cm mark.
- e. While keeping the garter steady, measure and record the new distances from Point A to all other points. Use the template below for recording the data.
- f. Explain why data accuracy matters in scientific and engineering careers they might pursue in the future.

Galaxy Pair	Start Distance (cm)	Stretched Distance (cm)	Difference (cm)
A to B	2 cm		
A to C	4 cm		
A to D	6 cm		
A to E	8 cm		
A to F	10 Cm		

3. Analyze your results by discussing these questions:
 - a. Observe the dots. Did the dots move along the garter, or did the garter itself stretch? (Expected answer: The dots stayed in the same places on the garter; the garter stretched. This shows how space-time expands, carrying galaxies with it.)
 - b. Compare the distances of Point B and Point F from Point A in your table after stretching. Which point moved farther? (Point F moved a greater distance than Point B, showing that the farther apart two objects are, the more space expands between them.)
4. Remember, this activity demonstrates one theory about the universe's expansion. We will explore other theories together later.

gradual expansion of the universe so that the measurers can see the changes in real time. After the tables are completed, gather the class's attention. Instead of providing the answer to Question "a," ask learners to look closely at the ink dots: "Did the ink move to a new spot on the garter, or is it just the same garter getting bigger?" This helps them see that space is expanding. Point to a group's data comparing Point B and Point F and ask, "In one pull, Point F moved much farther than Point B. Why do you think that happened?" This leads the class toward discovering Hubble's Law without naming it yet.

IDF Application:

This activity combines hands-on skills and conceptual understanding through precise measurement and basic physics concepts. Learners collect and record their own data instead of just being told about galaxy motion. This reflects an evidence-first approach, where abstraction emerges from the hands-on garter activity.

	<p>2. Discussing New Concept Teacher- led Discussion Procedures:</p> <ol style="list-style-type: none"> 1. Discuss the following ideas and theories on the origin of the universe. Access these ideas and theories through this link: https://drive.google.com/file/d/1uXAWhgk3lCvHGmQTkNvWcnQBWrIEMWU/view?usp=drive_link 2. After the discussion, check how well the learners understand the material by asking questions such as: <ol style="list-style-type: none"> a. Which theory has no beginning and end? b. Who proposed the heliocentric universe? c. Which theory suggests that about 13.8 billion years ago, the entire cosmos began as a tiny, very hot, and extremely dense point called a singularity?? <p>3. Developing Mastery Option 1: “Arrange Me! Game”</p> <ol style="list-style-type: none"> 1. After the lesson, the class divides into three groups. 2. Each group gets a set of cards that describes different ideas, explanations, and theories about the universe. These include religious, philosophical, and modern scientific views. 3. Group members work together to determine the order of events or theories, identifying which came first and which followed. 4. Finally, the learners line up at the front of the class according to the timeline, from the oldest idea to the most recent theories. 5. Ask them to explain their reasoning for the arrangement. 	<p>Note to the teacher: <i>Present the following key points using a PowerPoint presentation. Include illustrations or images that support the ideas. Make sure all the learners stay engaged and encourage them to take notes on the key points. Respond to any questions quickly as they come up during the discussion. After the discussion, offer moments to check understanding. You can add questions beyond the three provided.</i></p> <p>IDF Application: <i>The discussion helps learners understand the historical development of the origin of the universe. It encourages them to focus on the Big Ideas, which is a main goal of the curriculum.</i></p> <p>Note to the teacher: <i>Prepare three sets of cards. Explain the activity and divide the class into three groups, giving each a set of cards on different theories of the universe. Have them discuss and arrange the ideas in historical order. Once done, representatives line up in front from the oldest to the most recent theories, and explain their reasoning for the arrangement. End</i></p>
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	<p>Option 2: The Universe Quiz Challenge Procedures:</p> <ol style="list-style-type: none"> 1. Host a live quiz using the Kahoot app or any other assessment app. 2. Everyone with a smartphone or tablet should join the quiz. 3. Questions about different ideas and theories of the universe will appear on the main screen. Learners will answer them in real time on their devices. 4. Provide a printed version of the quiz for those who cannot access the application or do not have devices. This way, they can still participate and show what they have learned. 5. Afterward, offer immediate support for the questions that received the fewest correct responses. 	<p><i>with a short discussion to reinforce the timeline and key concepts.</i></p> <p>Note to the teacher: <i>Prepare 10 questions to include in the application or on the test paper based on the discussion. Announce the "Universe Quiz Challenge" and give the directions. For learners without devices, hand out printed copies or test papers.</i></p> <p>IDF Application: <i>Using an application like Kahoot gives instant feedback. In the IDF, feedback is an essential part of the learning process. If the teacher notices that 70% of the class missed a question, e.g., on Steady State Theory, they should pause and offer immediate help (remediation).</i></p>
<p>C. Demonstrating Knowledge and Skills</p>	<p>1. Finding Practical Application Real-Life Reflection Procedures:</p> <ol style="list-style-type: none"> 1. Ask the following questions: <ol style="list-style-type: none"> a. Why is it important for us to learn the different explanations and theories about the origin of the universe? b. How does knowing the scientific evidence we have today change your view on the future of our world and the cosmos? 	<p>Note to the teacher: <i>Ask the learners questions using a PowerPoint Presentation. Then, give them time to think, and have each learner share their answers with the class.</i></p> <p>IDF Application: <i>This activity directly supports the "Reflective" pillar of the 3Rs. By encouraging learners to look inward, the framework makes sure that learning involves personal growth</i></p>

	<p>2. Making Generalization The Timeline of the Universe Procedures:</p> <ol style="list-style-type: none"> 1. Build a simple timeline that shows how ideas about the universe's origin have evolved. 2. Share your timeline by making an infographic or drawing it on a poster board. 3. The timeline should begin with ancient religious and philosophical explanations and progress to modern scientific theories. It should clearly display the historical development of the universe's origin. Include the names of those who proposed each theory and the dates they were established. 	<p>and critical self-awareness, not just external data.</p> <p>Note to the teacher: Ask the class to make a simple timeline using an infographic or illustration board. Make sure everyone is involved. Move around the room and address any student questions right away.</p> <p>IDF Application: This activity is the "Generalization" phase of the lesson. It requires learners to organize scattered facts into a clear "Big Picture." Creating a timeline helps learners understand the progression of human thought throughout history.</p>												
<p>V. ASSESSMENT <i>(Assessing Learnings)</i></p>	<p>Option 1: Classification with Justification Directions: Assign each cosmological theory to one of the following categories: Religious, Philosophical, or Scientific. Then, explain why it fits into that category using at least one main idea. A worked example is provided for you.</p> <table border="1"> <thead> <tr> <th>Theory</th><th>Classification</th><th>Justification</th></tr> </thead> <tbody> <tr> <td> Example: Theory of Divine Creation </td><td>Religious</td><td>This view comes from traditional religious writings, such as the <i>Book of Genesis</i>. It explains the origin of the universe as the result of a deliberate act by a supreme being, rather than as the result of natural or physical forces.</td></tr> <tr> <td>1. Big Bang Theory</td><td></td><td></td></tr> <tr> <td>2. Atomist Universe</td><td></td><td></td></tr> </tbody> </table>		Theory	Classification	Justification	Example: Theory of Divine Creation	Religious	This view comes from traditional religious writings, such as the <i>Book of Genesis</i> . It explains the origin of the universe as the result of a deliberate act by a supreme being, rather than as the result of natural or physical forces.	1. Big Bang Theory			2. Atomist Universe		
Theory	Classification	Justification												
Example: Theory of Divine Creation	Religious	This view comes from traditional religious writings, such as the <i>Book of Genesis</i> . It explains the origin of the universe as the result of a deliberate act by a supreme being, rather than as the result of natural or physical forces.												
1. Big Bang Theory														
2. Atomist Universe														

3. Steady State Theory		
4. Brahmanda (Cosmic Egg)		
5. Aristotelian Universe		
6. Heliocentric Universe		
7. Ptolemaic System		
8. Oscillating Universe Theory		
9. Inflationary Theory		

Option 2: Multiple Choices

Directions: Carefully read each question and select the best answer from the options provided. Write your answers in the space given.

_____ 1. Which chronological order best represents the evolution of human ideas about the cosmos, starting from the earliest to the most recent?

- A. Brahmanda, Divine Creation, Aristotelian, Atomist, Ptolemaic, Heliocentric, Big Bang, Inflationary
- B. Divine Creation, Brahmanda, Atomist, Aristotelian, Heliocentric, Ptolemaic, Big Bang, Inflationary
- C. Divine Creation, Atomist, Brahmanda, Aristotelian, Heliocentric, Ptolemaic, Steady State, Big Bang
- D. Brahmanda, Atomist, Aristotelian, Heliocentric, Ptolemaic, Steady State, Big Bang, Inflationary

Answer: B. Divine Creation, Brahmanda, Atomist, Aristotelian, Heliocentric, Ptolemaic, Big Bang, Inflationary

_____ 2. According to the Oscillating Universe Theory, which statement accurately describes the nature of the universe?

- A. The universe began once and will eventually end in a state of heat death.
- B. New matter is continuously generated to keep the universe's density constant.
- C. The universe experiences endless cycles of expansion followed by contraction.
- D. The Sun occupies the center, with stars fixed in their positions.

Answer: C. The universe experiences endless cycles of expansion followed by contraction.

_____ 3. What key characteristic differentiates the Brahmanda (Cosmic Egg) model from the Aristotelian concept of the universe?

- A. Earth remains immobile at the center of a system of nested spheres.
- B. The cosmos operates cyclically, undergoing phases of expansion and contraction.
- C. Celestial bodies move around the Sun in perfect circular orbits.

D. The universe consists of indivisible atoms existing in empty space.

Answer: B. The cosmos operates cyclically, undergoing phases of expansion and contraction.

____ 4. A philosopher suggests that all matter consists of tiny, indivisible particles moving through empty space and that no divine force is necessary for the universe's existence. Which cosmological model does this philosophy represent?

- A. Atomist Universe
- B. Aristotelian Universe
- C. Steady State Theory
- D. Big Bang Theory

Answer: A. Atomist Universe

____ 5. What is the primary improvement that the Inflationary Theory offers over the traditional Big Bang Theory?

- A. It places Earth at the universe's center.
- B. It accounts for the universe's rapid initial expansion and its large-scale uniformity.
- C. It suggests matter is constantly created to maintain a stable density.
- D. It describes the universe as undergoing cycles of expansion and contraction.

Answer: B. It accounts for the universe's rapid initial expansion and its large-scale uniformity.

____ 6. How does the Steady State Theory fundamentally contradict the observational evidence that supports the Big Bang Theory?

- A. It completely rejects the idea that the universe is expanding.
- B. It proposes an eternal, unchanging universe, conflicting with the discovery of cosmic microwave background radiation.
- C. It insists that Earth is the central point of the universe.
- D. It forecasts repetitive cycles of contraction and expansion rather than ongoing expansion.

Answer: B. It proposes an eternal, unchanging universe, conflicting with the discovery of cosmic microwave background radiation.

____ 7. Which example best demonstrates the practical impact of adopting the Heliocentric model in explaining planetary motion?

- A. Understanding why planets sometimes seem to move backward (retrograde motion) in the sky.
- B. Calculating the exact time frame for a possible Big Crunch.
- C. Showing that the universe has no beginning or end.
- D. Explaining how the universe maintains a constant density.

Answer: A. Understanding why planets sometimes seem to move backward (retrograde motion) in the sky.

____ 8. What philosophical similarity exists between the Theory of Divine Creation and the Brahmanda Universe model?

- A. Both use mathematical epicycles to describe planetary orbits.
- B. Both rely on a central divine or cosmic principle to explain the origin of the universe.

	<p>C. Both are based on observable, testable phenomena. D. Both describe an immediate exponential expansion of the universe right after its origin. Answer: B. Both rely on a central divine or cosmic principle to explain the origin of the universe.</p> <p>____ 9. If someone claims that “the universe has been expanding from a singular origin point for billions of years and continues to do so,” which cosmological model are they referring to? A. Big Bang Theory B. Steady State Theory C. Oscillating Universe Theory D. Aristotelian Universe Answer: A. Big Bang Theory</p> <p>____ 10. Among all cosmological theories, what is the strongest reason for the transition from philosophical or religious explanations to modern scientific models? A. Early models were overly simplistic and thus discarded. B. Empirical discoveries, such as redshift and cosmic microwave background radiation, enabled the creation of models that can be tested and predicted. C. Philosophical models were purely metaphorical and never intended as scientific explanations. D. Previous models incorrectly assumed the Earth or Sun as the universe’s center. Answer: B. Empirical discoveries, such as redshift and cosmic microwave background radiation, enabled the creation of models that can be tested and predicted.</p>
VI. REFLECTION <i>(Feedback and Continuous Improvement)</i>	<p>In this section, teachers are encouraged to record important observations during the teaching and learning process, such as learners’ behavior, participation, engagement, and performance on assessment. Teachers should reflect on which strategies worked well, which parts of the lesson learners found difficult, and what adjustments should be made to address those difficulties. They should also note potential improvements for future lessons. These reflections help identify best practices and areas for improvement in instruction.</p>
VII. USE OF GENERATIVE AI	<p>In preparing this Learning Exemplar (LE), the author(s) used Google Gemini and Grammarly to enhance the coherence and grammar of the content, activities, assessment. The author(s) reviewed and finalized the writing of the content. The author(s) take full responsibility for the content of this LE.</p>

Lesson Title/Topic	The Characteristics of Celestial Objects Present in the Solar System	Lesson Exemplar	2
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I. OBJECTIVE	
A. Content Standard	The learners learn that the objects making up the universe have distinct characteristics.
B. Performance Standard	By the end of the quarter, learners describe the origin of the solar system and Earth's historical evolution. They relate Earth's unique position in the solar system to its composition, structure, and the dynamic nature of its outer layers. Learners explain how scientists determine the nature of Earth's interior. They also collaboratively create detailed models and scientific analyses and use evidence-based findings to illustrate the nature and composition of the Earth.
C. Learning Competencies	The learners distinguish the characteristics of celestial objects present in the solar system, including moons, asteroids, meteoroids, and comets.
II. REFERENCES and MATERIALS (<i>Selecting Resources and Materials</i>)	<ul style="list-style-type: none"> • "Meteoroid." 2024. Nationalgeographic.org. 2024. https://education.nationalgeographic.org/resource/meteoroid/5th-grade/. • NASA. "Dwarf Planets." <i>NASA Science</i>. Last modified April 29, 2025. Accessed March 28, 2026. https://science.nasa.gov/dwarf-planets/ • National Aeronautics and Space Administration (NASA). "Asteroids." <i>NASA Science</i>. Last modified 2024. https://science.nasa.gov/solar-system/asteroids/ "Meteoroid." 2024. Nationalgeographic.org. 2024. https://education.nationalgeographic.org/resource/meteoroid/5th-grade/. • Tallassee City Schools. <i>Earth Science Book</i> (PDF). Tallassee, AL: Tallassee City Schools. Accessed March 28, 2026. https://images.pcmac.org/SiSFiles/Schools/AL/TallasseeCitySchools/TallasseeHigh/Uploads/DocumentsCategories/Documents/ES_BOOK.pdf
III. CONTENT (<i>Sequencing Content</i>)	The Characteristics of Celestial Objects Present in the Solar System
IV. OBJECTIVES (<i>Setting Clear Objectives and Analyzing the Tasks</i>)	<ol style="list-style-type: none"> 1. Recall basic celestial objects that can be found in the solar system 2. Distinguish the unique characteristics of asteroids and meteoroids by describing their composition, location, orbit, and activity 3. Distinguish the unique characteristics of moons and comets by describing their composition, location, orbit, and activity 4. Using a table or chart, classify different celestial objects present in the solar system that include their key characteristics and examples

ANNOTATIONS

IV. PROCEDURES

(Selecting Strategies, Making Meaningful Content, Delivering Lessons, and Assessing Learning)

**Instruction to the teacher on how to facilitate the activities.*

**In the Annotation, explicitly explain how the IDF is applied in each part of the lesson*

A. Activating Prior Knowledge

1. Activating Prior Knowledge Name That Space Object!

Procedures:

1. Show a series of images of celestial objects using PowerPoint, Canva slides, or printed posters. Include objects such as:
 - Stars
 - Planets and dwarf planets
 - Natural satellites (moons)
 - Comets
 - Asteroids
 - Meteoroids
 - Galaxies
2. Ask learners to look closely at each image and write down all the celestial objects they recognize on a piece of paper.
3. After showing all images, have learners swap their papers with a classmate to check each other's answers.
4. Go through the images one by one and present the correct answers while learners mark their classmates' work.
5. After checking, lead a brief discussion by asking learners:
 - Which objects were easy and difficult to identify, and why?
6. Collect answers and feedback from the learners.

Note to the teacher:

Provide images of the enumerated celestial objects. Then, start the activity by showing the images to the class one by one. Ask learners to identify and write down the names of the objects they recognize. Afterward, have them exchange papers with a seatmate for peer checking. Then, facilitate a brief discussion on which objects were easy or difficult to identify and why, emphasizing that similar features can make some objects challenging to distinguish.

IDF Application:

This activity focuses on the learners. It engages them by tapping into what they already know about celestial objects. Using images helps them identify and understand the task. The activity serves as a relevant introduction, linking what they know to the upcoming lesson.

	<p>2. Establishing the Purpose of the Lesson The Interplanetary Travel Agent Procedures</p> <ol style="list-style-type: none"> Set the scene in an engaging way by letting the learners read it: “You are a travel agent in the future who specializes in space tourism. Today, you have four clients with specific and unusual requests.” <ul style="list-style-type: none"> • Client 1: Wants to go ice skating on a “dirty snowball” that travels in a long, oval path around the Sun. • Client 2: Wants to mine for valuable materials like gold, iron, and other heavy metals while staying within the belt. • Client 3: Wants to visit a world that orbits a planet instead of the Sun. • Client 4: Wants to observe a “space pebble,” a small rocky fragment, before it enters an atmosphere and becomes a streak of light. Let learners think individually for a few seconds. Then, have them discuss their answers in pairs or small groups. <ul style="list-style-type: none"> • Expected answers: <ul style="list-style-type: none"> ○ Client 1 → Comet ○ Client 2 → Asteroid ○ Client 3 → Moon ○ Client 4 → Meteoroid Affirm learners’ responses and highlight the key idea: Understanding the characteristics of celestial objects is important because it helps us make informed decisions, just like real scientists and space explorers. 	<p>Note to the teacher: <i>Present the scenario of the four future clients and explain each client’s specific request. Ask learners to consider which celestial object fits each client’s needs. Have learners share their answers while the teacher listens and clears up any misunderstandings. Highlight the importance of understanding the characteristics of comets, asteroids, moons, and meteoroids, and link the activity to real-world applications and to the new lesson. Finally, clearly state the learning objectives so learners understand what they need to accomplish at the end of the lesson.</i></p> <p>IDF Application: <i>Setting a scene makes the activity more relevant and easier for learners to relate to. Collaborative learning happens when they work in pairs or small groups. Connecting the activity to real-life situations makes learning more effective and engaging for the learners.</i></p>
<p>B. Instituting New Knowledge</p>	<p>1. Presenting Examples Think – Pair – Share: “Same or Different” Procedures:</p> <ol style="list-style-type: none"> Show two pairs of celestial objects (a moon and an asteroid, and a comet and a meteoroid) using images or video clips showing their appearance and behaviors or activities. Ask: <ul style="list-style-type: none"> ○ What do you notice about these two? ○ How are they similar to each other? ○ How are they different? 	<p>Note to the teacher: <i>Let learners think independently, then discuss with a partner using observable traits like appearance and activity. Ensure both contribute and justify their answers. Guide sharing by organizing ideas through a Venn diagram. Validate evidence-based responses and address misconceptions through questions.</i></p>

	<p>3. Guide them to focus on the appearance and on the activities of these celestial objects.</p> <p>5. Learners pair up and compare their answers.</p> <p>6. Each pair must agree on at least two similarities and two differences and justify their answers based on their observations. Record answers using a Venn diagram.</p> <p>7. Conclude, "You have already identified key characteristics of these celestial objects. Let us now explore these features more deeply so we can clearly distinguish and classify each one."</p> <p>2. Discussing New Concept Teacher-led Discussion Procedures:</p> <p>1. Distinguish the unique characteristics of asteroids and moons, and meteoroids and comets by describing their composition, location, orbit, and activity through a discussion.</p> <p>2. Access the content of the discussion through the link below:</p> <ul style="list-style-type: none"> • https://drive.google.com/drive/folders/1rJo3cE-wKlHk1i5PF-M7gM7nczWy5wIx?usp=drive_link <p>3. Provide a check for understanding activity after the discussion by giving drills.</p> <p>4. Kindly verify the contents using the links below:</p> <ul style="list-style-type: none"> • https://images.pcmac.org/SiSFiles/Schools/AL/TallasseCitySchools/TallasseeHigh/Uploads/DocumentsCategories/Documents/ES_BOOK.pdf • https://science.nasa.gov/dwarf-planets/ • https://science.nasa.gov/solar-system/asteroids/ • https://education.nationalgeographic.org/resource/meteoroid/5th-grade/ 	<p><i>Conclude by linking their observations to the lesson, emphasizing how these traits help in classifying celestial objects.</i></p> <p>IDF Application: <i>The Think-Pair-Share activity fosters learners' critical thinking by using a Venn diagram. Graphic organizers help improve learners' cognitive skills.</i></p> <p>Note to the teacher: <i>Conduct the discussion using PowerPoint or Canva slides. Use visuals, diagrams, or short prompts to help learners understand abstract ideas. Focus on the composition, location, orbit, and activity of each celestial object. This can be done effectively by comparing the asteroids to moons, and meteoroids to comets. Connect their features to previous activities to reinforce learning.</i></p> <p>IDF Application: <i>The teacher leads the discussion of the content while ensuring that learners actively participate. Allowing learners to read and explain what they know about the topic helps maintain a learner-centered instructional environment.</i></p>
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	<p>3. Developing Mastery Cosmic Sorting Center Procedures</p> <ol style="list-style-type: none"> 1. Prepare a set of mystery object cards, each with several descriptive clues about a celestial object. This method encourages learners to examine various traits to identify each object correctly. Examples of mystery cards include: Mystery A: Mainly made of ice, it follows a highly elliptical orbit and develops a glowing tail when near the Sun. (Answer: Comet) Mystery B: Made of rock and metal, found mainly in a belt between Mars and Jupiter, orbits the Sun. (Answer: Asteroid) Mystery C: Made of solid rock, moves in a nearly circular orbit around a planet, and reflects sunlight. (Answer: Moon) Mystery D: A small rocky fragment drifting through interplanetary space, not confined to any specific belt or region. (Answer: Meteoroid) 2. Have learners work individually or in small groups to analyze the clues on each card and match the mystery object to the correct celestial body. 3. Move around the classroom to observe learners' reasoning, promote deeper critical thinking, and clear up any misunderstandings. 4. Once learners have completed their identifications, reveal the correct answers and briefly review the key features of each celestial object type. 5. Emphasize the importance of considering traits such as composition, orbit, location, and activity when classifying celestial objects in the solar system. 	<p>Note to the teacher: <i>Begin by preparing a set of mystery object cards. Make sure the texts are visible to the learners so they can read them clearly. Have them work individually or in small groups. Ensure that everyone is participating by moving around the classroom. Observe how the learners behave and engage. After they answer, reveal the correct answers and highlight the key features of each type of celestial object to reinforce their understanding of the topic. Stress the importance of considering different traits, such as composition, orbit, location, and activity, when classifying celestial objects in the solar system.</i></p> <p>IDF Application: <i>This activity encourages collaboration among the learners. It acts as a drill that gives them a chance to master the lesson. The mystery card activity engages their thinking.</i></p>
<p>2. Demonstrating Knowledge and Skills</p>	<p>1. Finding Practical Application Option 1: Earth-Space Connection Procedures:</p> <ol style="list-style-type: none"> 1. After the class discussion, have learners fold an index card or a sheet of paper into three labeled sections: Resources, Protection, and History. 	<p>Note to the teacher: <i>Guide learners to connect lesson content to real-world applications using index cards or paper sections. Encourage thoughtful responses by prompting learners to provide</i></p>

	<ol style="list-style-type: none"> 2. Provide guiding questions for each section: <ul style="list-style-type: none"> • Resources: "Between asteroids and meteoroids, which would be the more viable source for mining rare metals, and why?" • Protection: "Why is it important for organizations like PAGASA or NASA to monitor meteoroids and asteroids daily?" • History: "How might comets, often called 'dirty snowballs,' have helped deliver water to Earth's oceans?" 3. Ask learners to write thoughtful responses in each section, using evidence and reasoning from the lesson. 4. Facilitate a class-sharing session in which learners present their ideas, compare viewpoints, and discuss the practical importance of celestial objects to Earth's resources, safety, and history. 5. Conclude by stressing the real-world importance of understanding celestial bodies and connecting insights to the lesson's goals. <p>Option 2: The Solar System Daily News Report Procedures</p> <ol style="list-style-type: none"> 1. Divide the class into small groups called "News Teams." 2. Assign each team a specific Breaking News scenario: <ul style="list-style-type: none"> Meteoroid Desk: Report on a recent meteor shower. Explain that meteors are fragments of a parent body (comet or asteroid) and why they glow in the atmosphere. Asteroid Watch: Report on a Near-Earth Object (NEO) flyby. Explain its rocky makeup and the potential consequences if its orbit crosses Earth's path. Comet Hunter: Report on a long-period comet visible from Earth. Explain how its coma or tail forms and why it appears only every few decades or centuries. Moon Mission: Report on a lunar eclipse or a mission to find water-ice on a moon. 3. Each team gives a 3-minute "Live Report." 	<p><i>evidence from the discussion and previous activities. During the class sharing session, make sure all learners can contribute. Facilitate discussion by pointing out connections between celestial objects and Earth's resources, protection, and history.</i></p> <p>IDF Application: <i>This activity helps learners recognize the importance of the lesson in real-world contexts. It strengthens the connection between theory and practical application, making the learning more meaningful. Through this, learners become more aware of celestial objects and their significance.</i></p> <p>Note to the teacher: <i>Set a lively, cooperative tone for this activity. Encourage learners to take charge of their "News Team" roles. Make sure each group understands their scenario and the key characteristics they need to report on. Remind them to use visual aids to support their explanations and to ensure the information is interesting and correct. During the live reports, watch the audience to ensure they join in on fact-checking and identifying key characteristics. After all the presentations, lead a class discussion to point out connections to real-world issues, including resources, protection from hazards,</i></p>
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4. Learners use a visual aid (a drawing, diagram, or simulated satellite image) to show key features, such as the comet's icy tail or the asteroid's rocky surface. After each report, the audience fact-checks. Learners identify one key feature from the report that helps confirm the object's correct identification.
5. Facilitate a class discussion that connects the activity to real-world relevance, including:
 - Earth's resources (asteroids or comets as possible sources)
 - Protection from potential hazards (NEO monitoring)
 - Scientific discovery (missions to moons, watching meteor showers)
6. Use the rubrics below.

Criteria	Excellent (4)	Good (3)	Fair (2)	Needs Improvement (1)
Content Accuracy	All information is correct and clearly explained.	Most information is correct.	Some information is correct.	Mostly incorrect or missing
Visual Aid	Clear and helps understanding	Mostly clear	Somewhat unclear	Missing or confusing
Presentation	Confident, organized, all members participate	Mostly clear, minor issues	Somewhat unclear; few participate	Unclear, disorganized, few/no participation
Real-world connection	Clearly links objects to Earth's	Connection mostly clear	Weak or unclear connection	No connection

and scientific discovery. Use the rubric to give structured feedback, focusing on both content accuracy and communication skills. Reinforce the importance of connecting observations to practical applications in space science.

IDF Application:

Taking on the role of a news reporter in this activity makes learning engaging and meaningful. Learners have the chance to experience a role they may pursue in college or future jobs. This helps them see the lesson's value in real-life situations. The activity builds a strong link between theory and practical use, making learning more important. Using rubrics gives clear guidance and expectations. This allows learners to track their performance and take responsibility for their own learning.

	resources, hazards, or discovery				
<p>2. Making Generalization Option 1: 3-2-1 Exit Slip Procedures:</p> <ol style="list-style-type: none">1. On a sheet of paper or index card, write:<ol style="list-style-type: none">a. Three things you learned today about celestial objects.b. Two insights or connections you noticed among the objects.c. One question you still have or one thing you wonder about.2. Pair up or form small groups to discuss your answers.3. Provide clarifications or corrections if needed.4. Highlight strong insights and generalizations that come from learners' connections.					<p>Note to the teacher: <i>Encourage honest and thoughtful responses. Allow learners to discuss their answers in pairs or small groups to create deeper connections. Clarify misconceptions as they arise. Ask probing questions and point out strong insights or patterns that come up. Conclude by highlighting the key generalizations learners made and showing how these connections support the lesson’s goals.</i></p> <p>IDF Application: <i>The 3-2-1 Exit Slip activity helps learners summarize what they have learned. It offers a clear way to organize their thoughts and see the overall concept. This also allows learners to think logically before combining their ideas.</i></p>
<p>Option 2: “Celestial Venn Diagram Challenge” Procedures</p> <ol style="list-style-type: none">1. Provide a Venn diagram template for each group. You can draw it on the board, project it, or print it out.2. Assign each group a specific pair of celestial objects to compare:<ul style="list-style-type: none">• Moon and Asteroid• Comet and Meteoroid3. Divide learners into small groups and give each group one pair of objects.					<p>Note to the teacher: <i>Guide learners to use their prior knowledge and reference materials to analyze the characteristics of moons, asteroids, comets, and meteoroids. Encourage collaboration within groups and ensure all members participate in completing the Venn diagram. When groups share their generalizations, lead a discussion to confirm and improve their ideas.</i></p>

	<ol style="list-style-type: none"> 4. Instruct them to examine the characteristics of their assigned celestial objects using previous activities, notes, or reference materials. 5. Ask learners to complete the Venn diagram by: <ul style="list-style-type: none"> • Writing the unique characteristics of each object in the non-overlapping sections. • Writing the shared characteristics (such as composition, motion, or behavior) in the overlapping section. 6. Have each group write one general statement based on their comparison. 7. Let groups present their Venn diagram and share their general statement with the class. 8. Facilitate a class discussion to connect all group results, confirm answers, and summarize the main similarities and differences among the celestial objects. 	<p><i>highlighting important similarities and differences. End by emphasizing that observing patterns across objects helps classify and understand celestial bodies.</i></p> <p>IDF Application: <i>Using graphic organizers, such as Venn diagrams, helps learners structure information. This improves their comprehension and critical thinking. The activity guides learners in organizing key ideas and showing their connections, leading to stronger generalizations. Teacher facilitation makes sure concepts are correct and that misconceptions are cleared up.</i></p>
<p>V. ASSESSMENT <i>(Assessing Learnings)</i></p>	<p>Option 1: Multiple Choices Directions: Carefully read each question and select the best answer from the options provided. Write your answers in the space provided.</p> <p>____ 1. A “dirty snowball” from the outer solar system approaches the Sun and develops a bright tail. What can you infer about its composition and origin?</p> <ol style="list-style-type: none"> A. It is rocky and metallic, formed in the Asteroid Belt B. It is icy with dust and frozen gases, coming from the Kuiper Belt or Oort Cloud C. It is a fragment of a moon D. It is a small planet orbiting another planet <p>Answer: B. It is icy with dust and frozen gases, coming from the Kuiper Belt or Oort Cloud</p> <p>____ 2. If a meteoroid enters Earth’s atmosphere and creates a bright streak of light, how would you classify it during this phase, and what might it become if it lands on Earth?</p> <ol style="list-style-type: none"> A. Asteroid, a comet if it survives B. Meteor, a meteorite if it survives C. Moon, a meteoroid if it disintegrates D. Comet, an asteroid, if it lands <p>Answer: B. Meteor, a meteorite if it survives</p> <p>____ 3. Asteroids are mostly inactive and concentrated in a belt between Mars and Jupiter. Given this, what challenges would a spacecraft face if it tried to land on one?</p> <ol style="list-style-type: none"> A. Strong gravity is pulling it in B. Lack of atmosphere and irregular surface shapes 	

- C. High temperatures and active volcanic activity
- D. Tidal forces affecting its orbit

Answer: B. Lack of atmosphere and irregular surface shapes

____ 4. Most comets follow highly elliptical orbits around the Sun. How would this shape influence the frequency and visibility of comets from Earth?

- A. They are visible continuously.
- B. They appear briefly when near the Sun, then retreat far away.
- C. They never approach Earth.
- D. They remain in a circular orbit in the Asteroid Belt.

Answer: B. They appear briefly when near the Sun, then retreat far away

____ 5. If a planet has a small moon versus a large moon, how would its tides and axial stability be affected?

- A. Both tides and stability would be more significant with a large moon.
- B. Small moons cause stronger tides.
- C. Axial stability is unrelated to the moon's size.
- D. Tides only depend on comets.

Answer: A. Both tides and stability would be more significant with a large moon

Option 2: Justification and Application

Instructions: Answer the following questions in complete sentences.

1. Explain one unique characteristic that distinguishes a moon from an asteroid.
2. Why do comets form tails, but asteroids do not?
3. If a small meteoroid were to enter Earth's atmosphere, what would it become, and why?
4. Which celestial object could be mined for rare metals, and what characteristics make it suitable?
5. Imagine you are planning a space mission. Which object would be safer to visit—a Moon or a Meteoroid? Explain your reasoning based on orbit, activity, and size.

	<table><tr><th>Score</th><th>Criteria</th></tr><tr><td>5</td><td>The answer is fully correct, well-explained, and supported by clear details. Complete sentences show a solid understanding of the concepts.</td></tr><tr><td>4</td><td>The answer is mostly correct but has minor inaccuracies or omissions. The explanation is clear, but it lacks some detail. The justification is mostly reasonable.</td></tr><tr><td>3</td><td>The answer is partially correct. The explanation is basic or a bit unclear. The justification is weak or incomplete. Some key concepts might be missing or mixed up.</td></tr><tr><td>2</td><td>The answer shows limited understanding. It contains significant errors or misconceptions. The explanation and justification are unclear or incomplete.</td></tr><tr><td>1</td><td>Answer is incorrect, off-topic, or not provided. No clear explanation or justification is given.</td></tr></table>	Score	Criteria	5	The answer is fully correct, well-explained, and supported by clear details. Complete sentences show a solid understanding of the concepts.	4	The answer is mostly correct but has minor inaccuracies or omissions. The explanation is clear, but it lacks some detail. The justification is mostly reasonable.	3	The answer is partially correct. The explanation is basic or a bit unclear. The justification is weak or incomplete. Some key concepts might be missing or mixed up.	2	The answer shows limited understanding. It contains significant errors or misconceptions. The explanation and justification are unclear or incomplete.	1	Answer is incorrect, off-topic, or not provided. No clear explanation or justification is given.
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<div><div><div>VI. REFLECTION</div><div>(Feedback and Continuous Improvement)</div></div><div><p>In this section, teachers are encouraged to record important observations during the teaching and learning process, such as learners’ behavior, participation, engagement, and performance on assessment.</p><p>Teachers should reflect on which strategies worked well, which parts of the lesson learners found difficult, and what adjustments should be made to address those difficulties. They should also note potential improvements for future lessons. These reflections help identify best practices and areas for improvement in instruction.</p></div></div>													
<div><div><div>VII. USE OF GENERATIVE AI</div></div><div><p>In preparing this Learning Exemplar (LE), the author(s) used Google Gemini and Grammarly to enhance the coherence and grammar of the content, activities, and assessments. The author(s) reviewed and finalized the writing of the content. The author(s) take full responsibility for the content of this LE.</p></div></div>													

Lesson Title/Topic	Earth's Position Within the Solar System	Lesson Exemplar	3
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I. OBJECTIVES	
A. Content Standard	The learners learn that the Earth is the only planet in the solar system that supports life
B. Performance Standard	By the end of the quarter, learners describe the origin of the solar system and Earth's historical evolution. They relate Earth's unique position in the solar system to its composition, structure, and the dynamic nature of its outer layers. Learners explain how scientists determine the nature of Earth's interior. They also collaboratively create detailed models and scientific analyses and use evidence-based findings to illustrate the nature and composition of the Earth.
C. Learning Competencies	The learners describe the features of Earth that classify it as a habitable planet able to support life, and relate these features to its position in the solar system.
II. REFERENCES and MATERIALS	<ul style="list-style-type: none"> • European Space Agency. "ESA Kids - Home Page - Explore." European Space Agency. Accessed May 24, 2024. https://www.esa.int/kids/en/home. • Kasting, James F., Daniel P. Whitmire, and Ray T. Reynolds. "Habitable Zones Around Main Sequence Stars." <i>Icarus</i> 101, no. 1 (1993): 108-128. • NASA. "Exoplanet Exploration: Planets Beyond our Solar System." NASA. Accessed May 24, 2024. https://exoplanets.nasa.gov/. • NASA. "Solar System Exploration." NASA. Accessed May 24, 2024. https://solarsystem.nasa.gov/. • National Geographic Society. "Our Focus: Space." National Geographic Society. Accessed May 24, 2024. https://www.nationalgeographic.org/society/our-focus/space/. • National Geographic Society. "Space." National Geographic. Accessed May 24, 2024. https://www.nationalgeographic.com/science/space. • Nisbet, Euan G., and Christopher F. Chyba. "Comparative Habitability of the Earth, Venus and Mars in the Young Solar System." In <i>European Planetary Science Congress 2008</i>, 844. 2008. https://ui.adsabs.harvard.edu/abs/2008epsc.conf..844N. • Tuthill, George, and Kim Obbink. "Center for Educational Resources (CERES) Project." NASA/Center for Educational Resources Project/Montana State University. https://ask.orkg.org/item/5214717/Center-for-Educational-Resources-(CERES)-Project.
III. CONTENT	Earth's Position Within the Solar System

IV. OBJECTIVES	<ol style="list-style-type: none"> 1. Identify the key features of Earth that allow it to support life. 2. Describe how Earth's position in the solar system influences these features that make it habitable. 3. Compare how the positions of different planets in the solar system affect their ability to support life. 	
IV. PROCEDURES	ANNOTATIONS	
A. Activating Prior Knowledge	<p>A. Activating Prior Knowledge To activate learners' prior knowledge, the teacher begins by engaging them in a short discussion about the basic requirements for life and the environments in which living organisms can survive.</p> <p>• Reflect The teacher asks learners to consider the environments where living organisms can survive and grow. The teacher then poses the following question: "What conditions do living organisms need in order to survive and sustain life?" Learners are given a few moments to think about their responses based on their prior knowledge from previous science subjects, such as Biology and Earth Science.</p> <p>• Share Ideas The teacher invites several learners to share their responses. As learners answer, the teacher lists key ideas on the board, such as:</p> <ul style="list-style-type: none"> • <i>Liquid water</i> • <i>Suitable temperature range</i> • <i>Atmosphere</i> • <i>Energy source (such as sunlight)</i> <p>The teacher asks follow-up questions to deepen learners' thinking:</p> <ul style="list-style-type: none"> • Why is liquid water important for living organisms? • How does temperature influence the survival of living things? • Why is an atmosphere important for life on a planet? <p>Learners briefly explain their ideas.</p>	<p><i>This activity activates prior knowledge by prompting students to recall basic life requirements from earlier science lessons. The Reflect-Share-Connect structure builds confidence through individual thinking before group sharing, while allowing you to assess what students already know.</i></p> <ul style="list-style-type: none"> • <i>Give students genuine thinking time—count silently to ten after asking the Reflect question, then call for answers. This "wait time" dramatically improves the quality of responses, especially for students who process more slowly.</i> • <i>When students share, resist the urge to immediately correct partially incorrect answers. Instead, say "That's interesting, tell me more" or write it on the board with a question mark. This keeps the atmosphere safe and encourages participation.</i>

	<p>• Connect The teacher then asks the class: “Considering these conditions, why do you think Earth is capable of sustaining life while many other planets cannot?” Learners provide their initial ideas. The teacher acknowledges their responses and explains that Earth has specific environmental and physical features that enable it to maintain life-supporting conditions. The teacher explains that these characteristics will be examined in the lesson.</p> <p>B. Establishing the Purpose of the Lesson After learners recall the basic conditions necessary for life, the teacher introduces the importance of understanding why Earth can sustain life. The teacher explains that scientists study Earth's characteristics to understand why life exists on our planet and to determine whether similar conditions might exist elsewhere in the universe. To emphasize the lesson's relevance, the teacher may conduct one of the following activities.</p> <p>Option 1: Searching for Habitable Planets The teacher presents the following scenario: <u>“Scientists are currently searching for planets beyond our solar system that could potentially support life. To determine whether a planet might be habitable, scientists must compare its characteristics with those of Earth.”</u> The teacher then asks learners:</p> <ul style="list-style-type: none"> • Why do scientists study the characteristics of Earth when searching for habitable planets? • What features of Earth might scientists look for in other planets? <p>Learners share their responses briefly. The teacher then explains that understanding the features that allow Earth to support life helps scientists evaluate whether other planets might also be capable of sustaining life.</p>	<ul style="list-style-type: none"> • <i>The Connect question is your chance to spot misconceptions early. Listen for whether students blame Earth's life on luck, God's design, or random chance—these are entry points for the scientific explanations to come.</i> <p><i>This section answers the crucial "why" question that students naturally ask. By connecting the lesson to real-world science—such as searching for habitable exoplanets or exploring human survival on other planets—you make the content immediately relevant and personally meaningful, which boosts engagement and curiosity.</i></p> <ul style="list-style-type: none"> • <i>When presenting the scenario, use an excited tone, as if you're sharing breaking news. Say "Scientists just discovered..." rather than "Scientists are searching..." to create a sense of immediacy.</i> • <i>For Option 1, show a quick image of an exoplanet from NASA's website—it takes seconds, but makes it real.</i>
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	<p>Option 2: Survival on Another Planet</p> <p>The teacher presents the following situation: “Visualize that humans must live on another planet in the future. Before choosing a planet, scientists must determine whether it has conditions suitable for human survival.”</p> <p>The teacher asks learners:</p> <ul style="list-style-type: none"> • What conditions would humans need in order to survive on another planet? • Which of these conditions already exist on Earth? <p>Learners briefly share their ideas.</p> <p>The teacher lists the responses on the board and highlights important conditions such as water, atmosphere, temperature, and energy from the Sun.</p> <p>The teacher explains that these conditions are related to the key features that allow Earth to support life, which will be examined in the lesson.</p>	<ul style="list-style-type: none"> • <i>For Option 2, ask "Who here would volunteer to live on another planet?" to get hands raised and personal investment. Either way, spend no more than 5 minutes here; the goal is sparking interest, not deep discussion.</i>
<p>B. Instituting New Knowledge</p>	<p>1. Presenting Examples</p> <p>Begin Day 2 with a short review of the ideas discussed in the previous lesson about the features of Earth that allow it to support life.</p> <p>To introduce the new concept, the teacher presents several examples of planets in the solar system and briefly describes their environmental conditions.</p> <p>The teacher explains that:</p> <ul style="list-style-type: none"> • Mercury is very close to the Sun and experiences extremely high temperatures. • Mars is much farther from the Sun and has very cold surface conditions. • Earth lies between these two planets and maintains temperatures that allow liquid water to exist. <p>The teacher then asks the learners the following guide questions:</p> <ul style="list-style-type: none"> • How does a planet's distance from the Sun impact its temperature? • Why might planets that are too close or too far from the Sun have difficulty supporting life? 	<p><i>This part introduces the core concept using concrete, relatable examples from our own solar system. By comparing Mercury, Earth, and Mars, students can intuitively grasp the relationship between distance and temperature before you introduce formal terms like "habitable zone." The examples create a mental anchor for new learning.</i></p> <ul style="list-style-type: none"> • <i>Use a simple diagram on the board—draw the Sun and the three planets at their approximate distances. Point to each as you describe it so visual learners can connect the position with the conditions. When asking the guide questions, call on different students for each one to keep everyone engaged. If a student struggles, rephrase: "So if Mercury is burning hot and Mars</i>

	<ul style="list-style-type: none"> • How might Earth's distance from the Sun help maintain conditions that support life? <p>Learners share their initial ideas with the class. The teacher acknowledges their responses and explains that scientists study the position of planets relative to the Sun to understand why certain planets may or may not support life.</p> <p>After presenting the examples, the teacher guides learners in exploring the scientific explanation behind these differences. The teacher explains that the amount of energy a planet receives from the Sun depends on its distance from the Sun. This energy affects the planet's surface temperature and environmental conditions.</p> <p>The teacher introduces the idea that there is a specific region around the Sun where temperatures may allow liquid water to exist on a planet's surface. Scientists often refer to this region as the habitable zone.</p> <p>The teacher asks learners to reflect on the following questions:</p> <ul style="list-style-type: none"> • Why is liquid water important for living organisms? • How does Earth's distance from the Sun help maintain the right temperature for life? • What might happen if Earth were much closer to or much farther from the Sun? <p>Learners share their responses while the teacher clarifies key concepts. The teacher will emphasize that Earth's position allows it to receive a balanced amount of solar energy, which helps maintain suitable temperatures, stable environmental conditions, and the presence of liquid water.</p> <p>Carry out a brief activity to validate the learners' answers.</p> <p>Activity 1: Planet Investigation Task</p> <p>Procedure</p> <p>The teacher assigns learners into small groups and provides each group with information about different planets in the solar system, such as Mercury, Venus, Earth, and Mars.</p>	<p><i>is freezing cold, where does that leave Earth?" This leads them to discover the "just right" idea on their own.</i></p> <p><i>This section transitions students from concrete examples to scientific explanation by introducing the habitable zone concept. The hands-on activities then let students actively apply this new knowledge, moving from passive listening to collaborative investigation—which deepens understanding and retention.</i></p> <ul style="list-style-type: none"> • <i>When explaining the habitable zone, draw it on your board diagram: shade a "just right" region between too hot and too cold. This visual sticks better than words alone.</i> <p><i>For group activities, assign roles (leader, recorder, reporter) to ensure everyone participates. Give each group a printed card with planet data so they can physically hold and reference the information. Each card should include specific scientific data such as:</i></p> <p>Mercury – Average temperature: ~167°C (day up to 430°C, night down to -180°C);</p>
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	<p>Each group analyzes the following aspects:</p> <ul style="list-style-type: none"> • Distance from the Sun • Surface temperature conditions • Presence or absence of liquid water • Possibility of supporting life <p>Learners discuss how the planet's position in the solar system affects these conditions.</p> <p>After the analysis, each group answers the guiding question: "How does the position of a planet in the solar system influence its ability to support life?"</p> <p>Groups share their findings with the class.</p> <p>The teacher highlights that Earth's location provides balanced solar energy, which helps maintain moderate temperatures and the presence of liquid water, making life possible.</p> <p>Begin with a short review of the key ideas from Day 2, particularly how a planet's position relative to its star influences the conditions that make life possible.</p> <p>Instead of using Mercury, Venus, Earth, and Mars, students will think of an exoplanet system outside our solar system that is similar to ours.</p> <p>Conduct Activity No. 1:</p> <p>Planet Habitability Investigation (see Learning Activity Sheet).</p> <p><i>Instructions</i></p> <ol style="list-style-type: none"> 1. Students will examine how the positions of selected exoplanets relative to their star (similar to the Sun) affect their environmental conditions and ability to support life. 2. Using information provided by the teacher, learners will compare four hypothetical exoplanets (labeled A, B, C, and D) in terms of: <ul style="list-style-type: none"> ○ Relative position from their star ○ Amount of stellar energy received ○ Temperature conditions 	<p><i>Distance from Sun: 57.9 million km; Diameter: 4,879 km; Moons: 0</i></p> <p>Venus – Average temperature: ~464°C; Distance from Sun: 108.2 million km; Diameter: 12,104 km; Moons: 0</p> <p>Earth – Average temperature: ~15°C; Distance from Sun: 149.6 million km; Diameter: 12,742 km; Moons: 1</p> <p>Mars – Average temperature: ~-63°C; Distance from Sun: 227.9 million km; Diameter: 6,779 km; Moons: 2</p> <p><i>This Day 3 activity serves as the Main Investigative Task, in which students apply concepts from Day 2 by comparing hypothetical exoplanet data (or real data from an exoplanet system, if provided). Completing the table and answering the guide questions moves them from abstract understanding to concrete analysis, directly addressing all three learning objectives.</i></p> <ul style="list-style-type: none"> • Before distributing the activity sheet, do a quick 3-minute review: ask "What is the habitable zone?" and "Why would a planet in the right position relative to its star be more likely to support life?" This primes their memory for the task ahead,
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	<ul style="list-style-type: none">○ Presence or absence of conditions necessary for life																										
	3. After completing the table, learners will answer the guide questions using evidence from their comparison.																										
	<table><tr><th>Exoplanet</th><th>Relative Position from Star</th><th>Likely Temperature Condition</th><th>Key Effect of Position on the Planet</th><th>Does the Planet have Conditions Favorable for Life?</th></tr><tr><td>A</td><td></td><td></td><td></td><td></td></tr><tr><td>B</td><td></td><td></td><td></td><td></td></tr><tr><td>C</td><td></td><td></td><td></td><td></td></tr><tr><td>D</td><td></td><td></td><td></td><td></td></tr></table>		Exoplanet	Relative Position from Star	Likely Temperature Condition	Key Effect of Position on the Planet	Does the Planet have Conditions Favorable for Life?	A					B					C					D				
	Exoplanet		Relative Position from Star	Likely Temperature Condition	Key Effect of Position on the Planet	Does the Planet have Conditions Favorable for Life?																					
	A																										
	B																										
	C																										
	D																										
	<p><i>Guide Questions</i></p> <ul style="list-style-type: none">• How does a planet’s position relative to its star affect the amount of stellar energy it receives?• Why do planets closer to the star tend to have different conditions from planets farther away?• Among the exoplanets compared, which one has the most favorable position for supporting life? Why?																										
	<p>3. Developing Mastery</p> <p>Students will form groups of five and collaboratively create a concept map that explains how the positions of planets in the solar system influence their ability to support life. The concept map should connect the following key ideas:</p>																										
<p><i>without relying on Earth as the only example.</i></p> <ul style="list-style-type: none">• Distribute the Learning Activity Sheet and read the instructions aloud while students follow along. Clarify that the table must be completed first before moving to the questions—this prevents jumping ahead and missing evidence.• After individual work, consider a quick pair-share where students compare answers before a whole-class discussion.• End by asking selected students to share their answers to the guide questions, reinforcing correct reasoning (e.g., relating position to stellar energy and temperature) and gently correcting errors.																											
<p><i>This collaborative task requires students to synthesize everything they've learned into a visual framework. Creating concept maps helps cement understanding by forcing students to organize and connect ideas logically.</i></p> <ul style="list-style-type: none">• Before groups start, model a tiny concept map on the board using a different example (like "Sun → Energy → Temperature → Life"). Show how to use arrows and linking words. Assign each group one domain to focus on—this ensures depth and makes the																											

	<p>Planet Position→ Distance from the Sun→ Temperature Conditions→ Environmental Characteristics→ Ability to Support Life</p> <p>Students will use the information gathered from the previous Planet Comparison Analysis activity to organize their ideas.</p> <p>Domains to Map</p> <p>Each group will focus on one key factor related to planetary habitability.</p> <ul style="list-style-type: none">• Group 1: Distance from the Sun• Group 2: Surface Temperature• Group 3: Presence of Liquid Water• Group 4: Atmospheric Conditions• Group 5: Habitability Comparison of Planets <p>Each group will present its concept map to the class and Explain.</p> <p>Concept Map Rubric:</p> <table><tr><th>Criteria</th><th>3</th><th>2</th><th>1</th></tr><tr><td>Chain of Ideas</td><td>Complete & accurate</td><td>Mostly complete</td><td>Broken or wrong</td></tr><tr><td>Assigned Factor</td><td>Clearly connected</td><td>Vague connection</td><td>Missing</td></tr><tr><td>Evidence & Teamwork</td><td>Specific facts, a clean map, all contributed</td><td>General ideas, messy map, uneven teamwork</td><td>No facts, confusing map, little collaboration</td></tr></table> <p>Extend the Concept Mapping Activity. Select from the options below:</p> <p>Option 1: Planet Explanation Role-Play</p> <p>After presenting their concept maps, groups prepare a short explanation activity in which one member plays the role of a scientist to explain why a given planet cannot support life.</p> <p>Option 2: Digital Concept Mapping</p> <p>Students may use digital tools such as Canva, MindMeister, or Lucidchart to create a digital concept map showing the relationship between:</p>	Criteria	3	2	1	Chain of Ideas	Complete & accurate	Mostly complete	Broken or wrong	Assigned Factor	Clearly connected	Vague connection	Missing	Evidence & Teamwork	Specific facts, a clean map, all contributed	General ideas, messy map, uneven teamwork	No facts, confusing map, little collaboration	<p><i>gallery walk more valuable. During presentations, note misconceptions to address in your final synthesis.</i></p> <ul style="list-style-type: none">• <i>Set clear expectations—students should write one observation or question on a sticky note for each map they visit.</i>• <i>If tech is available, introduce one simple tool (Canva works well) and give a quick 2-minute demo. This builds 21st-century skills.</i>• <i>For brave classes, this is gold. Give groups 3 minutes to prepare a 1-minute "scientist explanation." The act of teaching others solidifies their own understanding.</i>
Criteria	3	2	1															
Chain of Ideas	Complete & accurate	Mostly complete	Broken or wrong															
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	<p>Planet Position – Solar Energy – Temperature – Environmental Conditions – Habitability</p> <p>Option 3: Gallery Walk After completing their concept maps, groups post their outputs around the classroom. Students rotate in groups and observe each concept map.</p>	
C. Demonstrating Knowledge and Skills	<p>Finding Practical Application Begin the lesson with a short review of key ideas from Day 3, particularly how the positions of planets relative to the Sun affect their environmental conditions and their ability to support life. The teacher asks the learners the following questions:</p> <ul style="list-style-type: none"> • What factors affect whether a planet can support life? • Why is Earth considered suitable for supporting life compared with other planets? • How does a planet's distance from the Sun influence its temperature and environmental conditions? <p>The teacher then highlights examples related to planetary habitability and space exploration:</p> <ul style="list-style-type: none"> • Why Mercury experiences extremely high temperatures • Why is Mars colder than Earth • Why is Earth located in the region where liquid water can exist <p>The teacher explains that scientists study planetary conditions to understand which planets may potentially support life. The teacher may say: "Now that we have explored how the position of planets affects their environmental conditions, let us think about how scientists use this knowledge when studying other planets and searching for places that might support life." "Ask the learners:</p> <ul style="list-style-type: none"> • If scientists discover a new planet in another solar system, what information would they need to determine if it could support life? • Why do scientists look at the distance of a planet from its star when searching for habitable planets? 	<p><i>This section connects classroom learning to the real-world work of astronomers searching for exoplanets. By asking students to consider how they would evaluate a newly discovered planet, you assess their ability to transfer knowledge to new situations—the highest level of understanding.</i></p> <ul style="list-style-type: none"> • <i>Frame this as a problem-solving challenge: "You're part of a NASA discovery team—what do you look for first?" This role-play instantly boosts engagement. When students answer, push for evidence by asking "Why would distance matter?" or "What specific feature tells you that?" This reinforces scientific reasoning and prevents vague responses.</i>

	<p>Learners share their responses based on their understanding of planetary position and environmental conditions.</p> <p>Making Generalization</p> <p>The teacher guides learners to form a general understanding of the concept by asking:</p> <ul style="list-style-type: none"> Based on our activities, how does the position of a planet in the solar system influence its ability to support life? <p>The teacher emphasizes that Earth's location within the solar system is critical to maintaining conditions suitable for life.</p> <p>Ask the learners:</p> <ul style="list-style-type: none"> Why is Earth often described as being in the "right position" in the solar system? How does this position contribute to the presence of liquid water and life on Earth? <p>The teacher explains that scientists apply these concepts when studying exoplanets, which are planets found outside our solar system.</p> <p>As a class, reflect on the following questions:</p> <ul style="list-style-type: none"> Why is Earth's position in the solar system important for the existence of life? How do scientists determine whether other planets may support life? Why is it important to continue studying planets and space environments? <p>Additional Activities</p> <p>To further deepen learners' understanding, the teacher may encourage students to explore how scientists study other planets and search for habitable worlds beyond our solar system.</p> <p>Students may explore online resources and virtual space science platforms to learn more about planetary exploration and the search for life in the universe.</p> <p>Suggested Virtual Exploration Resources</p> <ul style="list-style-type: none"> NASA Solar System Exploration 	<p><i>This step guides students to articulate the core lesson concept in their own words. Having them form the generalization themselves ensures deeper retention than simply telling them the answer.</i></p> <ul style="list-style-type: none"> <i>Instead of accepting the first correct answer and moving on, ask "Who can say that in a different way?" or "How would you explain this to a younger sibling?" Write the final class generalization on the board and leave it visible—this will serve as their anchor for future lessons</i> <p><i>These reflection questions and online resources extend learning beyond the classroom, encouraging students to see Earth's place in the bigger universe picture and fostering curiosity about ongoing space exploration.</i></p> <ul style="list-style-type: none"> <i>For the virtual exploration, don't just list links—give a simple mission: "Find one fact about an exoplanet that surprised you and share it tomorrow." This turns passive browsing into purposeful investigation. If internet access is limited, print 2-3 interesting articles or images from these sites beforehand and let students explore them in small groups. The goal is to plant seeds for lifelong</i>
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	https://solarsystem.nasa.gov • NASA Exoplanet Exploration Program https://exoplanets.nasa.gov • European Space Agency – Space Exploration Resources https://www.esa.int • National Geographic Space Science Resources https://www.nationalgeographic.com/science/space	<i>curiosity, not to require extensive homework.</i>																									
V. ASSESSMENT	Part I: Multiple Choice Instructions: Encircle the letter of the correct answer. Scenario: Mission to Find a Second Earth You are part of a team of scientists tasked by a space agency to evaluate planets for potential human settlement. Your team has collected data on four planets in the solar system. Your mission is to analyze which factors make a planet habitable and recommend the best candidate. Use the information below to answer the questions that follow.																										
	<table><tr><th>Planet</th><th>Distance from Star (million km)</th><th>Average Surface Temperature</th><th>Atmosphere</th><th>Liquid Water</th></tr><tr><td>W</td><td>58</td><td>167°C</td><td>Very thin</td><td>No</td></tr><tr><td>X</td><td>108</td><td>462°C</td><td>Thick CO₂, toxic</td><td>No</td></tr><tr><td>Y</td><td>150</td><td>15°C</td><td>Nitrogen, oxygen, protective ozone</td><td>Yes</td></tr><tr><td>Z</td><td>228</td><td>-65°C</td><td>Thin CO₂</td><td>Frozen only</td></tr></table>	Planet	Distance from Star (million km)	Average Surface Temperature	Atmosphere	Liquid Water	W	58	167°C	Very thin	No	X	108	462°C	Thick CO ₂ , toxic	No	Y	150	15°C	Nitrogen, oxygen, protective ozone	Yes	Z	228	-65°C	Thin CO ₂	Frozen only	
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	1. During the mission briefing, your lead scientist asks: What is the single most important reason Earth is already able to support life while the other planets in our data cannot? A. It has a magnetic field. B. It has a rocky surface. C. It has liquid water on its surface. D. It has a moon that creates tides.																										
	2. While comparing Venus and Earth, a colleague notices both are rocky planets. Yet Venus is uninhabitable. Based on the table, which two factors working together explain why Earth’s surface temperature is suitable for life? A. Distance from the Sun and atmospheric composition B. Distance from the Sun and number of moons C. Atmospheric composition and planet size D. Planet size and surface color																										

3. Your team is designing a habitat for Mars. One member argues that even if the temperature were controlled, the lack of a proper atmosphere would still be a problem. What essential role of Earth's atmosphere should your team replicate to support life?
- It creates beautiful sunsets.
 - It provides a breathable mixture of gases and protects from harmful radiation.
 - It reflects all of the Sun's light back into space.
 - It makes the planet appear blue from space.
4. A news reporter asks your team: Why is a stable temperature so critical for life? How should you respond?
- It allows for the formation of mountains.
 - It allows liquid water to exist and supports chemical processes for life.
 - It creates wind patterns.
 - It helps the planet rotate on its axis.
5. Imagine a hypothetical scenario: Earth's orbit slowly shifts so that it ends up at the same distance from the Sun as Venus (108 million km). Based on the data in the table, what would most likely happen to Earth's ability to support life?
- Its atmosphere would become breathable for humans.
 - Its surface temperature would become too hot for liquid water to exist.
 - It would develop rings like Saturn.
 - Its rotation would stop completely.

Part II. Planet Comparison Analysis

Instructions: Complete the table below and answer the guide questions in 3-4 sentences each. Use evidence from the table to support your answers.*

A. Complete the table. Use your knowledge from the lesson activities to fill in the missing information.

Planet	Relative Position from the Sun	Approximate Temperature Range	Presence of Liquid Water	Ability to Support Life
Mercury				
Venus				
Earth				
Mars				

B. Answer the guide questions.

- Based on the table, compare Earth and Mars. How do their different positions relative to the Sun affect their temperature conditions and ability to support life?
- Using Earth as an example, describe how its position in the solar system helps maintain the specific temperature range and environmental conditions necessary for life.

3. If a new planet were discovered very close to its star, what would you predict about its environmental conditions and ability to support life based on your comparison of planets in our solar system?

Pointing System

Criteria	4 - Excellent	3 - Good	2 - Developing	1 - Beginning
Content & Accuracy	The answer is scientifically accurate and fully addresses the question, supported by strong evidence from the table.	The answer is mostly accurate and addresses the question with some evidence.	The answer contains inaccuracies and addresses the question only partially.	The answer is inaccurate or does not address the question.
Connection to Position	Clearly and correctly explains how planetary position causes the described conditions.	Explains how position causes conditions, but with minor gaps in logic.	Mentions position but does not clearly connect it to conditions.	Does not connect the position to planetary conditions.
Clarity & Completeness	The answer is well-written, complete, and easy to understand.	The answer is understandable but lacks some detail.		

VI. REFLECTION

The teacher notes that most learners understood how the positions of the planets in the solar system influence environmental conditions and the ability to support life. Through activities such as planetary comparison, concept mapping, and group discussions, learners demonstrated their understanding of how distance from the Sun affects planetary temperature and habitability. Some learners needed additional guidance in explaining their answers using appropriate scientific concepts. More examples and guided questions may be provided in the next lesson to strengthen learners' ability to analyze and explain planetary conditions. The teacher also observed that collaborative activities helped increase learner participation and engagement. Follow-up activities may be conducted to further reinforce the concept of planetary habitability and the habitable zone. These observations will help improve the implementation of future lessons and will serve as inputs for discussion during the Learning Action Cell (LAC) sessions.

VII. USE OF GENERATIVE AI

In preparing this Learning Exemplar (LE), the author(s) used Deepseek and ChatGPT in order to assist in organizing the lesson structure, drafting annotations, and ensuring alignment with the Instructional Design Framework. These tools helped generate initial drafts of teacher guidance notes, suggest appropriate pedagogical strategies, and format the document for clarity and consistency. The author(s) reviewed and finalized the writing of the content. The author(s) take full responsibility for the content of this LE.

Lesson Title/Topic	Earth's Position Within the Solar System	Lesson Exemplar	4
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I. OBJECTIVES	
A. Content Standard	The learners learn that Earth's position in the solar system contributes to its structure and dynamics.
B. Performance Standard	By the end of the quarter, learners describe the origin of the solar system and Earth's historical evolution. They relate Earth's unique position in the solar system to its composition, structure, and the dynamic nature of its outer layers. Learners explain how scientists determine the nature of Earth's interior. They also collaboratively create detailed models and scientific analyses and use evidence-based findings to illustrate the nature and composition of the Earth.
C. Learning Competencies	The learners describe the connection between the Philippines' position on Earth and its tectonic activities using suitable sources, including images, maps, and cross-sections.
II. REFERENCES and MATERIALS	<ul style="list-style-type: none"> • Department of Science and Technology - Philippine Institute of Volcanology and Seismology (PHIVOLCS). "Earthquake Information." Philippine Institute of Volcanology and Seismology. Accessed May 24, 2024. https://earthquake.phivolcs.dost.gov.ph. • Department of Science and Technology - Philippine Institute of Volcanology and Seismology (PHIVOLCS). "PHIVOLCS Volcano Monitoring." Philippine Institute of Volcanology and Seismology. Accessed May 24, 2024. https://www.phivolcs.dost.gov.ph. • National Disaster Risk Reduction and Management Council (NDRRMC). "National Disaster Risk Reduction and Management Plan (NDRRMP) 2020-2028". Quezon City, Philippines: NDRRMC, 2020. https://ndrrmc.gov.ph. • Tarbuck, Edward J., Frederick K. Lutgens, and Dennis G. Tasa. <i>Earth: An Introduction to Physical Geology</i>. 12th ed. Hoboken, NJ: Pearson, 2017. • United States Geological Survey (USGS). "Latest Earthquakes Map." USGS. Accessed May 24, 2024. https://earthquake.usgs.gov/earthquakes/map. • Yumul, Graciano P., Jr., Carla B. Dimalanta, Rodolfo A. Tamayo, and Decibel V. Faustino-Eslava. "Geology and Geodynamic Setting of the Philippines." <i>Island Arc</i> 17, no. 1 (2008): 45-63.
	III. CONTENT
IV. OBJECTIVES	Earth's Position Within the Solar System
	<ol style="list-style-type: none"> 1. Characterize the tectonic environment of the Philippines 2. Illustrate the interactions of tectonic plates surrounding the Philippines using maps, images, and cross-sectional diagrams. 3. Explain how the Philippines' tectonic setting contributes to the occurrence of earthquakes and volcanic activity in the country.

IV. PROCEDURES		ANNOTATIONS
<p>A. Activating Prior Knowledge</p>	<p>A. Activating Prior Knowledge To activate prior knowledge, the teacher begins by engaging learners in a discussion about their personal experiences and existing understanding of geologic events in the Philippines.</p> <p>Procedure Reflect The teacher asks learners to think about their own experience with natural disasters in the Philippines and poses the following questions:</p> <ul style="list-style-type: none"> • Have you ever experienced an earthquake? What did it feel like? • Have you seen a volcano? Do you know the names of any active volcanoes in the Philippines? <p>Learners are given time to recall experiences or information from news reports, documentaries, or previous lessons.</p> <p>Share Ideas The teacher invites several learners to share their responses. As learners respond, the teacher writes key observations on the board, such as:</p> <ul style="list-style-type: none"> • <i>The ground shook</i> • <i>I saw cracks on the wall</i> • <i>Mayon Volcano, Taal Volcano</i> <p>The teacher then asks follow-up questions to deepen learners' thinking:</p> <ul style="list-style-type: none"> • Why do you think earthquakes happen? • Why does the Philippines have many active volcanoes? <p>Learners briefly explain their ideas. Some responses may include statements such as "the ground moves" or "pressure builds up underground."</p> <p>Connect The teacher then asks:</p> <ul style="list-style-type: none"> • Considering these experiences, why do you think the Philippines experiences earthquakes and volcanic 	<p><i>This activity connects the lesson to students' lived experiences, making abstract geologic concepts immediately personal and relevant. By starting with earthquakes and volcanoes they've actually felt or seen, you validate their experiences while surfacing prior knowledge and common misconceptions about why these events happen.</i></p> <ul style="list-style-type: none"> • <i>During the Reflect stage, give students genuine quiet time to recall experiences—some may have powerful stories to share. When asking "Why do you think earthquakes happen?" accept all answers without judgment; statements like "the ground moves" or "pressure builds up" give you valuable insight into their current understanding.</i> • <i>The Connect question comparing the Philippines to Saudi Arabia or Sweden creates productive cognitive dissonance—students sense there's a reason but may not know it yet. This curiosity is your bridge to the lesson ahead. Keep this entire segment warm and conversational; you're building a safe space for sharing personal connections to science.</i>

	<p>activity more often than some other countries, such as Saudi Arabia or Sweden?</p> <p>Learners share their initial hypotheses.</p> <p>The teacher acknowledges their responses and explains that these events are not random occurrences. Instead, they are directly connected to the Philippines' unique location on Earth.</p> <p>B. Establishing the Purpose of the Lesson</p> <p>After learners share their ideas, the teacher introduces the lesson's main goal: understanding why the Philippines is geologically active.</p> <p>The teacher explains that understanding the relationship between the country's location and tectonic activity helps people better prepare for and reduce the risks associated with natural hazards.</p> <p>Scenario: The Safe and Resilient Philippines Project</p> <p>The teacher presents the following situation:</p> <p>"The Department of Tourism and the National Disaster Risk Reduction and Management Council (NDRRMC) are launching a project called Safe and Resilient Philippines. They want to create informational materials for tourists and new residents explaining why earthquakes and volcanoes occur in the Philippines and how the country prepares for these hazards. They need your help to develop the scientific explanation for these materials."</p> <p>The teacher asks:</p> <ul style="list-style-type: none"> • What scientific information should be included in these materials? • Why is it important for residents and visitors to understand this? <p>Learners briefly share their responses.</p> <p>The teacher then explains that in the next few days, the class will gather the necessary scientific information by exploring plate tectonics and the Philippines' position within this system.</p>	<p><i>This section establishes the lesson's real-world relevance by framing it as a civic project. Connecting to the Department of Tourism and NDRRMC makes the learning meaningful—students aren't just studying plate tectonics; they're helping create materials that could actually inform and protect people.</i></p> <ul style="list-style-type: none"> • <i>Present the scenario with genuine enthusiasm: "Our country needs your help!" This taps into students' sense of purpose and pride. When asking what information should be included, keep the brainstorming quick and open-ended—accept all ideas and jot them on the board. Some may mention safety tips, others may name specific volcanoes. That's fine. The goal isn't just correct answers; it's getting them invested. End by saying "Over the next few days, we're going to become experts so we can create these materials together."</i>
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B. Instituting New Knowledge

1. Presenting Examples

The teacher begins the lesson with a short review:

“What is the main question we are trying to answer in this lesson?”

Expected response: Why is the Philippines geologically active?

The teacher introduces the concept of **Plate Tectonics**.

The Earth’s outer layer, called the lithosphere, is not a single continuous piece. Instead, it is divided into several tectonic plates that slowly move over the semi-fluid mantle beneath them.

Demonstrations: The teacher may use simple demonstrations to illustrate this idea.

- Hard-boiled egg analogy: The cracked eggshell represents the Earth’s crust broken into plates.

The teacher then shows a map of the Philippines and the surrounding regions.

The teacher asks: “Considering that Earth’s surface is made of moving plates, what do you observe about the location of the Philippines?”

Learners may respond that the country is surrounded by oceans and lies near deep-sea areas.

The teacher overlays a tectonic plate boundary map showing the:

Philippine Sea Plate, Eurasian Plate, and Pacific Plate

The teacher explains that the Philippines lies near convergent plate boundaries, where plates collide. Subduction occurs when a denser plate moves beneath a less dense plate, sinking into the mantle.

The teacher may demonstrate this process using two pieces of cardboard sliding under one another.

The teacher then asks guiding questions:

- Which plates are interacting near the Philippines?

This section introduces the core scientific concept—plate tectonics—using a memorable analogy and a map analysis. The eggshell demonstration makes an invisible, abstract idea visible and tangible, while the map observation lets students discover the Philippines’ unique location for themselves.

- *When using the hard-boiled egg, hold it up and literally crack it slightly so students can see the pieces. Say “The eggshell is like Earth’s crust—one whole piece, but broken into plates that move.” For the map, don’t tell students what to see—ask “What do you notice?” and let them point out that the Philippines is surrounded by water, near deep areas, or located where plates might meet. If they struggle, guide them with “Look at the edges of the land—what’s nearby?”*

This section moves from the simple eggshell analogy to the actual scientific model—introducing specific plates, boundary types, and subduction.

- *When overlaying the plate map, use two different colors to highlight the Philippine Sea Plate, Eurasian Plate, and Pacific Plate. Point directly to where they meet near the Philippines and say, “Right*

	<ul style="list-style-type: none"> • What tectonic features form when plates collide? • How might magma form during subduction? <p>Learners share ideas based on the map and the concept explained.</p> <p>Learning Activity: Plate Boundary Map Analysis</p> <p>Students analyze a tectonic map of the Philippines.</p> <p>They identify: Philippine Sea Plate, Eurasian Plate, Pacific Plate, Philippine Trench, Manila Trench</p> <p>Guide questions include:</p> <ul style="list-style-type: none"> • Where do plates converge? • What do trenches indicate about plate boundaries? • How might these trenches relate to volcano distribution? <p>Groups present their findings.</p> <p>The teacher begins Day 3 with a short review of the previous lesson about subduction and the tectonic plates surrounding the Philippines. The teacher reminds learners that the Philippines experiences frequent earthquakes and volcanic eruptions because it is located near convergent plate boundaries.</p> <p>The teacher then introduces</p> <p>Activity No. 1: Philippines Tectonic Setting Investigation. (See Learning Activity Sheet)</p> <p>In this activity, learners will examine maps to see how the locations of trenches, volcanoes, and earthquake epicenters are related.</p> <p>Learners will work in pairs or small groups. Each group will receive:</p> <ul style="list-style-type: none"> • A map of the Philippines showing major tectonic plates and trenches 	<p><i>here—this is why we have earthquakes and volcanoes." For the cardboard demonstration, physically slide one piece under another while saying, "The denser plate sinks, melts into magma, and eventually rises to form volcanoes." Repeat this twice—students need to see the process more than once.</i></p> <p><i>Demonstrate first while students watch, then let them create. Circulate and ask, "Which plate is denser? What happens when they collide?" If clay is unavailable, use stacked books or even their hands—one hand sliding under the other works fine.</i></p> <p><i>Provide printed maps with trenches labeled. Ask groups to trace the trenches with their fingers and notice where volcanoes are located. The lightbulb moment comes when they see the pattern: trenches + volcanoes = subduction zones.</i></p> <ul style="list-style-type: none"> • <i>Keep presentations lightning-fast—30 seconds per group. End by connecting back: "See? Every trench and volcano on our map confirms what we just modeled."</i>
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- A map or list showing the locations of active volcanoes
 - A map showing recent earthquake epicenters
- Students will compare the maps and look for patterns. Based on their observations, they will complete the table below.

Tectonic Feature	Interacting Plates	Type of Boundary	Associated Geologic Event	Example in the Philippines
Philippine Trench				
Manila Trench				
East Luzon Trough				

Guide Questions

1. Where are most earthquake epicenters and active volcanoes located on the map?
2. How are these locations related to trenches or plate boundaries?
3. How does the process of subduction lead to the formation of volcanoes?

After completing the activity, groups briefly share their answers. The teacher emphasizes that the Philippines is located in a tectonically active region where several plates interact, which explains why earthquakes and volcanic eruptions frequently occur in the country.

3. Developing Mastery

In groups of 4-5, students create a one-page infographic showing the connection between the Philippines' location and its tectonic activity.

Activity: "Tectonic Trio" Infographic Challenge

Role	Responsibility
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This Day 3 activity transforms abstract knowledge into concrete understanding by letting students discover patterns themselves. Comparing maps of trenches, volcanoes, and earthquake epicenters allows them to see firsthand that these features are not random—they're concentrated along plate boundaries, exactly where subduction occurs.

- *Before distributing materials, do a quick 3-minute review: point to a classroom map and ask, "Where do plates meet near us?" and "What happens at subduction zones?" This primes their brains for pattern-seeking. During the activity, circulate and ask guiding questions, such as "What do you notice about where the volcanoes are?" rather than giving answers. If groups finish early, challenge them: "Can you explain to your neighbor why this pattern exists using what we learned about subduction?" Keep group sharing quick—one observation per group—then synthesize by tracing the pattern yourself on a master map: trenches here, volcanoes here, earthquakes here—all connected.*

This infographic challenge moves students from analysis to synthesis—

	<table><tr><td>Cartographer</td><td>Draws a simple map showing plates (Philippine Sea, Eurasian) and trenches.</td></tr><tr><td>Illustrator</td><td>Creates a labeled cross-section of subduction (plate melting → magma rise).</td></tr><tr><td>Writer</td><td>Write clear captions explaining how subduction causes earthquakes and volcanoes.</td></tr><tr><td>Designer</td><td>Ensures layout is clean, organized, and visually appealing.</td></tr></table> <p>Requirements:</p> <ul style="list-style-type: none">• Map of plates/trenches surrounding the Philippines• Cross-section diagram showing subduction• Brief explanation linking subduction to both earthquakes and volcanoes• One "Did You Know?" fact about a Philippine volcano or earthquake <p>Materials: Paper, markers, printed reference maps. Digital option: Canva or Google Drawings.</p> <p>Gallery Preview: Groups post infographics for a quick 5-minute walk-through before the Extend activity.</p> <p>Extended activity : Press Conference</p> <p>Groups become "expert panels." Each expert speaks for 30-45 seconds on their role (Cartographer on plates, Illustrator on subduction, Writer on earthquakes/volcanoes).</p> <p>Then the class acts as "press", asking questions (e.g., "Why do earthquakes and volcanoes happen in the same places?"). Teacher moderates.</p> <p>Purpose: Builds communication skills and deepens understanding through Q&A.</p>	Cartographer	Draws a simple map showing plates (Philippine Sea, Eurasian) and trenches.	Illustrator	Creates a labeled cross-section of subduction (plate melting → magma rise).	Writer	Write clear captions explaining how subduction causes earthquakes and volcanoes.	Designer	Ensures layout is clean, organized, and visually appealing.	<p>they must now explain the entire tectonic system visually and verbally. Creating something themselves deepens understanding far more than just answering questions, while the gallery walk and extension options build communication and application skills.</p> <ul style="list-style-type: none">• Before groups start, show one quick example infographic (even a simple hand-drawn one) to set clear expectations. Circulate while they work and nudge groups that get stuck: "Where should the trench go? What happens to the plate next?" For the gallery walk, give students sticky notes to write one compliment or question for each group—this keeps them focused and encourages positive feedback.• During the Press Conference, remind "experts" that it's okay to say "Let me check with my team" if unsure—this models real scientific collaboration. For
Cartographer	Draws a simple map showing plates (Philippine Sea, Eurasian) and trenches.									
Illustrator	Creates a labeled cross-section of subduction (plate melting → magma rise).									
Writer	Write clear captions explaining how subduction causes earthquakes and volcanoes.									
Designer	Ensures layout is clean, organized, and visually appealing.									
<p>C. Demonstrating Knowledge and Skills</p>	<p>Finding Practical Application</p> <p>The teacher begins the lesson with a short review of the key ideas discussed on Day 3, particularly the location of the Philippines along tectonic plate boundaries and the process of subduction.</p>	<p>This section connects scientific understanding directly to real-life disaster preparedness in the Philippines. By asking students to explain why earthquakes occur near specific areas and how this knowledge helps communities, you make learning</p>								

	<p>The teacher asks the learners the following questions:</p> <ul style="list-style-type: none"> • Why does the Philippines experience frequent earthquakes and volcanic eruptions? • What tectonic plates interact around the Philippines? • How does the movement of these plates create geologic hazards? <p>The teacher then connects the discussion to real-life situations in the Philippines.</p> <p>The teacher may ask:</p> <ul style="list-style-type: none"> • Why do many earthquakes occur near the eastern and western parts of the Philippines? • Why are many active volcanoes found near plate boundaries and trenches? • How does understanding plate tectonics help communities prepare for natural hazards? <p>The teacher explains that scientists and disaster management agencies study the tectonic setting of the Philippines to better understand earthquakes, volcanic activity, and other geologic hazards.</p> <p>The teacher may say: "By studying the position of the Philippines on Earth and the movement of tectonic plates, scientists can better understand why earthquakes and volcanic eruptions occur and how communities can prepare for them."</p> <p>Learners share their responses based on their understanding of the Philippines' tectonic setting.</p> <p>Making Generalization</p> <p>The teacher guides learners to form a general understanding by asking:</p> <ul style="list-style-type: none"> • Based on our activities, how does the position of the Philippines on Earth influence its tectonic activity? <p>The teacher emphasizes that the Philippines is located near the convergent boundaries of several tectonic plates, including the Philippine Sea Plate and the Eurasian Plate. Because of this</p>	<p><i>immediately relevant and personally meaningful.</i></p> <ul style="list-style-type: none"> • <i>Use local examples students recognize—ask "Why do you think Bicol has so many volcanoes?" or "Why did the 1990 Luzon earthquake happen?" This grounds abstract concepts in familiar places. When students answer, push for specific language: encourage them to use terms like "subduction," "convergent boundary," and "Philippine Sea Plate" rather than vague explanations. This builds scientific confidence and accurate communication.</i> <p><i>This step guides students to articulate the big picture—that the Philippines' location along plate boundaries directly causes its geologic activity. Naming the Pacific Ring of Fire connects local experience to a global phenomenon, helping students see their country's place in Earth's larger systems.</i></p> <ul style="list-style-type: none"> • <i>After students share their ideas, write the final generalization on</i>
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	<p>location, the country experiences frequent earthquakes, volcanic eruptions, and other geologic events.</p> <p>The teacher asks additional questions:</p> <ol style="list-style-type: none"> 1. Why are trenches, volcanoes, and earthquake epicenters commonly found near plate boundaries? 2. How does the process of subduction contribute to volcanic activity in the Philippines? <p>The teacher highlights that the Philippines' tectonic position explains why it lies within the Pacific Ring of Fire, where many earthquakes and volcanoes occur.</p> <p>Additional Activities</p> <p>The activities in this lesson help learners understand the tectonic setting of the Philippines. These can be improved by using online simulations and videos to better visualize plate movements and subduction.</p> <p>Online Resources:</p> <ul style="list-style-type: none"> • https://www.iris.edu/hq/inclass/animation/subduction_zone_tsunamis_generated_by_megathrust_earthquakes • https://phet.colorado.edu/en/simulations/plate-tectonics <p>Class Reflection:</p> <p>Imagine your community often experiences earthquakes. Some people say studying tectonic activity is not useful, while others believe it helps save lives.</p> <ul style="list-style-type: none"> • Why is it important for Filipinos to understand tectonic activity? • How can this help communities prepare? • Do you think scientists should continue studying it? Why? <p>To deepen understanding, students may explore real-time data from:</p> <ul style="list-style-type: none"> • PHIVOLCS: https://earthquake.phivolcs.dost.gov.ph • https://www.phivolcs.dost.gov.ph • https://earthquake.usgs.gov/earthquakes/map 	<p><i>the board in simple terms: "The Philippines lies where plates meet. Plates move → subduction happens → earthquakes and volcanoes occur." Then point to a world map showing the Ring of Fire and say, "We're not alone—this entire ring experiences what we do."</i></p> <p><i>These reflection questions and PHIVOLCS resources help learners see that science is real and ongoing. By connecting lessons to real-time earthquake and volcano data, students begin to understand that tectonic activity is not just in books—it is happening around them.</i></p> <ul style="list-style-type: none"> • <i>If the internet is available, the teacher may show the PHIVOLCS earthquake map and highlight recent activity. If not, a printed screenshot can be used to guide discussion by asking students to identify the patterns they notice. As a simple follow-up, learners may be asked to check PHIVOLCS at home and share one observation the next day. This encourages curiosity and helps students connect</i>
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		<i>classroom learning to real-life events.</i>
V. ASSESSMENT	<p>I. Multiple Choice Encircle the letter of the correct answer.</p> <ol style="list-style-type: none"> What makes the Philippines a unique and geologically dynamic country? <ol style="list-style-type: none"> It is located in the middle of the Pacific Plate. It is situated at the convergent boundary of several tectonic plates. It has more active volcanoes than any other country. It experiences the most typhoons in the world. Which process is primarily responsible for the formation of the deep trenches surrounding the Philippines, such as the Philippine Trench? <ol style="list-style-type: none"> Seafloor spreading Transform faulting Subduction Continental rifting How does the subduction of the Philippine Sea Plate under the Eurasian Plate generate magma? <ol style="list-style-type: none"> The friction from the plates sliding past each other melts the rock. The subducting plate carries water and sediments, which lowers the melting point of rock in the mantle. The plates pull apart, allowing magma from the mantle to rise directly to the surface. The intense pressure of the collision instantly turns rock into liquid magma. If you were looking at a map of earthquake epicenters in the Philippines, where would you expect to see the highest concentration? <ol style="list-style-type: none"> In the middle of the Sulu Sea Along the coasts facing the deep ocean trenches In the center of the island of Palawan Randomly scattered across all islands equally A cross-sectional diagram of a subduction zone would show: <ol style="list-style-type: none"> Two plates are moving away from each other with magma rising between them. Two plates sliding horizontally past each other. One plate slides beneath another plate into the mantle. A single, thick plate with no movement. <p>II. Diagram Analysis and Explanation Write your answers in 4–5 sentences.)</p> <ol style="list-style-type: none"> Draw a simple labeled cross-sectional diagram showing the interaction between the Philippine Sea Plate and the Eurasian Plate. Your diagram must include the following labels: <ul style="list-style-type: none"> Philippine Sea Plate 	

- Eurasian Plate
- Mantle
- Philippine Trench
- Volcano

2. Below your diagram, write a short paragraph explaining how the interaction you illustrated leads to the formation of earthquakes and volcanoes in the Philippines.

Criteria	3 (Excellent)	2 (Satisfactory)	1 (Needs Improvement)
Diagram Accuracy	The diagram clearly shows the correct interaction of tectonic plates and the subduction process.	The diagram shows the general idea of plate interaction, but has minor errors.	The diagram is unclear or does not correctly show plate interaction.
Labeling	All required parts are correctly labeled.	Some parts are labeled, but a few are missing or incorrect.	Labels are mostly missing or incorrect.
Explanation	The explanation clearly describes how plate interaction causes earthquakes and volcanoes.	The explanation shows partial understanding of the processes.	The explanation is unclear or incorrect.

VI. REFLECTION

Most learners successfully connected the Philippines' location to its tectonic activity. The hands-on modeling and map analysis activities were particularly effective in helping students visualize abstract processes such as subduction. Some learners initially found it difficult to distinguish between the causes of earthquakes (stress accumulation and fault movement) and volcanic eruptions (magma generation during subduction). In future lessons, more focused questions and comparison activities will be used to clarify these processes. Collaborative group work, especially the final presentation, encouraged strong engagement and allowed learners to demonstrate their understanding creatively. These observations will be shared during the next LAC session to support discussions on teaching complex Earth science concepts.

VII. USE OF GENERATIVE AI

In preparing this Learning Exemplar (LE), the author(s) used DeepSeek and ChatGPT in order to assist in organizing the lesson structure, drafting annotations, and ensuring alignment with the Instructional Design Framework. These tools helped generate initial drafts of teacher guidance notes, suggest appropriate pedagogical strategies, and format the document for clarity and consistency. The author(s) reviewed and finalized the writing of the content. The author(s) take full responsibility for the content of this LE.

Lesson Title/Topic	Earth's Origin: Nebular Hypothesis and Planetary Formation	Lesson Exemplar	5
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I. OBJECTIVES	
A. Content Standard	Learners learn that historical and contemporary models and theories provide the scientific basis for explaining Earth's origin, its plates, and boundaries.
B. Performance Standard	By the end of the quarter, learners describe the origin of the solar system and Earth's historical evolution. They relate Earth's unique position in the solar system to its composition, structure, and the dynamic nature of its outer layers. Learners explain how scientists determine the nature of Earth's interior. They also collaboratively create detailed models and scientific analyses and use evidence-based findings to illustrate the nature and composition of the Earth.
C. Learning Competencies	The learners use information from secondary sources to outline the historical development of the Earth's origin based on the nebular hypothesis and planetary formation.
II. REFERENCES and MATERIALS (Selecting Resources and Materials)	<ul style="list-style-type: none"> ○ NASA Space Place. "How Did the Solar System Form?" National Aeronautics and Space Administration, 2024. https://spaceplace.nasa.gov/solar-system-formation/en/. ○ NASA Jet Propulsion Laboratory. "Mysteries of the Solar Nebula." 2001. https://www.jpl.nasa.gov/news/mysteries-of-the-solar-nebula/. ○ PBS LearningMedia. "How Did the Solar System Form?" Image. Accessed March 28, 2026. https://www.pbslearningmedia.org/asset/buac18-img-howdidsolarsystemform/EN/ ○ Johnson, Chris, Matthew Affolter, Paul Inkenbrandt, and Cam Mosher. "Ch. 8.2." In <i>An Introduction to Geology</i>. Geosciences LibreTexts, 2017. https://geo.libretexts.org. ○ JF SciTech. "Chapter 09 – Nebular Hypothesis." YouTube video, 8:15. Posted July 19, 2025. https://www.youtube.com/watch?v=pFOiSwlhspc ○ Lincoln Learning Solutions. "Formation of the Planets." YouTube video, 3:29. March 2, 2020. https://www.youtube.com/watch?v=sCkhEu3lYNc. ○ NASA. "Solar System Facts." https://science.nasa.gov/solar-system/solar-system-facts/ ○ Kanba, Kouji. "Planetary Collisions During Planet Formation in the Early Solar System." Image. SciTechDaily. https://scitechdaily.com/how-planet-smashing-collisions-stole-earths-life-essential-elements/. ○ Science News Today. "How Planets Form: From Dust to Worlds." March 20, 2025. https://www.sciencenewstoday.org/how-planets-form-from-dust-to-worlds/. ○ Britannica Editors. "Planetary." <i>Encyclopedia Britannica</i>. October 11, 2023. https://www.britannica.com/science/planetary. ○ Owen, T.C. "Solar System." <i>Encyclopedia Britannica</i>. April 6, 2026. https://www.britannica.com/science/solar-system.

III. CONTENT (Sequencing Content)		Earth's Origin: Nebular Hypothesis and Planetesimal Formation				
IV. OBJECTIVES (Setting Clear Objectives and Analyzing the Tasks)		By the end of this lesson, the learners should be able to: <div><div>1. Identify key ideas in the development of explanations about Earth's origin based on the nebular hypothesis and planetesimal formation using secondary sources.</div><div>2. Organize information from secondary sources to create a historical outline that explains Earth's origin according to the nebular hypothesis and planetesimal formation, in sequence.</div><div>3. Explain how the nebular hypothesis and planetesimal formation contribute to current understandings of the Earth's formation process.</div></div>				
IV. PROCEDURES (Selecting Strategies, Making Meaningful Content, Delivering Lesson and Assessing Learning)		ANNOTATIONS				
A. Activating Prior Knowledge	<div><div>1. Activating Prior Knowledge</div><div><div></div><div><div>The Blue Marble</div><div>Description: The Apollo 17 crew caught this breathtaking view of our home planet as they were traveling to the moon on Dec. 7, 1972.</div></div></div></div>	This part utilizes NASA's iconic "Blue Marble" photograph as an anchor to surface learners' diverse prior knowledge.				
	<div><div>Option 1: Marble Matrix</div><div><div><div>1. Divide the class into small groups (3 to 5 learners).</div><div>2. As each group observes the Blue Marble photograph, the teacher asks: <i>"When you look at this planet, what stories have you heard about its beginning, and what physical materials do you actually see?"</i></div><div>3. The teacher uses a Categorized Board approach to organize their prior knowledge. This records learners' responses in two distinct columns to help them visualize the differences between cultural narratives and physical mechanisms.</div></div></div></div> <table><tr><th>Origins and Stories (The "Who/What")</th><th>Processes and Materials (The "How")</th></tr><tr><td></td><td></td></tr></table>	Origins and Stories (The "Who/What")	Processes and Materials (The "How")			<div><div>Source: NASA. "Earth – Full View from Apollo 17." Photograph. December 7, 1972. https://www.nasa.gov/image-article/earth-full-view-from-apollo-17/</div><div><div>IDF Relevance:</div><div>These options serve as a responsive activation strategy that centers on getting to know learners by surfacing their prior knowledge and diverse perspectives.</div></div><div><div>Option 1: Marble Matrix</div><div><div>Notes for the Teacher:</div><div><div>• Invite learners to share any cultural stories and scientific ideas they know to make</div></div></div></div></div>
Origins and Stories (The "Who/What")	Processes and Materials (The "How")					

	<ul style="list-style-type: none"> • The teacher invites the class to look at the “How” column. Ask: <i>“If we only had these materials and processes, how were they put together to build the Earth?”</i> Use their ideas to wonder about the 4.6-billion year-timeline of Earth’s origin. • The Hook (The Transition Script): <i>“We have a fascinating mix of ‘Who/What’ and ‘How’ on the board. While many cultures have beautiful stories about the Earth’s origin, scientists have spent centuries looking for physical evidence. We are diving deep into that scientific ‘How’, to see the development of explanations on the iconic ‘Blue Marble’ we have today.”</i> <p>Option 2: Marble Mapping Procedures:</p> <ol style="list-style-type: none"> 1. In small groups of 3 to 5, ask the learners to list every idea, story, or fact they have encountered regarding Earth’s beginning as the teacher displays the <i>Blue Marble</i> photograph. Provide three “category buckets”: <ul style="list-style-type: none"> • Scientific Buzzwords (e.g., Big Bang, dust, gravity) • Cultural/Mythological (e.g., creation stories from their own heritage or history) • Observations (e.g., “Earth is made of rock, so it must have come from bigger rocks.”) 2. Group Synthesis and Mapping. The teacher asks the learners to consolidate their ideas into a single mind map on a sheet of paper or whiteboard. <ul style="list-style-type: none"> • Use “Earth’s Origin” as the central node, with three primary branches: Scientific Ideas, Creation Stories, and Observations. • In each category (or primary branch), learners must be able to provide 1–3 responses. Smaller branches are optional for further specific responses. • The teacher moves between groups, asking: <i>“Looking at your map, which of these ideas actually explains the physical, step-by-step process of how the ground beneath our feet formed?”</i> 	<p>everyone feel that their contribution is valuable.</p> <ul style="list-style-type: none"> • If a learner says something scientific like “gravity made the planets from a gas cloud,” simply respond: “We will be looking at exactly how that worked later.” Do not correct or elaborate yet. • In the “Processes and Materials” column, the teacher looks for action words. If a learner says “dust,” write “clumping of dust.” <p>Option 2: Marble Mapping</p> <p>Notes for the Teacher:</p> <ul style="list-style-type: none"> • Mind maps are visual, hierarchical diagrams used to organize information, brainstorm ideas, and map out concepts, typically featuring a central theme branching into related subtopics. • Explicitly tell learners that “all ideas are welcome” to lower the barrier for those who may be intimidated by science. • Keep an eye out for learners who may be hesitant to share cultural or mythological stories. Validate these as important ways of knowing that human beings have used before formalizing the scientific methods we use today. • If a map is heavily weighted toward “Creation Stories,” use the prompt (“Which of these explains the physical, step-by-step
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3. The Hook (The Transition Script): *“Looking at your maps, we see a giant web of human curiosity. We have cultural stories sitting right next to modern observations. We are going to look at the scientific explanations about the origin of our Solar System and the Blue Marble we live on today.”*

2. Establishing the Purpose of the Lesson

Cosmic Before and After

Procedures:

1. The teacher displays an image of a nebula and the Earth side by side. The image of the Orion Nebula is used for visualization purposes only. It is not the actual nebula from which Earth and the Solar System formed.
2. Ask the learners to identify the two celestial objects, provide their definitions, and give descriptions.

	<p>Identify: Define: Describe:</p>		<p>Identify: Define: Describe:</p>
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Sources:

- Robberto, M., NASA, ESA, and the Hubble Space Telescope Orion Treasury Project Team. “Hubble Panoramic View of Orion Nebula Reveals Thousands of Stars.” Photograph. January 11, 2006. <https://www.spacetelescope.org/news/heic0601/>.
 - NASA. “Earth – Full View from Apollo 17.” Photograph. December 7, 1972. <https://www.nasa.gov/image-article/earth-full-view-from-apollo-17/>
3. As an Inquiry Prompt: *“On the left, we have the ‘Before’, a chaotic, glowing cloud of gas and dust, represented here by the Orion Nebula. While this is not the actual nebula where our Solar System formed, it helps us visualize what such environments look like. On the right, we have the ‘After’, a structured, habitable planet, represented by Earth, our Blue Marble.”* Point out that while they look completely different, they are made of the same fundamental “cosmic” materials.

process?”) to help learners discover where the scientific sources will fill in the gaps.

IDF Relevance:

This activity sets clear objectives by creating a visual bridge between the learners’ observations and the curriculum.

Option 1: Cosmic Before and After

Notes for the Teacher:

- The Orion Nebula shown is a modern example of a star-forming region. It is not the nebula where the Solar System originated.
- If learners struggle to “Define,” encourage them to use their own words first (e.g., “space cloud” or “home planet”) before providing the formal scientific definitions.
- A nebula is an enormous, interstellar cloud of dust and gases (primarily H and He).
- A solar nebula is the cloud of gas and dust that collapsed to form our Sun and Solar System approximately 4.6 billion years ago. Not all nebulae become solar systems.
- A planet is a large, celestial body that orbits a star and has become spherical due to its own gravity. Only eight celestial bodies are currently defined as a “planet.”

	<p>4. Goal Setting: The teacher explicitly states, <i>“Our mission today is to explore the scientific theories that explain how one became the other. We will analyze secondary sources to outline the explanations about the Earth’s origin based on the nebular hypothesis and planetesimal formation.”</i></p>	<ul style="list-style-type: none"> Emphasize that despite their differences in appearance, both are composed of the same fundamental cosmic materials (gas, dust, and elements).
<ul style="list-style-type: none"> Instituting New Knowledge 	<p>1. Presenting Examples</p> <p>Option 1: The Spinning Skater (for the nebular hypothesis)</p> <p>Procedures:</p> <ol style="list-style-type: none"> The teacher shows a short clip of a figure skater performing a scratch spin. Source: Miroschnichenko, T. “Man Spinning Around in an Ice Rink.” Pexels video, 0:13. Posted November 29, 2020. https://www.pexels.com/video/man-spinning-around-in-an-ice-rink-6015948/. <ul style="list-style-type: none"> Focus Point 1: The skater starts with arms and one leg spread wide, spinning slowly. Focus Point 2: The skater pulls his/her arms and legs in tight to his/her chest, and the speed increases. Ask the questions: <ul style="list-style-type: none"> What did the skater do? What is the effect of pulling the arms inward on the skater’s speed? The Connection “Script”: <i>“Our Solar System started as a giant, slow-moving cloud of gas, like the skater with their arms wide open. As the cloud pulled its arms in, it became smaller and began to spin faster. This intense spinning is what flattened the cloud into the disk where the ‘Blue Marble’ eventually formed.”</i> The teacher then presents a visual of a protoplanetary disk to help learners visualize the flattening process. <div> </div> <p>ALMA image of the protoplanetary disc around HL Tauri. It shows the protoplanetary disc surrounding the young star HL Tauri. Available from https://www.eso.org/public/images/eso1436a/</p>	<p>IDF Relevance: <i>The goal of this section is to use “Everyday Metaphors” to help learners internalize the mechanics of Earth’s origin before they “mine” technical secondary sources.</i></p> <p>Option 1: The Spinning Skater</p> <p>Notes for the Teacher:</p> <ul style="list-style-type: none"> If a learner suggests another example (e.g., a washing machine spin cycle), the teacher must validate it. This acknowledges the learners and incorporates their logic into the lesson. The Core Mechanic: Angular Momentum: explaining how a huge, slow cloud of gas collapses and speeds up to form a disk. If learners ask why the skater spins faster, tell them: “The skater has the same amount of spin energy the whole time; pulling inward just concentrates it.” Help learners identify that changing shape (pulling inward) leads to faster motion. A protoplanetary disk is a rotating circumstellar disc of dense gas and dust surrounding a young newly formed star.

	<p>Option 2: The Growing Dough (for accretion/planetesimal) Procedures:</p> <ol style="list-style-type: none"> 1. Show the clip of the chef kneading a ball of dough on a floured surface. Point out how the loose, dusty flour disappears as it gets swept up into the ball of dough. Source: Odintsov, R. “A Baker Kneading the Dough.” Pexels video, 0:15. Posted June 3, 2021. https://www.pexels.com/video/a-baker-kneading-the-dough-8190714/ 2. Ask the questions: <ul style="list-style-type: none"> • Watch the loose flour on the table. Where does it go? • What is the effect on the ball of dough? 3. The Connection Script: <i>“While the dough appears as a single growing mass, the early Earth did not begin as one piece. It started as many clumps of cosmic material that collided and stuck together, forming larger bodies called planetesimals. These planetesimals merged, gradually building larger and more massive bodies until they eventually formed planets like Earth, the ‘Blue Marble’ we live on today.”</i> <p>2. Discussing New Concept</p> <p>Evidence Table: The teacher introduces the Evidence Table, to be filled out by learners, which will serve as the “Miner’s Ledger” for using secondary sources. (See Activity Sheet).</p> <p>Guide Questions: The teacher informs learners that after extracting information from secondary sources, they must answer the guide questions.</p> <p>Nebular Hypothesis:</p> <p>1. The Trigger (The Beginning)</p> <ul style="list-style-type: none"> • According to your source, what was the “starting material” of our solar system? • What physical force caused it to change its shape? • Teacher’s Goal: To get learners to identify the nebula (gas and dust) and gravity as the primary force. 	<p>Option 2: The Growing Dough</p> <p>Notes for the Teacher:</p> <ul style="list-style-type: none"> • If a learner suggests another example (e.g., a snowball rolling downhill and collecting more snow), validate it. This is a strong analogy for accretion and worth briefly discussing. • Help learners see that the dough is “sticky” and “collects” everything it touches. Electrostatic forces are genuinely how early dust grains stuck together before gravity took over. • The Core Mechanic: Accretion is the process of tiny particles (flour) sticking together to form a larger, solid mass (the dough/planet). <p>IDF Relevance: <i>Providing multiple “Mining Options” (e.g., text, video, and infographics) is a responsive instructional strategy that ensures equitable access to complex astrophysical concepts. This approach allows them to engage with the lesson through the medium that best supports their understanding, effectively removing barriers to learning.</i></p> <p>Notes for the Teacher:</p> <ul style="list-style-type: none"> • Share the rubric before the start. This helps learners know they are not just looking for random facts.
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	<p>2. The Flattening (The Shape)</p> <ul style="list-style-type: none"> • As the nebula collapsed and spun faster, what specific shape did it take? • How does your source describe this transition? • Teacher’s Goal: To confirm they recognize the formation of the protoplanetary disk. <p>3. The Outcome (The Solar System)</p> <ul style="list-style-type: none"> • Based on your source, how did the collapse and flattening of the nebula set the stage for the Solar System we have today? • What was the result of this process? • Teacher’s Goal: To have learners connect the protoplanetary disk as the precursor to the Solar System (the Sun forming at the center, and the material for planets arranged in the disk). <p>Planetesimal Formation</p> <p>1. The Clumping (The Building)</p> <ul style="list-style-type: none"> • According to your source, how did tiny, individual particles eventually become solid planetesimals? • What was the “How” behind their growth? • Teacher’s Goal: To have learners describe accretion (collisions and sticking together). <p>2. The Growth (The Forces)</p> <ul style="list-style-type: none"> • What caused planetesimals to grow large enough to become planets eventually? • What forces were involved at different stages of their growth? • Teacher’s Goal: To distinguish electrostatic forces (which caused early dust grains to stick together) from gravity (which took over as bodies grew larger and more massive). <p>3. The Completion (The Solar System)</p> <ul style="list-style-type: none"> • How did the growth of planetesimals through accretion ultimately lead to the formation of the planets in our Solar System, including Earth? 	<ul style="list-style-type: none"> • The teacher facilitates a discussion of key ideas to develop explanations of Earth’s origin according to the nebular hypothesis and planetesimal formation, using guide questions. • Clarify that the nebular hypothesis and planetesimal formation are not competing theories. • Avoid presenting the theories as simultaneous processes. • The nebular hypothesis does not encompass planetesimal formation. • Remind learners that both theories are supported by physical evidence, such as the observed disk shapes around young stars (supporting the nebular hypothesis) and the existence of asteroids and comets as remnant planetesimals (supporting planetesimal formation). • Both theories are asked about the Solar System as their result because the Solar System is the shared destination, not because the theories overlap. • The nebular hypothesis and planetesimal formation are two distinct theories, but both are necessary to fully explain our Solar System — neither one alone is a complete explanation. • The rubrics and checklists are available in the corresponding learning activity sheets of this lesson exemplar.
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- Teacher’s Goal: To have learners recognize that planetesimal accretion completed the Solar System (turning the disk material into planets and other bodies such as moons, asteroids, and comets).

Option 1: Textual and Visual Secondary Sources

Materials:

- Textual Case Files: 2–3 short, curated excerpts from textbooks, scientific articles, or journals covering the nebular hypothesis and planetesimal formation.
- Visual Case Files: 1–2 scientific diagrams or illustrations showing:
 - The collapse and flattening of the solar nebula into a protoplanetary disk (nebular hypothesis)
 - The process of dust grains clumping into planetesimals and eventually planets (planetesimal formation)
- Miner’s Ledger: A printed Evidence Table for note-taking.
- Annotation Tools: Highlighters or colored pens.

Procedures:

1. Distribution of Sources. The teacher provides learners with the “Case Files.”
2. Learners read the excerpts and examine the diagrams individually or in collaborative groups (3–5 members). Using highlighters and colored pens, they must “mine” both sources for:
 - Key scientific terms and names (e.g., nebula)
 - Specific physical processes (e.g., spinning, clumping, gravitational collapse).
3. Learners populate the Evidence Table, making sure to record findings from both texts and diagrams under the correct theory. Then, they must answer the Guide Questions after completing the Ledger.
4. Teacher’s Script: *“Your texts and diagrams gave you the evidence. You now know that the nebular hypothesis explains how a cloud of gas and dust collapsed and flattened into a spinning disk. And you now know that planetesimal formation explains how the material in that*

Option 1: Textual and Visual Secondary Sources

Notes for the Teacher:

- Prepare the textual and visual case files in advance. Ensure that excerpts and diagrams are clearly labeled by theory, so learners do not conflate the two when filling out their Ledger. A sample file (HTML format) is available through this link: https://drive.google.com/drive/folders/1fiQuXscqLiYVnzKoBDSv-ftN_5oG1MI?usp=sharing
- The excerpts and diagrams should represent both theories, including modern refinements.
- Prioritize pairing strong readers with those who may struggle. Encourage them to read aloud, as hearing the scientific terms helps with memory retention.
- For learners who struggle with dense scientific text, the teacher can pre-underline complex sentences to help them focus on the data points.
- If learners are hesitant to highlight, tell them they are “detectives” and the highlights are “the fingerprints of physics.”
- Encourage learners to look for “action words” (verbs) when filling out the “How” column. Words like collapsed, flattened, clumped, collided, and accreted signal a physical process.

disk grew from tiny dust grains into the planets of our Solar System. Together, they are the most complete scientific explanation we have for how the Blue Marble came to be.”

Option 2: Video-Based Sources

Materials:

- Digital Case Files: 1–3 short, high-quality video clips showing simulations of the nebular hypothesis and planetesimal formation. For example:
 - JF SciTech. “Chapter 09 – Nebular Hypothesis.” YouTube video, 8:15. Posted July 19, 2025.
<https://www.youtube.com/watch?v=pF0iSwlhspc>
 - Lincoln Learning Solutions. “Formation of the Planets.” YouTube video, 3:29. March 2, 2020.
<https://www.youtube.com/watch?v=sCkhEu3lYNc>
 - Edu Sphere. “Formation of the Solar System - The Solar Nebula theory Explained.” YouTube video, 3:51. Posted January 12, 2024.
<https://www.youtube.com/watch?v=YgWBjteFxXo&t=10s>
- Miner’s Ledger: The same in Option 1.
- Playback Control: Tablets, laptops, or TV.

Procedures:

1. Strategic Viewing (The “Stop and Mine” Method):
 - First Watch: Learners watch the video through to the end to get the big picture.
 - Second Watch: The teacher (or within groups) pauses the video at key timestamps (e.g., when the disk flattens or when rocks collide).
 - During these pauses, learners “mine” the visual data to fill in their Miner’s Ledger under the correct theory.
2. Audiovisual Extraction: Learners describe what they watch in the ledger.
3. Learners answer the Guide Questions to confirm they understood the “How” shown in the video.
4. Teacher Script: *“Your videos gave you the evidence. You now know that the nebular hypothesis explains how a cloud of gas and dust collapsed and flattened into a*

- Avoid presenting the two theories as one continuous theory.

Option 2: Video-Based Sources

Notes to the teacher:

- Preview all video clips before the class to ensure they accurately represent each theory separately and do not blend the nebular hypothesis and planetesimal formation into one continuous narrative.
- Avoid presenting the two theories as one continuous theory.
- Since videos can move quickly, the teacher should use the “Pause-and-Post” technique. This prevents cognitive overload and keeps the task reflective.
- Advise learners to listen for cues that signal that a key term or process is being revealed.
- Terms/Concepts: Learners listen for the keywords (e.g., *Accretion*).
- Summary of Process: Describe the movement (e.g., *“The cloud flattened like a pancake,” “Rocks smashed together to get bigger”*).
- For learners who struggle to extract information from videos, assign specific roles within the group. This distributes the cognitive load and ensures all data is captured.
- Remind learners that video simulations are models. They are

	<p><i>spinning disk. And you now know that planetesimal formation explains how the material in that disk grew from tiny dust grains into the planets and other Solar System bodies. Together, they are the most complete scientific explanation we have for how the Blue Marble came to be.”</i></p> <p>3. Developing Mastery</p> <p>The Scrambled Sequence</p> <p>Procedures:</p> <ol style="list-style-type: none"> 1. Divide the class into small groups of 3–5 learners and distribute one set of 6 shuffled Evidence Strips to each group. Inform learners that this activity will test whether they can correctly sequence the stages of Earth's origin based on the two theories discussed. 2. Explain that the 6 strips are divided into two sets, 3 strips for the nebular hypothesis and 3 strips for planetesimal formation. Each strip describes a specific event in the formation of the Solar System and Earth. Refer to the Activity Sheet for the complete strips. 3. Instruct learners to start with the nebular hypothesis and arrange its 3 strips in the correct order: <ul style="list-style-type: none"> ○ Strip 1: The Solar Nebula (The Initial Cloud) ○ Strip 2: Contraction and Rotation (The Flattening Disk) ○ Strip 3: Protosun and Disk Formation 4. Once the nebular hypothesis strips are correctly arranged, instruct learners to proceed to planetesimal formation and arrange its 3 strips in the correct order: <ul style="list-style-type: none"> ○ Strip 1: Planetesimal Formation (Accretion) ○ Strip 2: Protoplanets and Earth Formation ○ Strip 3: Final Solar System Configuration 5. Teacher’s Script: <i>“Let us look at what you have just done. You took 6 scrambled events and put them back in the order that science tells us happened. Neither set alone tells the full story. Together, they give us the most complete scientific explanation we have for how the Blue Marble we live on came to be.”</i> 	<p>visual representations of processes that happened 4.6 billion years ago and cannot be directly observed. This is an opportunity to discuss the nature of scientific modeling with learners.</p> <p>IDF Relevance:</p> <p><i>This activity helps learners move to building a clear, source-based timeline independently, beyond just “mining” data.</i></p> <p>Teacher’s Notes for Mastery (Formative Assessment):</p> <ul style="list-style-type: none"> ● Circulate between groups and listen for whether learners can articulate cause and effect between each strip, not just the correct order, but why each event leads to the next. ● Evidence Strips: To be printed, cut, and shuffled before distributing to groups. Ensure that the strips from both theories are mixed in each set so learners cannot immediately identify which strips belong to which theory. ● Remind learners that the evidence supporting the nebular hypothesis is significantly more observable and direct compared to planetesimal formation. Both theories are well-supported. The nebular hypothesis simply has more directly observable evidence available today.
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<ul style="list-style-type: none"> Demonstrating Knowledge and Skills 	<p>1. Finding Practical Application</p> <p>Signal From Space Procedures:</p> <ol style="list-style-type: none"> The teacher presents “Telescope Data” from a newly discovered star system: “Our telescopes have detected a massive, slowly rotating cloud of gas and dust approximately 400 light-years away. The cloud appears to be collapsing inward under its own gravity. Early readings show the cloud is beginning to spin faster and flatten into a disk-like structure. The center of the disk is significantly hotter and denser than the outer edges.” The learners must use their knowledge of the nebular hypothesis to answer the following questions: <ul style="list-style-type: none"> What stage of the nebular hypothesis is this star system currently in? (Answer: <i>The system is in the contraction and rotation phase; the cloud is collapsing and flattening into a protoplanetary disk.</i>) What physical force is driving the collapse of the cloud? (Answer: <i>Gravity is driving the collapse.</i>) What will happen to the spin speed of the cloud as it continues to collapse? (Answer: <i>It will increase due to the conservation of angular momentum. As the cloud contracts, it spins faster.</i>) Based on the temperature difference between the center and the outer edges, what type of bodies would you expect to form near the center? What about the outer edges? (Answer: <i>Rocky, terrestrial bodies would form near the hotter center where temperatures are too high for ice and volatile materials to exist. Icy, gas-rich bodies would form toward the cooler outer edges, where lower temperatures allow materials to condense.</i>) Teacher’s Script: “What you just did is exactly what real astronomers do. NASA’s Exoplanet Exploration Program uses our knowledge of how Earth formed to search for other rocky, habitable planets. The nebular hypothesis is not just a theory about our past, it is the blueprint we use to search for other Blue Marbles in the universe.” 	<p>Signal From Space</p> <p>IDF Relevance: <i>This activity encourages reflective thinking by prompting learners to evaluate how the same physical principles that formed our Solar System can be applied to predict the behavior and outcome of newly discovered star systems beyond our own.</i></p> <p>Notes to the Teacher:</p> <ul style="list-style-type: none"> Learners evaluate a real-style telescope scenario and apply their knowledge to predict the behavior and outcome of a newly discovered star system. The scenario presented mirrors real astronomical observations. Astronomers actively observe protoplanetary disks forming around young stars today using telescopes such as the James Webb Space Telescope. Listen for whether learners cite specific stages and concepts, not just general descriptions of what is happening. Highlight and reward responses that use precise scientific terms such as protoplanetary disk, angular momentum, frost line, and gravitational collapse.
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2. Making Generalization

From Cloud to Blue Marble

Materials:

- Set of printed images for nebular hypothesis:
 - A swirling gas cloud (Solar Nebula)
 - A flattening, glowing disk (Protoplanetary Disk)
 - A bright, dense center with a surrounding disk (Protosun and Disk Formation)
- Set of printed images for planetesimal formation:
 - Irregular, rocky clumps colliding (Planetesimals)
 - A cooling, spherical body (Protoplanet)
 - Planets settled into stable orbits around the Sun (Final Solar System Configuration)
- Description Cards: Brief descriptions of each stage.
- Keyword Cards (Physical Drivers)
- Connector Arrows: Paper arrows or markers

Procedures:

1. Distribute the scrambled nebular hypothesis images, description cards, keyword cards, and connector arrows to each group. Keep the planetesimal formation materials separate for now.
2. Round 1 (Nebular Hypothesis): Learners arrange the 3 images in the correct sequential order. Between each pair of images, they place a Connector Arrow and the corresponding Keyword Card to explain what physical force or process caused one stage to lead to the next.
3. Once Round 1 is complete, distribute the materials for Round 2 (Planetesimal Formation).
4. Round 3 (The Full Chain): Ask the learners to place both completed sequences end to end, connecting the last image of the nebular hypothesis (protosun and disk formation) to the first image of planetesimal formation (planetesimals).
5. Teacher's Script: *"Look at what you have built. Every arrow you placed, every keyword you chose, each one represents a real physical process that science tells us*

From Cloud to Blue Marble

IDF Relevance:

This facilitates learners to move from the abstract to a structured sequence of formation.

Notes to the Teacher:

- Refer to the corresponding learning activity sheets for this part of the lesson.
- For the nebular hypothesis: Solar Nebula → (Gravity) → Protoplanetary Disk → (Conservation of Angular Momentum) → Protosun and Disk Formation
- For the planetesimal formation: Planetesimals → (Electrostatic Forces, then Accretion) → Protoplanet → (Gravity and Accretion) → Final Solar System Configuration
- For each connection, learners must answer: *"How did this keyword physically change the system from one stage to the next?"*
- This activity supports visual learners who may find the textual secondary sources too abstract.
- If learners struggle with any connection, use it as a signal to revisit that concept before moving on to the assessment.

	<p><i>happened 4.6 billion years ago. Together, the nebular hypothesis and planetesimal formation are the most complete scientific explanation we have for how our Solar System and our home came to be.”</i></p>	<ul style="list-style-type: none"> • Remind learners to avoid presenting the nebular hypothesis and planetesimal formation as one continuous theory.
<p>V. ASSESSMENT (Assessing Learnings)</p>	<p><i>This section will serve as a culminating assessment intended to evaluate the entire unit, including both the Content Standard and the Performance Standard.</i></p> <p>Part I: Multiple Choice. For each item, choose the letter of the option that best answers the question or completes the statement.</p> <p>_____ 1. What force caused the nebula to collapse and begin forming the Solar System? A. Magnetism B. Friction C. Gravity D. Radiation</p> <p>_____ 2. As the nebula collapsed, it began to spin faster due to the conservation of _____. A. energy B. inertia C. mass D. angular momentum</p> <p>_____ 3. Scientists observe that all planets in our Solar System orbit the Sun on a relatively flat plane. If your classmate argues that Earth was a “stray rock” captured by the Sun's gravity later, how does the nebular hypothesis disprove this? A. Earth’s flat, circular orbit is a direct result of the nebula flattening into a disk. B. A captured rock would orbit in a random, tilted path, not the flat, circular orbit Earth has. C. The Sun’s heat would have melted any “stray rock” that came too close to its center. D. Earth is too large to have been a stray rock; only small asteroids can be captured.</p> <p>_____ 4. Look at the image of the NWA 869 Meteorite. This space rock is made of tiny, rounded grains (chondrules) that have been squeezed together. How does this physical evidence support the concept of accretion in planetesimal formation?</p> <div> </div> <p>Raab, H. “NWA 869 Meteorite.” Photograph. December 2005. Wikimedia Commons. https://commons.wikimedia.org/wiki/File:NWA869Meteorite.jpg.</p> <p>A. It suggests that planets formed as larger bodies that later broke into smaller pieces. B. It shows that small particles collided and combined to form larger solid bodies. C. It suggests that Earth formed rapidly from a single explosive event in space. D. It shows that gravity had little role in the early formation of the Solar System.</p>	

5. A team of astronomers is using a high-powered telescope to observe a young star system. They find a massive, spinning disk of dust and gas. At the very center, the material is extremely hot and dense, while the outer edges are much cooler. Based on the nebular hypothesis, what is the most likely physical process occurring in the center of this disk compared to the outer edges?
- A. The center is losing mass to the outer edges because material naturally moves outward as the disk spins.
 - B. The center cools to form rocks while the outer edges heat up to form gas giants.
 - C. The center forms a protostar through gravitational compression while the outer edges settle into a protoplanetary disk.
 - D. The entire disk disappears because gravity only works on solid objects.

Part II: Error Miner

Directions: The paragraph below describes Earth's origin but contains five (5) deliberate scientific errors. Read the paragraph carefully and underline each error, which can be a word or a phrase.

In the beginning, our Solar System was a cold, static cloud of gas and dust that remained perfectly still in space. Due to the magnetic force, the cloud began to collapse inward and spin more slowly as it contracted, eventually flattening into a disk-like structure. Inside this disk, solid dust grains collided and stuck together through gravitational force only, growing into planetesimals. These planetesimals merged over millions of years, eventually forming a single, sudden collision that built the solid Earth we live on today.

VI. REFLECTION (Feedback and Continuous Improvement)

This section presents the key highlights and challenges encountered by both teachers and learners throughout the unit. It also includes the teacher's adjustments to improve instruction.

VII. USE OF GENERATIVE AI

In preparing this Learning Exemplar (LE), the author used ChatGPT, Gemini, and Claude for structural refinement, grammatical optimization, and the simplification of instructional procedures. The author reviewed and finalized the content. The author takes full responsibility for the content of this LE.

Lesson Title/Topic	The Structure and Composition of the Earth	Lesson Exemplar	6
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I. OBJECTIVES	
A. Content Standard	<i>The learners learn that seismic waves and their effects help to explain and understand the nature and composition of the Earth.</i>
B. Performance Standard	<i>By the end of the quarter, learners describe the origin of the solar system and Earth's historical evolution. They relate Earth's unique position in the solar system to its composition, structure, and the dynamic nature of its outer layers. Learners explain how scientists determine the nature of Earth's interior. They also collaboratively create detailed models and scientific analyses and use evidence-based findings to illustrate the nature and composition of the Earth.</i>
C. Learning Competencies	<i>The learners describe how scientists use the study of rocks, minerals, meteorites, seismology, and volcanology to infer the composition of the Earth.</i>
II. REFERENCES and MATERIALS	<p>RIS (Incorporated Research Institutions for Seismology). n.d. "Seismic Monitor." Accessed March 12, 2026. https://www.iris.edu/app/seismic-monitor/map.</p> <p>LibreTexts. 2023. "2.2: Layers of the Earth." In <i>Introduction to Geology</i>. Fullerton College. Last modified July 15, 2023. https://geo.libretexts.org/Courses/Fullerton_College/Introduction_to_Geology/02%3A_Plate_Tectonics/2.02%3A_Layers_of_the_Earth.</p> <p>NASA. n.d. "NASA Astromaterials Acquisition and Curation Office." Accessed March 12, 2026. https://curator.jsc.nasa.gov.</p> <p>National Geographic Society. n.d. "Meteorite." National Geographic Education. Accessed March 12, 2026. https://education.nationalgeographic.org/resource/meteorite/.</p> <p>National Geographic Society. n.d. "Xenolith." National Geographic Education. Accessed March 12, 2026. https://education.nationalgeographic.org/resource/xenolith/.</p> <p>Oldham, Richard Dixon. 1906. "The Constitution of the Interior of the Earth, as Revealed by Earthquakes." <i>Quarterly Journal of the Geological Society</i> 62: 456–75.</p> <p>Science101. 2018. "Structure of the Earth and Its Composition." YouTube video, 12:47. May 2, 2018. https://www.youtube.com/watch?v=SeFT0ewzM6g.</p> <p>Smithsonian Institution. n.d. "Global Volcanism Program." Accessed March 12, 2026. https://volcano.si.edu.</p>
	III. CONTENT
<i>The Structure and Composition of the Earth</i>	

IV. OBJECTIVES

At the end of this lesson, the learners shall be able to:

- describe how rocks and minerals from volcanic activity serve as evidence for the Earth's structure and composition.
- explain how evidence from meteorites supports understanding of the Earth's structure and composition.
- interpret how seismic wave behavior reveals information about the Earth's layers and composition.
- evaluate the reliability of multiple lines of evidence, volcanic samples, meteorites, and seismic data, in constructing a model of the Earth's interior.

IV. PROCEDURES

ANNOTATIONS

• Activating Prior Knowledge

1. Activating Prior Knowledge

(OPTION 1) Finding tools in Decoding the Earth, Sky and the Shock in Between

In this activity, the learners must identify the functions of the scientific instruments and group them into Event Zones: V (Volcano), M (Meteorite), or S (Seismic Wave). Then, explain their function in each zone.

Illustration	Event Zone (Write the letter only)	Function
 <p>Fig. 1. A tiltmeter on the flank of Mauna Loa (USGS 1987)</p>		
 <p>Fig. 2. A handheld metal detector used to locate coins (Zandane 2005).</p>		
 <p>Fig. 3. A high-precision GPS receiver for monitoring tectonic movements (Sveinsson 2023).</p>		

1. Activating Prior Knowledge

(OPTION 1) Finding tools in Decoding the Earth, Sky and the Shock in Between

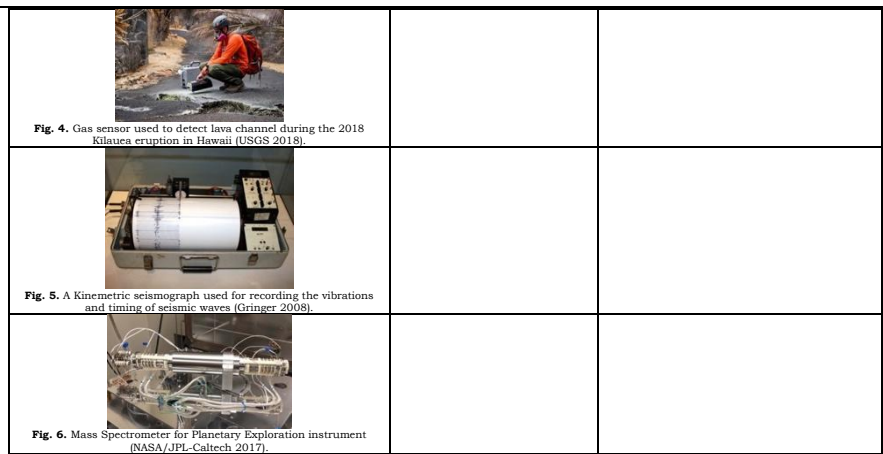
IDF Relevance:

In this activity, Learners recall scientific instruments for volcanology, meteorite study, and seismic wave analysis. This activates prior knowledge, scaffolds Earth's structure exploration via real-world measurements, and enables formative assessment for spiral progression.

Note to teacher:

- Print/project clear illustrations and instructions.
- Prepare a slide on the instruments' importance.
- Roam to monitor groups during the activity.
- Pose the post-activity question; scaffold to activate prior knowledge.

Post-Activity Question:



(NOTE: see the Lesson 6 Learning Activity Sheet for the whole instruction and the activity material)

(OPTION 2) KWLA Chart

In this activity, the learners must a KWLA Chart to assess prior knowledge before and acquired knowledge after the discussion

PROCEDURE:

- The learners shall fill the first 2 columns on what they know and what they want to know about the structure and composition of the Earth.
- The last 2 columns will be accomplished after the lesson.

What I Know?	What I Want to Know?	What I Learned?	How Can I Apply it?

2. Establishing the Purpose of the Lesson

(OPTION 1) VIDEO ANALYSIS

The teacher starts with a thought-provoking question:

"If no human has ever seen the center of the Earth, how do we know what's inside it?"

1. What is the importance of these scientific instruments in their specific field of use?
2. Do you think these tools can be used to determine the structure and composition of the Earth?

(OPTION 2) KWLA Chart

IDF Relevance:

In this activity, Learners recall prior knowledge of Earth's structure and composition, sparking curiosity and preparing them to refine misconceptions with evidence. This builds schema for inquiry and embodies reflective principles via metacognition and self-assessment.

Note to teacher:

- Give lesson overview before eliciting prior knowledge.
- Print/project the KWLA table; have students copy it in notebooks for completion after the lesson.

2. Establishing the Purpose of the Lesson

(OPTION 1) VIDEO ANALYSIS

IDF Relevance:

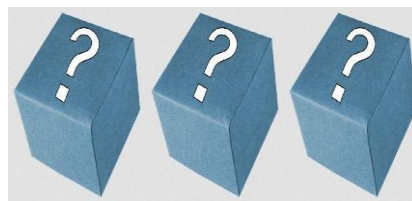
In this activity, Learners watch an instructional video reflecting on inferring Earth's deep structure without direct access. This builds curiosity for three key evidences and

	<p>PROCEDURE:</p> <p>The teacher presents a BBC News YouTube video about the Journey to the Center of the Earth (link: https://www.youtube.com/watch?v=SeFT0ewzM6g)</p> <p>After watching the video, the learners will be asked: <i>"If we can only drill a few miles into the ground, how do we know what the Earth looks like thousands of miles deep?"</i></p>  <p>The teacher must highlight that in this lesson, learners will discover three lines of evidence used to describe the Earth's structure and composition despite limited direct access.</p> <p>(OPTION 2) Pair, Stick, and Share</p> <p>This activity transitions learners from individual reflection to collaborative discussion, building a collective 'knowledge wall' on the board. The learners must answer these questions:</p> <ol style="list-style-type: none"> 1. Why does Earth have different layers? 2. What if earth is only made of one material, what will happen to humans? <p>PROCEDURE:</p> <ol style="list-style-type: none"> 1. Have learners turn to their shoulder partner. 2. Allow 2 minutes silent think time before sharing. 3. The teacher must roam around the room. If a pair is stuck, use a "nudge" question. 4. On signal, one member per pair posts sticky note on board. 5. At the end of the given time, Randomly select notes for class sharing. <p>After the activity, the teacher will explain the three objectives for this lesson.</p>	<p>aligns with inquiry-based principles, promoting critical thinking and evidence-based reasoning via multimedia</p> <p>Teacher Note:</p> <ul style="list-style-type: none"> ▪ Narrate key inputs while playing the video and pause to highlight critical part. ▪ The video can be downloaded or recorded to be ready for connectivity issues. <p>(OPTION 2) Pair, Stick, and Share</p> <p>IDF Relevance</p> <p>In this activity, Learners shift from individual think time to pair discussion, posting sticky-note responses on a collective 'knowledge wall' for random sharing. This surfaces diverse ideas and misconceptions before setting objectives, advancing collaborative learning, teamwork, oral communication, and formative assessment.</p> <p>Teacher Note:</p> <ol style="list-style-type: none"> 1. Allocate 5-10 minutes for this activity 2. Prepare sticky notes or remind learners to bring their own. 3. Circulate and prompt learners with questions to ensure on-task focus.
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- **Instituting New Knowledge**

**Presenting Examples
(OPTION 1) THE BLACK BOX CHALLENGE**

In this activity, the learners must guess the difference in density of each box and describe it using their senses.



MATERIALS:

- **Box A-** Any light object
- **Box B-** Any heavy object
- **Box C-** Any object heavier than box c and has magnetic characteristic.

TEACHER PREPARATION & PROCEDURE:

1. Prepare three identical sealed cardboard boxes with assigned materials inside.
2. Pass boxes around; instruct students to perform these data-gathering tests:
 - **Density Tilt:** Slowly tilt the box side-to-side to estimate mass distribution.
 - **Magnetic Survey:** Slide magnet outside to detect if the object is magnetic or not.
3. After recording observations, the teacher reveals these boxes represent Earth's compositional layers.

(OPTION 2) PHOTO ANALYSIS

PROCEDURE:

1. The teacher presents an illustration of the Earth's interior.
2. Learners are given 2–3 minutes of "silent looking" to observe labels, colors, and the relative thickness of each layer.

**Presenting Examples
(OPTION 1) THE BLACK BOX CHALLENGE**

IDF Relevance:

In this activity, Learners use touch, shaking, tilting, and magnets to infer sealed boxes' contents, gathering 'seismic-like' data. This analogizes indirect evidence for Earth's interior and exemplifies experiential learning through hands-on inquiry.

Note to Teacher

- Set up the boxes beforehand to keep the surprise element and to spark curiosity.
- Allow the students to share their observation to the class so the curiosity of the others will start building even before their turn.

(OPTION 2) PHOTO ANALYSIS

IDF Relevance:

In this activity, Learners examine an illustration showing the Earth's features, layer knowledge, and discovery methods. This visual analysis activates schema and highlights indirect evidence like seismic data. This supports the ideational principle, encouraging idea

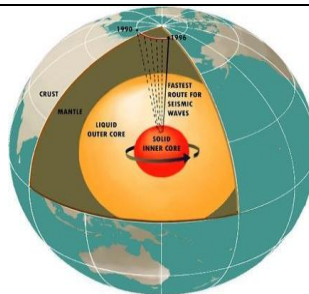


Fig. 1. A composite satellite view of Earth's surface, illustrating the distribution of landmasses and oceans (NASA 2011).

After analyzing, the learners must answer the following guide questions:

1. What is shown in the photo?
2. What do you know about these layers?
3. How did scientists discover the different layers of Earth's interior?

2. Discussing New Concept

(OPTION 1) Investigating the Earth's Interior: Analyzing Evidences

In this activity, the learners will investigate three main evidences used by scientists to describe the layers of the earth.

MATERIALS:

- Activity Sheet and Pen for Writing
- Mobile Phone or any digital device
- Access to the Internet

PROCEDURE:

1. The class will be grouped with 4 members each.
 - Each member will have their specific roles: The Lead Scientist, The Data Analyst, The Learning Advocate, and The Presenter.
 - There will be 4 stations: STATION A (Volcanic Evidence), STATION B (Meteorite Evidence), STATION C (Seismic Wave Evidence), and STATION D (The final Synthesis).

generation and evidence-based reasoning aligned with Earth Science competencies.

Note to Teacher:

- Print and paste illustration on board or project digitally.
- Give learners an idea that the deepest hole ever drilled (the Kola Superdeep Borehole) only reached about 12 kilometers. Highlight that everything we see in this diagram is a result of brilliant scientific deduction.

2. Discussing New Concept (OPTION 1) Investigating the Earth's Interior: Analyzing Evidences

IDF Relevance:

In this activity, Learners form groups with defined roles and rotate through stations analyzing evidences and culminating in synthesis. This structured inquiry reveals how scientists infer Earth's composition without direct access. This embodies the collaborative and differentiated guiding principles fostering 21st-century skills like teamwork, critical analysis, and evidence synthesis.

Note to Teacher:

- All the materials and the information needed for each station can be accessed in the Learning Activity Sheet.

	<ul style="list-style-type: none"> • Each station provides a piece of evidence that will be analyzed by the members. • After understanding the evidence, they need to answer challenge questions. <p><i>(NOTE: see the Lesson 6 Learning Activity Sheet for the whole instruction and the activity material)</i></p> <p>(OPTION 2) Virtual Investigation: Exploring Earth's Interior</p> <p>In this activity, the learners will act as “Geoscience detectives”, utilizing real digital tools to gather evidences about what lies deep beneath the Earth's surface.</p> <p>MATERIALS:</p> <ul style="list-style-type: none"> • Activity Sheet and Pen for Writing • Mobile Phone or any digital device • Access to the Internet <p>PROCEDURE:</p> <ul style="list-style-type: none"> • The class will be grouped with 4 members each. • The learners will utilize 3 virtual tools to observe and gather evidence. <ul style="list-style-type: none"> ○ For rocks and minerals from volcano: ○ https://volcano.si.edu ○ For meteorites: ○ https://curator.jsc.nasa.gov ○ For Seismic Waves: ○ https://www.iris.edu/app/seismic-monitor/map • The learners will record their observation and answer related questions to discover how these evidences were used in describing the structure and composition of the Earth. • After answering the guide questions, the learners must present their findings to the class. <p><i>(NOTE: see the Lesson 6 Learning Activity Sheet for the whole instruction and the activity material)</i></p>	<ul style="list-style-type: none"> ▪ Give clear, step-by-step instruction to the students ▪ Stations can be run simultaneously (jigsaw model) or sequentially. <p>(OPTION 2) Virtual Investigation: Exploring Earth's Interior</p> <p>IDF Relevance:</p> <p>Learners use digital tools to analyze evidence in a virtual exploration that simulates how scientists infer Earth's properties from remote data. This method aligns with the IDF by combining technology-enabled learning with inquiry-based discovery, strengthening students' data interpretation and digital literacy skills.</p> <p>Note to Teacher:</p> <ul style="list-style-type: none"> ▪ All the materials and the information needed for each virtual tool can be accessed in the Learning Activity Sheet. ▪ Deliver clear, step-by-step instruction to the students ▪ Ensure devices have stable internet access before the session. ▪ The IRIS Seismic Waves Viewer works best in Chrome or Firefox. ▪ To ensure accessibility, these materials can be downloaded or recorded in advance so that
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	<p>3. Developing Mastery Connect the Evidences</p> <p>Instruction: The table below lists evidence types on the left and Earth’s layers / features on the right. For each row: (1) place a tick ✓ in every layer the evidence helps us understand, and (2) write a one-sentence reason in the “How it helps” column.</p> <table><tr><th>Evidence</th><th>Crust</th><th>Upper Mantle</th><th>Lower Mantle</th><th>Core</th><th>How it helps</th></tr><tr><td>Xenoliths(peridotite)</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Magma chemistry (Mg/Fe ratios)</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Chondrite meteorites</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>P-wave shadow zone</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>S-wave shadow zone</td><td></td><td></td><td></td><td></td><td></td></tr></table>	Evidence	Crust	Upper Mantle	Lower Mantle	Core	How it helps	Xenoliths(peridotite)						Magma chemistry (Mg/Fe ratios)						Chondrite meteorites						P-wave shadow zone						S-wave shadow zone						<p>students can complete the activity offline.</p> <p>3. Developing Mastery Connect the Evidences IDF Relevance:</p> <p>In this activity, Learners tick applicable Earth’s layers for each evidence type, and explain how it reveals Earth structure. This targeted analysis links evidences to specific layers, solidifying inference skills. In the IDF, it advances the analytical and formative assessment principles, targeting Earth Science competencies.</p> <p>Note to teacher:</p> <ul style="list-style-type: none">▪ Have the table printed or projected virtually▪ Give students enough time to analyze and reflect on the importance of each evidence.
Evidence	Crust	Upper Mantle	Lower Mantle	Core	How it helps																																	
Xenoliths(peridotite)																																						
Magma chemistry (Mg/Fe ratios)																																						
Chondrite meteorites																																						
P-wave shadow zone																																						
S-wave shadow zone																																						
<ul style="list-style-type: none">• Demonstrating Knowledge and Skills	<p>Finding Practical Application (OPTION 1) ACTIVITY: Hazard Consultants</p> <p>The teacher will Set up four "Consultation Folders" around the room. Each folder contains a Problem and the Geological Evidence needed to solve it</p> <p>Station 1: The Luxury Hunt (Diamonds & Xenoliths)</p> <ul style="list-style-type: none">• The Scenario: A mining company found a volcano. They need to know if it is worth 1 million pesos in diamonds or just 1000 pesos in gravel.• The Evidence: They found Peridotite (mantle rock) inside the lava.• The Task: Explain why finding Peridotite is a "green light" for diamond hunting. <p>Station 2: The City Planner (Seismic Mapping)</p>	<p>Finding Practical Application (OPTION 1) ACTIVITY: Hazard Consultants</p> <p>Expected Answer (Application): Station 1: Since diamonds are Xenoliths that form in the high-pressure mantle, the presence of Peridotite proves the volcano tapped into the "Diamond Stable Zone." Station 2: By mapping how seismic waves travel, engineers can predict which buildings are at risk and adjust Building Codes to save lives. Station 3: Understanding the density and mass of meteorites allows scientists to calculate the potential</p>																																				

- **The Scenario:** A new city is being built in an earthquake zone. One side of the city sits on soft clay; the other sits on hard granite bedrock.
- **The Evidence:** An engineer sends a Seismic Wave through the ground. The wave moves fast through the granite but slows down and shakes violently in the clay.
- **The Task:** Which side of the city needs stronger building codes?

Station 3: Planetary Defense (Meteorite Impact)

- **The Scenario:** A "Near-Earth Object" (Asteroid) is headed toward Earth.
- **The Evidence:** Telescopes show it has the same density as an Iron-Nickel meteorite.
- **The Task:** Calculate if we should try to "nudge" it or "blast" it.

After presenting the report, the teacher will ask:

Which of these three applications do you think is most important and why?

(OPTION 2) ACTIVITY: KWLA Chart

In this activity, the learners will be finishing their KWLA Chart to assess their acquired knowledge after the discussion.

PROCEDURE:

1. Learners are required to complete the final two columns after the lesson. In these sections, they will reflect on what they have learned and describe how those concepts can be applied to real-life scenarios.

What I Know?	What I Want to Know?	What I Learned?	How Can I Apply it?

Guide Questions:

1. Are your prior and new knowledge the same or different?

impact force. This helps them design the right "deflection" mission to protect the planet

IDF Relevance:

In this activity, Learners act as consultants using evidences to advise how to solve each problem. This applies layer knowledge to real-world decisions. It help learners to transition from "learning facts" to "valuing the science." In the IDF, it reflects the contextualization principle, connecting Earth Science evidences to practical applications like resource exploration and hazard assessment.

(OPTION 2) ACTIVITY: KWLA Chart IDF Relevance:

In this activity, Learners complete the final columns of their KWLA Chart ("What I Learned" and "How Can I Apply It?"), reflecting on Earth's structure knowledge gained and its real-life applications post-lesson. This metacognitive exercise consolidates understanding and personalizes relevance. In the IDF, it embodies the reflective guiding principle promoting self-assessment, transfer of learning, and 21st-century skills.

Note to teacher:

	<p>2. What are new discoveries that you have learned after this lesson?</p> <p>2. Making Generalization (Option 1) Concept Mapping</p> <p>To conclude the lesson, the teacher will ask students to create a concept map illustrating how volcanic rocks and minerals, evidence from meteorites, and seismic waves are used to identify the Earth's structure and composition.</p> <p>PROCEDURE:</p> <ol style="list-style-type: none"> 1. On a blank sheet of paper, students will place "Identifying Earth's Structure" at the center. 2. From the center, they must create three main branches for the primary sources of evidence. 3. For each branch, students must add "linking words" (e.g., shows that, proves, indicates) to explain what that specific evidence reveals about either the composition (what it's made of) of the Earth 4. Once the map is complete, students should write a final thought at the bottom: <u><i>"Which piece of evidence do you find the most convincing and why?"</i></u> <p>(Option 2) Thinking Cube</p>	<ul style="list-style-type: none"> • Make sure that the students have their answers to the first two columns. • Facilitate their reflection and ask questions on how their prior knowledge was either correct or wrong. <p>2. Making Generalization (Option 1) Concept Mapping</p> <p>IDF Relevance: In this activity, learners construct a concept map and provide a personal reflection. This visual synthesis integrates lesson concepts and evaluates understanding. Within the IDF, it aligns with ideational and reflective principles, enhancing synthesis skills and metacognition regarding Earth Science competencies and indirect evidence.</p> <p>Note to teacher:</p> <ul style="list-style-type: none"> • Facilitate the students in creating their concept map but let them explore on how they can connect the knowledge that they have gathered in this lesson. <p>(Option 2) Thinking Cube</p> <p>IDF Relevance: In this activity, Learners roll a six-sided cube (Key Idea, Example, Application, Question, Connection, Summary) to orally process evidences</p>
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	<p>Teacher Procedure:</p> <ol style="list-style-type: none"> 1. Provide or help students construct a sturdy cardboard six-sided cube. 2. Label each face: Key Idea, Example, Application, Question, Connection, Summary. 3. In small groups or whole class, a learner rolls the cube and responds orally/written to the top face prompt. 4. Summarize key concepts about Earth's structure/composition using volcanic rocks, meteorites, and seismic wave evidence on the six-sided cube. 5. Use as "Ticket to Leave": Students roll at your desk, answer individually, then exit. 	<p>from volcanic rocks/minerals, meteorites, and seismic waves. This gamified review supports active learning and multiple representations through varied processing and collaboration</p> <p>Note to teacher:</p> <ul style="list-style-type: none"> • Prepare scaffolding to assist students that cannot construct their thoughts.
<p>III. ASSESSMENT (Assessing Learnings)</p>	<p>(OPTION 1) Multiple Choice Assessment</p> <p>Instructions: Choose the best answer for each question.</p> <ol style="list-style-type: none"> 1. What does a peridotite xenolith in volcanic rock reveal about Earth's interior? <ol style="list-style-type: none"> a. It confirms that the outer core is a liquid metal. b. It shows that the mantle is entirely liquid like water. c. It provides a physical sample of the mantle's composition. d. It proves that the Earth's crust is made of iron and nickel. 2. Why do iron-nickel meteorites help us understand Earth's core? <ol style="list-style-type: none"> a. Meteorites are the only source of oxygen on Earth. b. Iron meteorites are the lightest rocks in the solar system. c. Meteorites are pieces of Earth's crust that were blasted into space. d. Earth and meteorites formed from the same solar nebula "ingredients." 3. During an earthquake, why do S-waves disappear at the outer-core boundary? <ol style="list-style-type: none"> a. The outer core is made of solid granite. b. The outer core is a complete vacuum. c. The outer core is a liquid layer. d. The inner core is colder than the crust. 4. How do xenoliths like peridotite help the jewelry and mining industry? <ol style="list-style-type: none"> a. It allows miners to turn basalt into gold. b. It proves that diamonds are made of volcanic ash. c. It helps predict exactly what day a volcano will erupt. 	

- d. It helps identify if a volcano originated deep enough to carry diamonds.
- 5. Why would an engineer use seismic wave data when mapping a city for building codes?
 - a. To determine the thickness of the ozone layer.
 - b. To find hidden gold deposits for the city budget.
 - c. To identify areas with soft soil versus hard bedrock.
 - d. To measure the exact temperature of the city streets.
- 6. If a scientist finds that a Near-Earth Object has the density of a metallic meteorite, how does this help planetary defense?
 - a. It proves the asteroid is a piece of the sun.
 - b. It tells them the asteroid is made of ice and will melt.
 - c. It allows them to ignore the asteroid because metal is harmless.
 - d. It helps calculate the potential impact force to design a deflection mission.
- 7. Why are platinum and chromium usually mined where mantle-like rocks are found?
 - a. The mantle is made of recycled plastic.
 - b. The crust is too hot for these minerals to exist.
 - c. These minerals only form in the presence of liquid water in the core.
 - d. The mantle contains higher concentrations of these heavy elements.
- 8. Which seismic wave travels through both solid and liquid layers and bends at boundaries, acting like an "X-ray" of Earth?
 - a. S-waves
 - b. P-waves
 - c. Ocean waves
 - d. Sound waves in the air
- 9. What is the "S-wave Shadow Zone"?
 - a. An area where the Earth's gravity is zero.
 - b. A zone where volcanoes are prohibited from erupting.
 - c. A place on Earth where no earthquakes ever happen.
 - d. The area where S-waves are blocked by the liquid outer core.
- 10. Where must Earth's extra heavy material be located if the crust is light but the planet is heavy overall?
 - a. In the atmosphere.
 - b. Concentrated in the metallic core.
 - c. Inside volcanic ash clouds.
 - d. Floating on top of the oceans.

(OPTION 2) Performance Task: The Deep Earth Expert Witness

Scenario: A wealthy private space company, "Astro-Dig," is claiming that the Earth is actually hollow and filled with giant caves. They are trying to convince the government to stop funding Earth science. You are a Geological Expert Witness called to testify before a government committee. You must present

a Case File that uses physical evidence to disprove the "Hollow Earth" theory and prove our current model of the Earth's interior.

Your Goal: Create a 5-minute presentation (or a 2-page formal report) that explains the evidence for Earth's layers. You must address the following three "Evidence Exhibits":

- **Exhibit A:** = Explain why finding Peridotite (mantle rock) in lava proves that the layer beneath the crust is solid, dense rock, not an empty cave.
- **Exhibit B:** Show a comparison between Iron-Nickel Meteorites and Earth's overall density.
- **Exhibit C:** Present a diagram of Seismic Waves.

RUBRICS:

Criteria	4 - Mastery	3 - Proficient	2 - Developing
Logic of Evidence	Explains the <i>process</i> of how waves or rocks prove a layer's state.	Identifies the evidence and the layer correctly.	Mentions evidence but cannot explain the connection.
Addressing Objectives	Integrates all 3 objectives (Volcanoes, Meteorites, Seismic) perfectly.	Covers 2 of the 3 objectives with clear detail.	Only focuses on one type of evidence.
Practical Application	Explains how this science is used in mining, engineering, or space defense.	Mentions an application but doesn't explain the link to the layer.	Fails to mention any real-world use for the information.

IV. REFLECTION

(Feedback and Continuous Improvement)

V. USE OF GENERATIVE AI

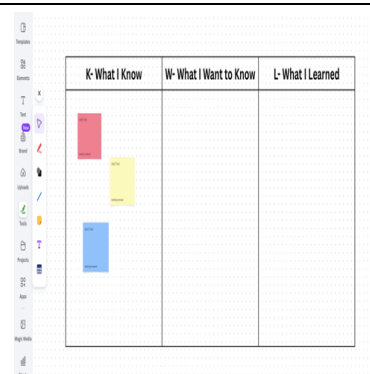
In preparing this Learning Exemplar (LE), the author(s) used Claude.ai and Perplexity.ai in order to craft relevant activities that uses technology and to check the grammar and sentence construction of the instructions. The author(s) reviewed and finalized the writing of the content. The author(s) take(s) full responsibility for the content of this LE.

Lesson Title/Topic	The Structure and Composition of the Earth	Lesson Exemplar	7
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I. OBJECTIVES	
A. Content Standard	The learners that seismic waves and their effects help to explain and understand the nature and composition of the Earth.
B. Performance Standard	<i>By the end of the quarter, learners describe the origin of the solar system and Earth's historical evolution. They relate Earth's unique position in the solar system to its composition, structure, and the dynamic nature of its outer layers. Learners explain how scientists determine the nature of Earth's interior. They also collaboratively create detailed models and scientific analyses and use evidence-based findings to illustrate the nature and composition of the Earth.</i>
C. Learning Competencies	<i>The learners determine the structure and composition of Earth's crust and interior, layers based on insights gained from seismic studies, focusing on their unique properties and boundaries.</i>
II. REFERENCES and MATERIALS	<p>Department of Education (DepEd). Science Learner's Module: Earth Science. Manila: Department of Education, 2016.</p> <p>Incorporated Research Institutions for Seismology (IRIS). "Earthquake Browser." IRIS Data Services. Accessed March 16, 2026. https://ds.iris.edu/ieb.</p> <p>Philippine Institute of Volcanology and Seismology (PHIVOLCS). "Earthquake Location Using P-S Time Differences. PHIVOLCS Training Manual. Quezon City: Department of Science and Technology, 2024." "Seismic Data Analysis Guidelines." Quezon City: PHIVOLCS, 2025. https://phivolcs.dost.gov.ph.</p> <p>United States Geological Survey (USGS). "Earth's Internal Structure." 2023. https://pubs.usgs.gov/gip/dynamic/inside.html. "Seismic Wave Propagation."</p> <p>USGS Earthquake Hazards Program. 2024. https://earthquake.usgs.gov/learn/topics/seismicwaves.php.</p> <p>University of Colorado Boulder. "Wave on a String." PhET Interactive Simulations. Accessed March 16, 2026. https://phet.colorado.edu/sims/html/wave-on-a-string/latest/wave-on-a-string_en.html.</p>
III. CONTENT	<i>The Structure and Composition of the Earth</i>
IV. OBJECTIVES	<ol style="list-style-type: none"> 1. Describe the composition and physical properties of Earth's layers based on volcanology, meteorites, and seismic wave behaviors. 2. Explain how seismic waves (P-waves and S-waves) behave differently as they travel through Earth's layers, including how they speed up, slow down, bend, or stop, and what this reveals about the composition and boundaries of each layer. 3. Determine the location and characteristics of major internal boundaries (such as the Mohorovičić discontinuity and the Gutenberg discontinuity) using seismic data from established studies.

IV. PROCEDURES		ANNOTATIONS
A. Activating Prior Knowledge	<p>1. Activating Prior Knowledge(OPTION 1) What's Inside the Earth?</p> <p>In this activity, the teacher launches a word cloud quiz using Kahoot projected on the screen.</p> <p>Procedure for the Teacher</p> <ul style="list-style-type: none"> • Create: Log in to Kahoot, select Create, and choose Word Cloud. • Setup: Enter your prompting statement. • Launch: Click Start to display the Game PIN. • Discuss: Use the largest generated words to start the lesson. <p>Procedure for the Learners</p> <ul style="list-style-type: none"> • Go to kahoot.it or open the Kahoot app. • Enter the Game PIN displayed on the screen. • Type in words related to the statement and click Submit. • Watch the screen to see how your answers contribute to the class cloud. • After the quiz, the teacher briefly discusses the results, highlighting correct answers and addressing misconceptions before transitioning to the lesson. 	<p>Activating Prior Knowledge (OPTION1)What's Inside the Earth? IDF Relevance:</p> <p>This activity aligns with the Strengthened SHS Framework by activating prior knowledge via gamified quizzing on Earth's layers, retrieving schema to spark curiosity through competition. It ensures responsive teaching with interactive lessons, immediate feedback, on-the-spot misconception correction, and reflective improvement for learner-relevant content.</p> <p>Note to teachers:</p> <ul style="list-style-type: none"> • Secure gadgets and ICT tools beforehand. • If possible, use the DCP or ICT room for stable computer and internet access. • Alternative: Allow verbal responses for non-digital learners; transition with "These ideas lead us to...".
	<p>(OPTION 2) Jamboard Recall</p> <p>In this activity, each learner accesses a Canva Online Whiteboard to fill with what they know about Earth's structure and composition, what they want to learn, and what they learned (post-lesson).</p> <p>Procedure for the Teacher</p>	<p>(OPTION 2) Jamboard Recall IDF Relevance:</p> <p>Using a Canva whiteboard for KWL (Know, Want to Know, Learned) activates prior knowledge by visually mapping learners' schema on Earth's structure, encouraging self-reflection and clear objectives for inquiry-based learning. It fosters reflective improvement through post-lesson</p>

- Setup: Create a Canva "Online Whiteboard" with K, W, and L columns.
- Share: Set permissions to "Anyone with the link can edit" and send to students.
- Run: Monitor entries and use the Timer for the recall phase.
- Close: Have students complete the "L" section at lesson end.



Procedure for the Learner

- Join: Open the teacher's Canva link.
- K & W Columns: Press 'S' for a sticky note; add one fact to K and one question to W.
- Visuals: Use the Elements tab to add an Earth graphic.
- L Column: Post-lecture, add three new facts to L.

2. Establishing the Purpose of the Lesson

(OPTION 1) Why Study What You Can't See

In this activity, the teacher will play a YouTube short clip clip.
(LINK: <https://www.youtube.com/shorts/7GfPcj2D-Ek>)

After the clip, the teacher poses the driving question:

"How do scientists figure out what Earth looks like on the inside — without ever going there?"



The teacher then reveals the lesson objectives on screen using a slide with the three learning competencies, framed as discoveries the students will make.

updates with feedback, reinforcing competencies in geological composition and scientific inquiry.

Note to teacher:

- Secure gadgets and ICT tools before the activity.
- If possible, conduct the class in the DCP or ICT room to ensure the continuous usage of computer and stable internet.
- Print for offline access.

2.Establishing the Purpose of the Lesson

(OPTION1) Why Study What You Can't See

IDF Relevance:

his activity aligns with the Strengthened SHS Framework by setting clear objectives via a video clip that hooks interest and poses a driving question. It ensures relevant content by linking abstract Earth science to real-world methods, motivating discovery without direct observation through engaging delivery.

Note to teacher:

- Secure gadgets and ICT tools beforehand.

	<p>(OPTION 2) The Mystery of the Deep — A Reading with Purpose</p> <p>The Deepest Drill in History</p> <p>In 1970, Soviet scientists began drilling the Kola Superdeep Borehole in northwestern Russia. After 24 years of work, they reached a depth of 12.2 km — still less than 0.2% of the way to Earth's center. They had to stop because the rocks at that depth were so hot they became semi-molten, destroying the drill.</p> <p>Despite decades of drilling, no human has ever directly sampled Earth's mantle, let alone its core. Yet scientists today can tell you the exact composition of each layer, whether each is solid or liquid, and even the temperature at Earth's center (approximately 5,100°C).</p> <p>How is this possible? The answer lies in seismic waves — vibrations produced by earthquakes that travel through Earth's entire interior. By studying how these waves speed up, slow down, bend, and stop, scientists have constructed a remarkably detailed picture of a place no human has ever seen.</p> <p>Answer these questions to set your learning purpose:</p> <ol style="list-style-type: none"> 1. Why can't scientists simply drill to Earth's core to study it? Write one reason from the passage and one of your own. 2. In your own words, why is studying seismic waves important for understanding Earth's interior? 3. Write a personal learning goal: What is ONE specific thing YOU want to understand by the end of this lesson? 	<ul style="list-style-type: none"> • If possible, use DCP or ICT room for stable computer/internet. <p>(OPTION 2) The Mystery of the Deep — A Reading with Purpose</p> <p>IDF Relevance:</p> <p>This activity aligns with DepEd's strengthened SHS Earth Science curriculum. Purposeful reading on the Kola Borehole fosters inquiry-based learning, critical thinking, and goal-setting for scientific literacy and disaster preparedness. The structured questions promote critical thinking, personal goal-setting, and 21st-century skills, ensuring relevance to performance standards for scientific literacy and disaster preparedness in the Philippine context.</p> <p>Note to Teacher:</p> <ul style="list-style-type: none"> • Roam around to guide responses, emphasizing seismic evidence over direct drilling to build foundational understanding. • Collect personal learning goals for formative assessment and revisit at lesson end.
B. Instituting New Knowledge	<p>1. Presenting Examples</p> <p>(OPTION 1) What the Seismograph Tells Us?</p>	<p>1. Presenting Examples</p> <p>(OPTION 1) What the Seismograph Tells Us?</p>

	<p>In this activity, the learners use three types of indirect evidence to determine what Earth looks like inside. Study each example below, then complete the analysis tasks.</p> <p>Evidence from Meteorites</p> <p>When iron-nickel meteorites are recovered on Earth, their chemical composition closely matches predictions for Earth's core. Chondritic meteorites (stony meteorites that have not melted) mirror the composition of Earth's mantle and crust. Since meteorites are remnants of the early solar system — formed from the same materials as Earth — they act as "free samples" of our planet's original building blocks.</p> <p>This tells us about: ((circle all that apply)</p> <p>CRUST / MANTLE / OUTER CORE / INNER CORE</p> <p>Evidence from Volcanology</p> <p>When volcanoes erupt, they sometimes bring up xenoliths — fragments of rock from deep underground that get carried along in rising magma. These xenoliths are often made of peridotite, a dense rock rich in olivine and pyroxene minerals. Scientists identify peridotite as the dominant rock type of Earth's upper mantle. Additionally, magma compositions give clues about the temperatures and pressures at depth.</p> <p>This tells us about: ((circle all that apply)</p> <p>CRUST / MANTLE / OUTER CORE / INNER CORE</p> <p>Evidence from Seismic Waves</p> <p>When an earthquake occurs, it sends out seismic waves in all directions through Earth's interior. Scientists at seismograph stations around the world record when and how strongly these waves arrive. Two key wave types are P-waves (primary/compressional) and S-waves (secondary/shear). Because P-waves and S-waves travel at different speeds through different materials, and because S-waves cannot travel through liquids at all, the pattern of arrivals — and the</p>	<p>IDF Relevance:</p> <p>This activity aligns with DepEd's strengthened SHS Earth Science curriculum, explaining indirect evidence like meteorites, volcanology, and seismic waves. By analyzing three indirect evidence types through circling tasks and synthesis, it promotes inquiry-based learning, evidence evaluation, and critical reasoning essential for scientific literacy and disaster preparedness in the Philippine context.</p> <p>Note to Teacher:</p> <ul style="list-style-type: none"> • Model seismic wave analysis first, then have students discuss synthesis in pairs. • Use responses to assess layer identification before simulations.
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areas where waves are absent — reveals the structure and state of every layer they pass through.

This tells us about: (circle all that apply)

CRUST / MANTLE / OUTER CORE / INNER CORE

Synthesis Question:

Of the three types of evidence above, which do you think gives scientists the MOST detailed information about all of Earth's layers? Explain your reasoning in 2–3 sentences.

(OPTION 2) Feel the Wave

In this activity, the teacher facilitate a physical demonstration. Two students will perform the demonstration by stretching a slinky or coiled spring across the room. The teacher demonstrates:

- P-waves (compressional): Push-pull motion along the length of the slinky.
- S-waves (transverse): Side-to-side shaking motion of the slinky.

The teacher asks:

How do the differences in motion between P-waves and S-waves explain why P-waves arrive first at a seismograph station, but S-waves cause more sideways shaking of buildings during an earthquake

This activity can have a follow up using virtual simulation. Use the PhET "Wave on a String" simulation(phet.colorado.edu). Project it to demonstrate how wave speed changes with the medium (like Earth layer transitions). Learners can observe on their devices or as a class.

Key Questions to Ask:

**(OPTION 2) Feel the Wave
IDF Relevance:**

This activity aligns with the Strengthened SHS Framework by using multi-modal demonstrations (slinkies and PhET simulations) to make P- and S-wave properties observable before abstract Earth applications. It delivers sequenced, relevant content by previewing S-wave limitations in liquids, scaffolding inferences about Earth's core within science competencies.

Note to teacher:

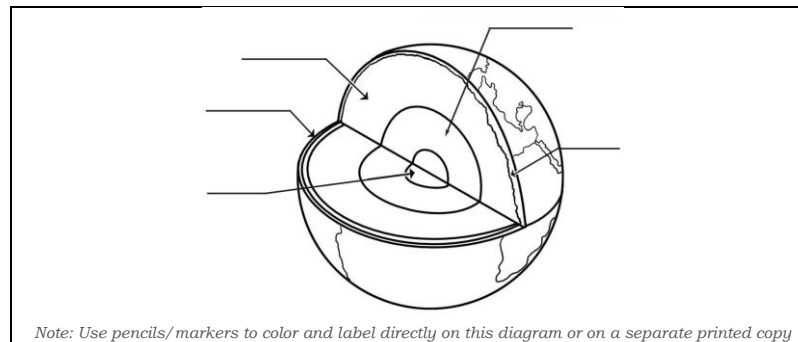
- Select two reliable students for slinky (stretch 4-6m across room); demo P (push-pull), S (side-shake) slowly.
- Link speed changes to layer boundaries; address "waves slow in softer materials."

"What happened to wave speed when you changed the material? What does that remind you of? Could something similar happen inside the Earth?"

2. Discussing New Concept (OPTION 1) Concept Worksheet

Using the blank cross-section diagram below, color and label Earth's four layers (crust, mantle, outer core, inner core) according to the provided color guide. Write each layer's name inside or beside it. Then color and label each layer on the illustration below.

Layer	Suggested Color	Depth Range	Your Label Color
Crust	Green	0 to ~7–70 km	_____
Mantle	Orange	~70 to 2,900 km	_____
Outer Core	Red	~2,900 to 5,100 km	_____
Inner Core	Yellow	~5,100 to 6,370 km	_____



Note: Use pencils/markers to color and label directly on this diagram or on a separate printed copy

(OPTION 2) Journey to the Center of the Earth

In this intervention, the Learners receive a digital scaffold (Google Doc or printed template) with an unlabeled cross-

2. Discussing New Concept (OPTION 1) Concept Discussion and Worksheet

IDF Relevance:

This worksheet aligns with the Strengthened SHS Framework by delivering clear content on Earth's layers, wave behaviors, and boundaries—building conceptual foundations for activity comprehension. It promotes reflective improvement through structured recall of evidence (shadow zones, P-speed jumps), supporting seismic inference competencies.

Note to teacher:

- Use slides/visuals for layers, linking each to prior slinky/seismograph examples.
- Preempt questions: "Mantle plastic = flows slowly"
- Connect PH quakes to Gutenberg zone.
- Transition: "Now apply this to your worksheet/mission diagram."

(OPTION 2) Journey to the Center of the Earth

IDF Relevance:

section and incomplete sentences. As the teacher explains each concept, learners fill in the gaps.

Guided Notes:

1. The Mohorovičić Discontinuity is the boundary between the _____ and the _____. P-wave speed here (increases / decreases) from about ____ km/s to ____ km/s.
2. S-waves cannot travel through the _____ because it is _____. This creates a shadow zone from ____° to ____° from the earthquake epicenter.
3. Evidence from _____ (type of rock) supports the idea that Earth's core is mainly iron and nickel.

The teacher narrates while learners write. Pause for Think-Pair-Share after each boundary. Use a timer (visible on projector) so transitions are smooth.

3. Developing Mastery

(OPTION 1) Seismic Analysis

In this activity, the learners will be analyzing data on seismic waves.

Situation: A magnitude 6.8 earthquake has just occurred somewhere in the Philippine Sea. Three seismic stations in the region — Station A (Manila), Station B (Davao), and Station C (Cebu) — all record data from the event. As junior geophysicists, your team must analyze the seismic data, determine the earthquake's approximate location, and brief a panel of engineers on what the wave patterns tell us about Earth's interior structure.

Station	P-wave Arrival Time	S-wave Arrival Time	P-S Time Difference (Δt)	Distance from Epicenter
(A) Manila	12:04:35	12:04:55	20 seconds	
(B) Davao	12:04:55	12:05:25	30 seconds	

This activity reinforces the Strengthened SHS Framework by having learners tabulate P/S-wave properties and boundaries after discussion, consolidating knowledge through guided practice on refraction, shadow zones, and discontinuities. It supports responsive teaching by addressing gaps (e.g., Moho depths) and building layer mapping competencies via task analysis and reflection.

Note to Teacher:

- Provide word banks; adapt depths to oceanic/continental PH context.
- End with "How does this complete your mission diagram?"

3. Developing Mastery

(Option 1) Seismic Wave Relay

IDF Relevance:

This data analysis extends developing mastery in the Strengthened SHS Framework by applying P-S time differences to triangulate epicenter distance and infer interior structure from wave patterns in a PHIVOLCS scenario, solidifying competencies through authentic, localized analyzing tasks. It ensures relevant content by linking Philippine quakes to layer boundaries via calculations and briefings, fostering reflective improvement.

(C) Cebu	12:04:45	12:05:10	25 seconds	
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Calculate Distances from Each Station

Using the P-S time difference formula, calculate the epicenter distance (in km) to each seismic station. Show all work clearly.

Station	P-S Interval (Δt)	Show Your Solution and Final Distance
Station A — Manila	$\Delta t = 20$ seconds	Distance = _____ km
Station B — Davao	$\Delta t = 30$ seconds	Distance = _____ km
Station C — Cebu	$\Delta t = 25$ seconds	Distance = _____ km

(OPTION 2) Seismic Wave Relay

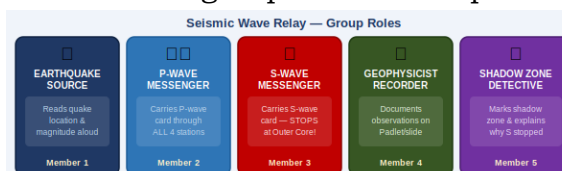
In this activity, the Learners are assigned one of five roles, to physically simulate how seismic waves travel through Earth's interior.

Materials:

- P-wave card (blue) and S-wave card (red)
- 4 Station Cards — cut and place around the room
- LAS sheet (one per learner)
- Colored pencils: blue and red

Procedure:

- Each member of the group will have a specific group:



- The Teacher must provide these cards to each group:

Note to Teacher:

- Group students into 4-5 members per team.
- Use table to calculate distances (~8 km/s $\times \Delta t$ rule: Manila 160 km, Davao 240 km, Cebu 200 km); plot/triangulate epicenter on PH map.
- Assign roles: Data analyst (calculations), mapper (diagram), briefer (wave-layer links, e.g., Δt reveals paths).
- Debrief: Share findings; emphasize "longer Δt = farther station." Provide CSV/template if needed.

(Option 2) Seismic Wave Relay

IDF Relevance:

This activity builds Strengthened SHS Framework mastery through kinesthetic wave path enactment—P-waves passing fully, S-waves stopping at the liquid outer core—to model Gutenberg discontinuity evidence. It supports responsive teaching with structured roles, charts, questions, and synthesis, achieving competency in linking simulations to seismic layer insights via task analysis and reflection.

Note to Teacher:

- Label stations

	<p>EARTHQUAKE SOURCE CARD</p> <p>Event: M 7.2 — Philippine Sea</p> <p>Depth: 35 km below seafloor</p> <p><i>"A magnitude 7.2 earthquake has struck. Seismic waves are traveling outward through Earth. Messengers — begin!"</i></p>	<p>P-WAVE CARD</p> <p>- Travels through solids AND liquids</p> <p>Push-pull motion (parallel)</p> <p>Arrives FIRST — faster wave</p> <p>PASS TO ALL 4 STATIONS ✓</p>	<p>S-WAVE CARD</p> <p>Travels through SOLIDS ONLY</p> <p>Side-to-side motion (perpendicular)</p> <p>Arrives SECOND — slower wave</p> <p>Δ STOP at STATION 3 ✗</p>	<ul style="list-style-type: none">• Prepare blue/red cards, charts, diagrams.• Run 2-3 relays/group (roles rotate);• Manage the space and noise.																														
	<p>Procedure:</p> <ul style="list-style-type: none">• Setup: Create four stations: Crust, Mantle, Outer Core, and Inner Core.• Relay: The P-wave messenger (blue card) visits all stations; the S-wave messenger (red card) stops at the Outer Core.• Roles: The Recorder logs arrivals on a chart while the Detective maps the S-wave shadow zone.• Group Task: Answer questions on wave travel, the Gutenberg Discontinuity, and the outer core's state.• Synthesis: Each student writes a statement connecting the relay to Earth's interior science.• The activity is scored using a 20-point rubric across three criteria:																																	
	<table><tr><th>Criteria</th><th>Excellent (4)</th><th>Proficient (3)</th><th>Developing (2)</th><th>Beginning (1)</th><th>Score</th></tr><tr><td>Role Performance (x2)</td><td>Relay completed correctly; all roles performed; S-wave stopped at Station 3.</td><td>Minor error in one role; relay essentially correct.</td><td>Relay had errors; roles unclear for 2 members.</td><td>Relay not completed or largely incorrect.</td><td>___/8</td></tr><tr><td>Observation Chart (x2)</td><td>All 4 stations correct with accurate observations and clear reasoning.</td><td>3 stations correct; reasoning mostly clear.</td><td>2 stations correct; observations vague.</td><td>Mostly blank or inaccurate.</td><td>___/8</td></tr><tr><td>Synthesis</td><td>Generalization complete, accurate, and in own words.</td><td>Mostly complete; 1–2 blanks vague.</td><td>Partially filled; lacks scientific depth.</td><td>Not completed.</td><td>___/4</td></tr><tr><td colspan="5">TOTAL</td><td>___/20</td></tr></table>					Criteria	Excellent (4)	Proficient (3)	Developing (2)	Beginning (1)	Score	Role Performance (x2)	Relay completed correctly; all roles performed; S-wave stopped at Station 3.	Minor error in one role; relay essentially correct.	Relay had errors; roles unclear for 2 members.	Relay not completed or largely incorrect.	___/8	Observation Chart (x2)	All 4 stations correct with accurate observations and clear reasoning.	3 stations correct; reasoning mostly clear.	2 stations correct; observations vague.	Mostly blank or inaccurate.	___/8	Synthesis	Generalization complete, accurate, and in own words.	Mostly complete; 1–2 blanks vague.	Partially filled; lacks scientific depth.	Not completed.	___/4	TOTAL				
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<p>C. Demonstrating Knowledge and Skills</p>	<p>1. Finding Practical Application</p> <p>In this activity, the learners Read each real-world scenario. Connect it to what you learned about Earth's layers, seismic waves, or discontinuities. Write your response in complete sentences.</p> <p>Earth's Magnetic Field and the Outer Core</p> <p>Scientists know that Earth has a magnetic field that protects all living things from harmful solar radiation. This magnetic field is generated by the movement of liquid iron-nickel in the outer core. Without the outer core being liquid, this field would not exist.</p> <p>Your connection: How does what you learned about the Gutenberg discontinuity and the state of the outer core relate to the existence of life on Earth?</p> <p>Earthquake Early Warning Systems</p> <p>Countries like Japan and the Philippines use seismic monitoring networks to detect P-waves from earthquakes and send automatic alerts BEFORE the slower, more destructive S-waves arrive. This gives people seconds to minutes of warning to take cover.</p> <p>Your connection: Explain in your own words WHY P-waves arrive first and why this difference in arrival time is critical for saving lives.</p> <p>Mining and Geothermal Energy in the Philippines</p> <p>The Philippines lies on the Pacific Ring of Fire and has significant geothermal energy resources. Geothermal plants tap heat from Earth's interior. Knowing the structure and composition of the mantle helps engineers understand heat flow, magma pathways, and safe drilling depths.</p> <p>Your connection: How does knowledge of the crust's depth (from the Moho) and mantle composition (from volcanology) directly help Filipino engineers working in geothermal energy?</p>	<p>1. Finding Practical Application</p> <p>IDF Relevance:</p> <p>This activity aligns with DepEd's strengthened SHS Earth Science curriculum, targeting competencies on Earth's internal structure/discontinuities, and applications to hazards/energy. Real-world scenarios on magnetic fields, early warnings, and Philippine geothermal energy, plus 3-2-1 or micro-summary synthesis, build practical connections, critical thinking, and societal relevance for disaster resilience.</p> <p>Note to Teacher:</p> <ul style="list-style-type: none"> • Assign scenarios to small groups • have pairs share connections, • Connect to PH Ring of Fire/geothermal sites • Prepare performance tasks from challenge responses. <p>2. Making Generalization</p> <p>(OPTION 1) 3-2-1 Synthesis</p>
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Challenge Question: If you were a geoscientist advising a government on where to install new seismograph stations, which factor from today's lesson would you prioritize? Write a brief recommendation (3–4 sentences).

2. Making Generalization (OPTION 1) 3-2-1 Synthesis

Learners respond individually to a quick structured exit reflection, displayed on Mentimeter for word cloud aggregation:

3	Three things you now know about Earth's layers or seismic waves that you did not know before.
2	Two ways seismic waves help scientists determine Earth's composition and boundaries.
1	One real-world situation where understanding Earth's interior matters for society.

Highlight recurring themes and correct any remaining misconceptions. Complete the 'L' column of the KWL Chart if Option B was used in Part 1.

(OPTION 2) Earth's Interior in 30 words

Procedure:

- Micro-Summary: Summarize the lesson in 30 words or fewer (like a tweet), including one seismic wave and one internal boundary.
- Share: Swap with a partner; select 2–3 for class sharing or Padlet.
- Wrap-up: Facilitate a 2-minute discussion: "What is your one biggest takeaway?"
- Closing: Teacher generalizes: "Seismic waves are our deepest instruments, revealing a core we have never physically reached."

IDF Relevance: This structured reflection aligns with IDF's "making generalizations" phase by synthesizing key lesson points on layers/waves and societal applications into personal insights, using word clouds for collective validation. It promotes reflective instruction by addressing misconceptions and consolidating seismic inference competencies.

Note to teacher:

- Display Mentimeter prompts.
- Highlight themes ("S-shadow proves liquid core"); correct errors ("P-waves travel through liquids too").
- If using KWL: Update "Learned" column digitally; transition to homework/extensions.

(OPTION 2) Earth's Interior in 30 words

IDF Relevance

This activity fosters generalizations in IDF by distilling seismic-boundary connections into concise headlines, shared via pairs/Padlet for peer refinement toward one core takeaway. It emphasizes Relevant instruction, reinforcing inquiry standards via real-world communication of indirect evidence.

V. ASSESSMENT
(Assessing Learnings)

Performance Task: Earth's Interior Revealed.

Task Overview: You are a geophysicist presenting to a panel of city engineers. Create an annotated cross-sectional model or digital presentation of Earth's interior that explains: (a) the composition and properties of each layer, (b) how seismic waves travel through and are affected by each layer, and (c) the location, depth, and significance of the Mohorovicic and Gutenberg Discontinuity. Your work must reference at least two scientific sources or evidence types (e.g., seismic data, meteorites, volcanology).

Scoring Rubric:

Criteria	Excellent (4)	Proficient (3)	Developing (2)	Beginning (1)	Score
Scientific Accuracy of Earth's Layers (x3)	All 4 layers accurately described with correct composition and properties.	3 layers accurately described; minor errors in 1.	2 layers described; some significant inaccuracies.	Fewer than 2 layers described or mostly inaccurate.	___/12
Seismic Wave Behavior (x3)	P and S-wave behavior through all layers is correctly explained, including bending, stopping, and shadow zones.	Most wave behaviors correct; shadow zone partially explained.	Some wave behavior addressed; major concepts missing.	Wave behavior absent or mostly incorrect.	___/12
Identification of Internal Boundaries (x3)	Both Moho and Gutenberg Discontinuity correctly located, named, and explained with depth and significance.	Both boundaries identified; one lacks depth or significance.	Only one boundary identified correctly.	Boundaries absent or incorrectly identified.	___/12
Use of Evidence (x2)	Two or more valid evidence types cited (e.g., seismic data, meteorite composition, volcanology) with explanation.	Two sources cited with minimal explanation.	One source cited.	No evidence cited.	___/8
Clarity and Scientific Communication (x2)	Presentation is clear, well-organized, and easy to follow; scientific vocabulary used accurately throughout.	Mostly clear and organized; some lapses in vocabulary.	Some organization; vocabulary inconsistently used.	Unclear presentation; little use of scientific language.	___/8
Creativity and Effort	Output is original, visually engaging, and demonstrates significant effort beyond minimum requirements.	Output shows good effort and some creativity.	Minimal effort; basic output only.	Little to no evident effort.	___/8

VI. REFLECTION

VII. USE OF GENERATIVE AI

In preparing this Learning Exemplar (LE), the author(s) used Claude.ai and Perplexity.ai in order to craft relevant activities that uses technology and to check the grammar and sentence construction of tge instructions. The author(s) reviewed and finalized the writing of the content. The author(s) take(s) full responsibility for the content of this LE.

Lesson Title/Topic	The Structure and Composition of the Earth (Earth's Layers: Structure, Composition, and Tectonic Significance)	Lesson Exemplar	8
I. OBJECTIVES			
A. Content Standard	The learners learn that seismic waves and their effects help to explain and understand the nature and composition of the Earth.		
B. Performance Standard	By the end of the quarter, learners create detailed models and scientific analyses and use evidence-based findings to illustrate the nature and composition of the Earth.		
C. Learning Competencies	The learners describe the structure and composition of Earth's layers in the Southeast Asian region surrounding the Philippines.		
II. REFERENCES and MATERIALS	<p>Books/Online Resources:</p> <ul style="list-style-type: none"> • Nguyen, Cong-Nghia, et al. "Slab Tearing and Lithospheric Structures in Luzon Island, Philippines: Constraints From P- and S-Wave Local Earthquake Tomography." <i>Frontiers in Earth Science</i> 11 (October 10, 2023). https://doi.org/10.3389/feart.2023.1213498. • Philippine Institute of Volcanology and Seismology (PHIVOLCS). "Tectonic Setting of the Philippines." Accessed 2024. https://www.phivolcs.dost.gov.ph. • Tarbuck, Edward J., Frederick K. Lutgens, and Dennis Tasa. <i>Earth: An Introduction to Physical Geology</i>. 12th ed. New York: Pearson, 2017. • United States Geological Survey (USGS). "The Structure of the Earth." Accessed 2024. https://www.usgs.gov. • National Geographic Education. "Layers of the Earth." YouTube video. Accessed 2024. https://www.youtube.com/results?search_query=layers+of+the+earth+national+geographic+education. • <i>Philippine Institute of Volcanology and Seismology (PHIVOLCS)</i>. "Primer on the 10 October 2025 Magnitude Mw 7.4 Offshore Davao Oriental Earthquake." Accessed March 13, 2026. https://www.phivolcs.dost.gov.ph/primer-on-the-10-october-2025-magnitude-mw-7-4-offshore-davao-oriental-earthquake/. <p>Other Materials:</p> <ul style="list-style-type: none"> • Printed blank cross-sectional diagram of the Earth • Colored pencils/markers, manila paper, Pentel pens 		
III. CONTENT	The Structure and Composition of the Earth <ul style="list-style-type: none"> • Earth's Layers: Structure, Composition, and Tectonic Significance 		
IV. LEARNING	At the end of the lesson, learners are expected to:		

OBJECTIVES	<ol style="list-style-type: none"> 1. Identify the four layers of the Earth according to composition and locate them on a cross-sectional diagram of the Earth. 2. Classify the layers of the Earth according to their physical properties (state of matter, temperature, pressure, and thickness). 3. Describe the significance of each Earth layer's composition to the tectonic and seismic activity of the Southeast Asian region surrounding the Philippines. 	
V. PROCEDURES	ANNOTATIONS	
A. Activating Prior Knowledge	<p>1. Activating Prior Knowledge</p> <p>Option 1: What's Inside the Earth? Post the following questions on the board. Give learners 2 minutes to think quietly, then have them pair up and share their ideas:</p> <ul style="list-style-type: none"> • What do you think is found deep inside the Earth? • Can you name any layer of the Earth? What is it made of? • If you could cut the Earth in half like an egg, what do you think the cross-section would look like? <p>After the discussion, record the learners' ideas on the board under the heading "What We Think the Earth Contains."</p> <p>Tell the learners that by the end of the lesson, they will check which of their predictions are correct and what new information they have discovered.</p> <p>Option 2: What Lies Below Post four sheets of manila paper around the room, each labeled with one Earth layer: Crust, Mantle, Outer Core, and Inner Core. In groups, learners rotate from one station to another and write what they know or think about each layer's composition either on sticky notes or directly on the paper. Each group will be given 3 minutes in each station. After the activity, the class conducts a quick gallery walk to review all responses. The teacher highlights accurate ideas and notes common misconceptions.</p>	

To start the lesson, choose **one** of the two options depending on your learners' readiness and available resources. This applies the Instructional Design Framework (IDF) by offering differentiated entry points so all learners can access the concept of Earth's layers.

Option 1: Think-Pair-Share
This works well for verbal-linguistic learners and classes comfortable with discussion. Post the three guide questions on the board and give learners 2 minutes of quiet thinking time. Remind them that all answers are acceptable at this stage, as the goal is to tap into prior knowledge. While pairs share, circulate, and listen. Record key ideas on the board under "What We Think the Earth Contains."
Explain that they will revisit this list at the end of the lesson to check which ideas were confirmed or corrected.

Option 2: Gallery Walk
This is ideal for active, collaborative classes or groups with varying

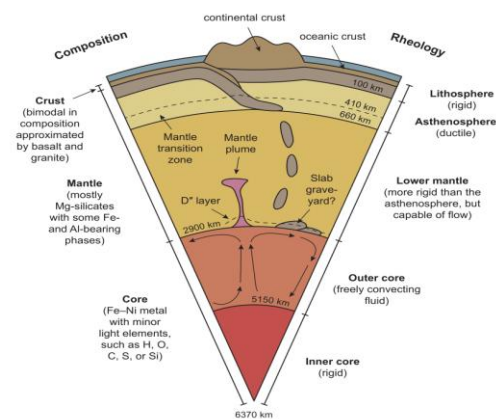
	<p>After the prior knowledge activity, the teacher will say: <i>You have shared interesting ideas about what lies beneath our feet. Now, let us watch a short video that shows why understanding the Earth's interior is not just a science lesson; it is a matter of safety and survival for all of us.</i></p> <p>2. Establishing the Purpose of the Lesson Show a 2–3 minute PHIVOLCS news clip of a recent Philippine earthquake or volcanic eruption. Ask:</p> <ol style="list-style-type: none"> 1. Where do you think the energy for this earthquake or volcanic eruption comes from? 2. How do you think the inside of the Earth is related to these events? <p>State the lesson purpose: <i>Today, we will identify the four layers of the Earth by composition, classify them by their physical properties, and describe how they drive tectonic and seismic activity in Southeast Asia.</i></p>	<p>readiness levels. Post the four labeled manila papers before class begins. Give each group 3 minutes per station to add what they know or think about each Earth layer. During the gallery walk, place a check mark beside accurate ideas and circle misconceptions, but do not correct them yet. Tell learners: “We will return to these ideas later and see which ones science confirms.”</p> <p>Link for the news clip: https://www.youtube.com/watch?v=V4I4-6MDrVY</p> <p>Play the PHIVOLCS news clip (probably 2–3 minutes). As learners watch, tell them to take note of what they observe. After viewing, facilitate the two discussion questions. Accept and validate all responses; the intent is to connect the visual stimulus to the Earth's interior. After the discussion, clearly state the lesson's purpose. Emphasize all three learning targets: identifying layers by composition, classifying them by physical properties, and describing their significance to Southeast Asian tectonic and seismic activity.</p>
B. Instituting New Knowledge	<p>1. Presenting Examples Task 1: The Earth in a Fruit Hold up a sliced avocado and ask learners to observe closely. Then pose these questions:</p>	<p>Task 1: The teacher begins by showing a sliced avocado and guiding learners' observations through three prompt questions. This activity uses Analogical Teaching, providing a</p>

- Look at the dark skin. Is it thick or thin compared to the green part? What does this tell you about how deep the Earth's crust might be?
- Look at the pit in the middle. What shape is it? Why do you think the "center" of the Earth is shaped like that?
- Feel the green flesh and the hard pit. Which one is soft and which one is solid? Which part do you think would be the hardest to move?
- Which of the three parts (skin, flesh, or pit) takes up the most space? Which layer of the Earth do you think is the biggest?

Call on 2–3 volunteers to share and record their responses.

Task 2: The Earth in Layers

Using a projected cross-sectional diagram of the Earth, discuss each of the four layers according to composition. Together with learners, build the following reference table on the board:



Source: https://www.researchgate.net/figure/Schematic-cross-section-through-the-present-day-Earth-outlining-differences-in_fig14_340454530

Layer	Composition
Crust	
Mantle	

concrete and familiar object to help visual and kinesthetic learners grasp an abstract concept. The analogy also serves as scaffolding, creating a natural bridge to the Earth's layered structure.

Task 2:

The teacher presents a cross-sectional diagram of the Earth and collaborates with learners to complete a reference table. This step applies Guided Instruction and Collaborative Concept Building, allowing learners to co-construct scientific knowledge while the teacher supports accuracy and understanding. The follow-up question about observable patterns uses Inquiry-Based Prompting, encouraging learners to identify trends such as increasing temperature, pressure, and changes in state of matter. Together, these tasks provide differentiated entry points and progressively deepen understanding from concrete to scientific models.

	<table><tr><td>Core</td><td></td></tr></table> <p>After the reference table activity, say: <i>Now that we know what each layer is made of and how it behaves physically, let us look more closely at what makes these layers different, not just in composition but in the way they actually move and respond to forces deep inside the Earth.</i></p> <p>2. Discussing New Concept</p> <p>Using a projected cross-section diagram of the Earth, discuss each of the four layers both by composition and by physical properties. Guide learners through the diagram and support their understanding with the following questions:</p> <p>Guide Questions:</p> <ul style="list-style-type: none">• What are the layers of the Earth based on composition?• What are the layers of the Earth based on physical properties?• How is the Lithosphere different from the Asthenosphere?• Why is the Inner Core solid even though it is hotter than the liquid Outer Core?• Which physical property do you think has the greatest effect on how each layer behaves? <p>Write the key vocabulary on the board: Lithosphere, Asthenosphere, Lower Mantle, Outer Core, Inner Core. Remind learners that these refer to physical property layers, distinct from the four layers classified by composition.</p> <p>After the discussion, say:</p> <p><i>Excellent! You have now discussed these layers as a class. This time, you will work independently or in groups to classify and organize everything you have learned so far.</i></p>	Core		<p>The teacher uses the guide questions to help learners differentiate between composition layers and physical property layers, giving students 30 seconds of think time before they share their responses.</p> <p>Key vocabulary (Lithosphere, Asthenosphere, Lower Mantle, Outer Core, and Inner Core) is written on the board as it arises naturally, with emphasis that these refer to physical property zones, not compositional layers. Projected diagrams are used to visually compare how the two classification systems overlap on the same Earth model.</p> <p>From an IDF perspective, this approach applies Inquiry-Based Prompting through guiding questions, Visual Scaffolding through diagrams, and Process Differentiation by providing think time and multiple entry points. It also uses Conceptual Contrast to address common misconceptions by directly comparing two similar but distinct classification systems.</p> <p>Option 1:</p>
Core				

3. Developing Mastery

Option 1: Classify and Complete

Distribute a blank classification chart. Each learner independently classifies the five physical property zones by filling in the columns:

Zone Name	State of Matter	Temperature Range	Pressure Level	Mechanical Behavior
Lithosphere				
Asthenosphere				
Lower Mantle				
Outer Core				
Inner Core				

Guide Questions:

- How are the Lithosphere and Asthenosphere different in terms of physical properties?
- Why does the Outer Core remain liquid while the Inner Core is solid, even though both are made of similar materials?
- Which zone has the highest pressure, and how does this affect its physical state?

Call on volunteers to share their answers, then display the completed chart on the board.

Option 2: Dual-Diagram Earth Model

Each learner draws two cross-sectional diagrams of the Earth side by side. On the left diagram, they label the four compositional layers (Crust, Mantle, Outer Core, and Inner Core) and note what each layer is made of. On the right diagram, they classify the same Earth model into its physical property zones (Lithosphere, Asthenosphere, Lower Mantle,

The learners work independently to fill in a classification chart, a structured task suited for students who organize information best through writing. The teacher circulates during the activity, offering prompts such as “Which row matches this zone?” to support learners without giving away answers. After completing the chart and the follow-up questions, a few volunteers share their responses, and the teacher displays the completed chart for class verification.

From an IDF perspective, this task uses Process Differentiation by providing an individual written activity, Guided Instruction through teacher prompts, and Graphic Scaffolding via the chart to help learners organize complex concepts. The follow-up questions reinforce Conceptual Processing, prompting learners to analyze and justify differences among Earth’s physical property zones.

Zone Name	State of Matter	Temperature Range	Pressure Level	Mechanical Behavior
Lithosphere	Solid	~0–1,300 °C	Low to moderate	Rigid and brittle; forms tectonic plates
Asthenosphere	Semi-solid (plastic)	~1,300–1,600 °C	Moderate	Soft and ductile; it slowly flows and allows plate movement

Outer Core, and Inner Core) and identify each zone with its state of matter, approximate temperature range, pressure level, and thickness.

Below the diagrams, learners write a short paragraph responding to the prompt:

- How are the four compositional layers and the five physical property zones related?
- Are they the same or different? Explain using specific examples.

Scoring Rubrics for Options 1 & 2:

Criteria	5	4	3	2	1
Accuracy	All answers correct.	1-2 minor errors.	3-4 errors.	Many errors.	Mostly incorrect.
Completeness	All items answered.	1-2 items missing.	3-4 items missing.	Half or more missing.	Mostly blank.
Use of Scientific Terms	Terms used correctly throughout.	Terms mostly correct.	Some terms are used.	Few terms used.	No scientific terms.
Understanding	Concepts fully explained.	Concepts are mostly clear.	Partial understanding.	Limited understanding.	No understanding shown.
Neatness & Organization	Very neat and organized.	Generally neat.	Somewhat organized.	Hard to follow.	Unclear/disorganized.

Lower Mantle	Solid	~1,600–4,000 °C	Very high	Strong and slowly flowing due to intense pressure
Outer Core	Liquid	~4,000–5,500 °C	Extremely high	Fluid; molten metals move and generate Earth's magnetic field
Inner Core	Solid	~5,500–6,000 °C	Extremely high	Very dense and rigid because of immense pressure

Option 2:

The learners draw two Earth diagrams, one showing compositional layers and the other showing physical property zones, and add brief notes on each. Circulate to support learners with prompts such as, “How does this zone behave based on what we learned?” Afterward, have them write a short comparison paragraph and invite a few volunteers to share before moving to the next lesson.

This task uses Representation Differentiation by having learners compare two visual models. The diagrams serve as Graphic Scaffolding, while the paragraph promotes Conceptual Processing. Teacher prompts provide Guided Instruction, helping learners refine understanding without giving direct answers.

C. Demonstrating Knowledge and Skills

1. Finding Practical Application

The teacher will say:

Now that you understand the structure and composition of the Earth's layers, let us apply this knowledge to explain why the Philippines and Southeast Asia experience frequent earthquakes and volcanic eruptions.

Reading the Earth Beneath Southeast Asia

Project or distribute the tomographic cross-section image of Luzon (Nguyen et al., *Frontiers in Earth Science*, 2023). Working in pairs, learners examine the image closely and respond to the photo-analysis guide questions.

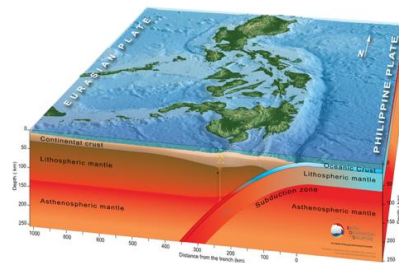


Image 1. Philippine-Eurasian plate subduction cross-section

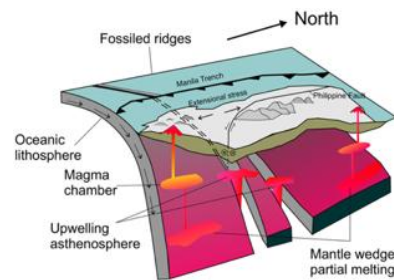


Image 2. Manila Trench subduction and volcanic arc formation

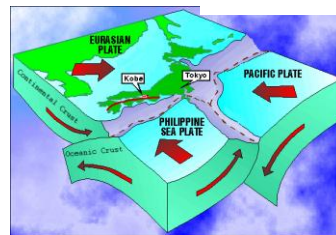


Image 3. Eurasian, Pacific, Philippine Sea Plate interactions near Japan

Sources:

- <https://www.coolgeography.co.uk/GCSE/Year11/Managing%20Hazards/Earthquakes/kobeplates2.gif>
- <https://earthobservatory.sg/earth-science-education/multimedia/graphics/subduction-zone-beneath-the-philippines>

IDF requires that learners apply new knowledge to authentic, real-world contexts. This section moves from abstract understanding to practical significance.

This activity uses a scientific tomographic image as a primary source. Project the image and give learners two minutes to observe before discussing in pairs. Circulate to help learners connect what they see to Earth's layers and processes. During the whole-class share, emphasize three key ideas: causes of earthquakes, the behavior of the subducting Philippine Sea Plate, and convection currents as the driving force. Encourage the use of accurate layer-specific vocabulary.

This activity uses evidence-based instruction through image analysis, inquiry through guided observation, and guided instruction through teacher prompts. Pair discussion supports collaborative meaning-making, while highlighting key processes strengthens conceptual understanding and disciplinary language development.

- *Nguyen et al., “Slab Tearing and Lithospheric Structures in Luzon Island, Philippines: Constraints From P- and S-Wave Local Earthquake Tomography.”*

Guide Questions:

- Based on image 1, what causes earthquakes in the Philippines and the rest of Southeast Asia?
- Based on images 1-3, which layers of the Earth and tectonic features can you identify? Describe what you see.
- What happens when the dense rock of the Philippine Sea Plate collides with the Eurasian Plate? Using the image and your understanding of Earth’s layers, explain what occurs at the boundary and where the subducting rock eventually goes.
- Which layer of the Earth do you think is most responsible for the frequent earthquakes and volcanic eruptions in the Philippines? Explain how this layer influences plate movement in Southeast Asia.

Pairs share answers with the class. The teacher highlights three key processes: the causes of earthquakes, the behavior of dense rock, and the driving force of rock movement.

After the activity, say: *You have now connected the Earth’s layers to real geological events in our region. To close our lesson, let us take a few minutes to reflect on and summarize the most important things you learned today.*

2. Making Generalization

Synthesis Exit Slip

On a half-sheet of paper, each learner writes:

- Key things they learned about the structure and composition of the Earth
- Connections between Earth’s layers and the tectonic or seismic activity in Southeast Asia

The *Synthesis Exit Slip* is an individual written reflection. Distribute half-sheets before giving instructions. Read the three prompts aloud: key learnings, connections to Southeast Asian tectonics, and any remaining question. Allow 5 minutes for writing. Collect exit slips and quickly scan for common remaining questions. These may inform your next lesson’s introduction.

	<ul style="list-style-type: none"> Any question or something they want to know more about 	
VI. ASSESSMENT <i>(Assessing Learnings)</i>	<p>PART I. MULTIPLE CHOICE</p> <p>Directions: Read each item carefully. Choose the letter of the BEST answer and write it in the space provided before each number.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p style="text-align: center;">READING PASSAGE</p> <p><i>Scientists have inferred the structure and composition of Earth's interior from the behavior of seismic waves produced by earthquakes. They have divided the Earth into layers using two different classification systems.</i></p> <p><i>By chemical composition. From the outermost surface inward, these layers are: the Crust, the Mantle, and the Core. The Crust is the thinnest layer and is made mostly of silicate rocks rich in silicon and oxygen. It ranges from about 5 km under ocean basins to 70 km under mountain ranges. Below it lies the Mantle, Earth's thickest compositional layer, making up approximately 84% of Earth's total volume. It is composed largely of iron- and magnesium-rich silicate rocks. The Core, at the very center, consists mainly of iron and nickel and is subdivided into an Outer Core and an Inner Core.</i></p> <p><i>By physical (mechanical) properties. The topmost physical layer, called the Lithosphere, includes the Crust and the uppermost part of the Mantle. It is solid, rigid, and brittle. Directly beneath it is the Asthenosphere, a zone of hot, semi-plastic (ductile) rock capable of slow, viscous flow. Deeper still, the Lower Mantle behaves as a solid under the immense pressures found there, despite its high temperature. The Outer Core is liquid iron and nickel, while the Inner Core is solid iron-nickel alloy—kept in solid form not by low temperature, but by the extreme pressure exerted upon it.</i></p> </div> <p>1. Based on the reading passage, which of the following correctly lists the four compositional layers of the Earth from outermost to innermost?</p> <div style="display: flex; justify-content: space-between;"> <div> <p>A. Crust, Lithosphere, Mantle, Core</p> <p>C. Mantle, Crust, Inner Core, Outer Core</p> </div> <div> <p>B. Crust, Mantle, Outer Core, Inner Core</p> <p>D. Lithosphere, Asthenosphere, Outer Core, Inner Core</p> </div> </div> <p>2. A cross-section diagram of the Earth shows multiple layers. According to the passage, which layer would appear as the thinnest band at the very surface, ranging from 5 to 70 km in thickness and composed primarily of silicate rocks?</p> <div style="display: flex; justify-content: space-between;"> <p>A. Crust</p> <p>B. Inner Core</p> <p>C. Mantle</p> <p>D. Outer Core</p> </div> <p>3. The passage states that one compositional layer accounts for about 84% of Earth's total volume and is composed largely of iron- and magnesium-rich silicate rocks. Which layer is being described?</p>	

- A. Crust B. Inner Core **C. Mantle** D. Outer Core

4. The passage explains that the Inner Core remains solid even though temperatures there are extremely high. Which of the following BEST explains this apparent contradiction, based on what the passage states?

- A. The Inner Core is insulated from heat by the thick Outer Core surrounding it.
 B. The Inner Core is made of lighter materials that solidify at lower temperatures.
C. The inner core remains solid due to the extreme pressure exerted on its iron-nickel alloy composition.
 D. The Inner Core has a lower temperature than the Outer Core due to its distance from the Mantle.

5. A student sorts Earth's physical layers by properties. She places one zone under the category: solid, rigid, brittle, low pressure, relatively low temperature. Based on the passage, which physical zone is she correctly describing?

- A. Asthenosphere **B. Lithosphere** C. Lower Mantle D. Outer Core

TABLE. Summary of Earth's Physical Zones

Physical Zone	Compositional Classification	Dominant Physical Property	State of Matter
Lithosphere	Crust + uppermost Mantle	Rigid / Brittle	Solid
Asthenosphere	Upper Mantle	Semi-plastic / Ductile	_____
Lower Mantle	Mantle	Solid (high-pressure)	Solid
Outer Core	Core	Liquid	_____
Inner Core	Core	Solid (extreme pressure)	Solid

6. Based on the table, both the Lithosphere and the Asthenosphere contain Mantle material, yet they behave very differently. What best explains this difference in behavior?

- A. They have different chemical compositions
 B. The Asthenosphere contains iron and nickel, while the Lithosphere does not
 C. The Lithosphere is rigid and brittle, while the Asthenosphere is semi-plastic and ductile
D. The Lithosphere is farther from Earth's surface than the Asthenosphere

7. Refer to Table 1. Two cells in the 'State of Matter' column are marked '_____'. Which of the following correctly fills in BOTH missing values for the Asthenosphere and the Outer Core, respectively?

- A. Liquid; Solid B. Solid; Liquid **C. Semi-plastic (viscous); Liquid** D. Gas; Semi-plastic (viscous)

PART II. ESSAY

Directions: Read the scenario below, then answer the question that follows. Your answer will be scored using the rubric provided below.

On October 10, 2025, a magnitude 7.4 earthquake struck Davao Oriental. Scientists explained that the earthquake was caused by the movement of the Philippine Sea Plate as it pushes against and sinks beneath the Eurasian Plate. The energy released from deep within the Earth traveled upward, causing destruction on the surface.

Based on the scenario, explain how the movement of tectonic plates leads to earthquakes in the Philippines. In your answer, discuss what causes the plates to move, what happens when they collide or sink, and how this results in seismic activity. You may refer to specific features such as the Philippine Sea Plate, the Philippine Trench, or the Marikina Valley Fault System.

Criteria	5 Excellent	4 Proficient	3 Developing	2 Beginning	1 Poor
Scientific Accuracy	All scientific information is correct, specific, and precisely worded.	Mostly accurate; only minor errors present.	Some accurate ideas but with notable scientific errors.	Limited accuracy; several misconceptions present.	Mostly inaccurate; major misconceptions throughout.
Depth of Explanation	Clearly explains how Earth layers drive seismic/tectonic activity with cause-and-effect reasoning.	Explains the connection but lacks depth or specificity.	Mentions the connection but doesn't fully explain it.	Connection is vague or superficial.	No explanation; connection is absent or inaccurate.
Use of Philippine Context	Cites a specific, named Philippine or SE Asian tectonic feature accurately.	References the Philippine context generally; no specific features are named.	Vague reference to the Philippines; no clear scientific link.	Mentions the Philippines without any geological connection.	No Philippine or regional context cited at all.

	Organization & Clarity	Clearly organized, logically sequenced, and uses scientific vocabulary correctly throughout.	Mostly organized; minor lapses in flow or vocabulary.	Some structure is present, but difficult to follow in places.	Little organization; vocabulary often absent or misused.	Disorganized; no scientific vocabulary used.
VII. REFLECTION	<ul style="list-style-type: none"> • What teaching strategies and activities in this lesson were most effective in helping learners identify, classify, and describe the layers of the Earth in relation to the tectonic and seismic activity of the Philippines? • What adjustments can the teacher make to better address learner difficulties and improve the delivery of the next lesson? 					
VIII. USE OF GENERATIVE AIE AI	In preparing this Learning Exemplar (LE), the author(s) used Claude to assist in structuring lesson activities. The author(s) reviewed and finalized the writing of the content. The author(s) take full responsibility for the content of this LE.					

Lesson Title/Topic	Mineral Resources (Identifying Minerals Through Their Physical Properties)	Lesson Exemplar	9
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I. OBJECTIVES	
A. Content Standard	The learners learn that minerals are essential for industrial development, economic growth, and technological advancement, but should be managed sustainably.
B. Performance Standard	By the end of the quarter, learners identify, describe, and classify a range of minerals, rocks, and soils using appropriate scientific techniques.
C. Learning Competencies	The learners identify minerals based on their properties, including hardness, luster, color, streak, cleavage, and composition, using available methods and technologies.
II. REFERENCES and MATERIALS	<ul style="list-style-type: none"> • Department of Education (DepEd). <i>K to 12 Senior High School Core Curriculum — Earth and Life Science Curriculum Guide</i>. Pasig City: Department of Education, 2016. • Department of Education (DepEd). <i>Most Essential Learning Competencies (MELC): Earth and Space 1</i>. Pasig City: Bureau of Curriculum Development, 2020. • Mines and Geosciences Bureau (MGB), Department of Environment and Natural Resources. <i>Philippine Mineral Resources</i>. Quezon City: MGB-DENR, 2022. Accessed March 2025. https://mgb.gov.ph. • Philippine Institute of Volcanology and Seismology (PHIVOLCS). <i>Philippine Geology: An Overview</i>. Quezon City: DOST-PHIVOLCS, 2020. Accessed March 2025. https://www.phivolcs.dost.gov.ph. • Mineralogical Society of America. "Mineral Data." Handbook of Mineralogy Online. Accessed March 2025. http://www.handbookofmineralogy.org. • Smithsonian National Museum of Natural History. "Geology, Gems and Minerals." Accessed March 2025. https://naturalhistory.si.edu/research/geology-gems-and-minerals. • Mindat.org. "The Mineral and Locality Database." Hudson Institute of Mineralogy, 2024. Accessed March 2025. https://www.mindat.org. • Geology.com. "Minerals: Information About Ore Minerals, Gem Minerals and Rock-Forming Minerals." Accessed March 2025. https://geology.com/minerals/.
III. CONTENT	Mineral Resources
IV. LEARNING OBJECTIVES	<ul style="list-style-type: none"> • Identifying Minerals Through Their Physical Properties <p>At the end of the lesson, learners are expected to:</p> <ol style="list-style-type: none"> 1. Define minerals.

2. Distinguish the six physical properties of minerals: hardness, luster, color, streak, cleavage, and composition.
3. Describe the methods and technologies used to identify minerals, including the Mohs hardness test, streak test, acid test, and luster and cleavage observation.
4. Evaluate common minerals (quartz, feldspar, mica, calcite, pyrite, halite) based on their observed physical properties using available methods and techniques.

V. PROCEDURES	ANNOTATIONS
<p>A. Activating Prior Knowledge</p>	<div> <p>1. Activating Prior Knowledge Rock or Mineral? Place one or two rock or mineral samples (or printed photo cards) on each desk pair. Give learners 1 minute to examine the sample and think individually, then have them share their observations with a partner using the following prompts:</p> <ul style="list-style-type: none"> • What do the samples look like? • Which samples look the same or similar? • What does the surface of each sample feel like? • Can you identify the minerals just by looking at them? <p>Call on 2–3 pairs to share their ideas with the class. As learners respond, record key descriptive words on the board (e.g., shiny, glassy, flaky, rough). The teacher will say: <i>The words you just used are the language of mineralogy. It is the way scientists describe and identify Earth materials.</i></p> </div> <div> <p>2. Establishing the Purpose of the Lesson Show two to three high-quality images of common Philippine minerals (e.g., a Philippine gold nugget, chromite ore from Zambales, and quartz crystals from Benguet).</p> </div> <div> <p>Learners observe rock or mineral samples, discuss their properties with a partner, and share observations with the class. The teacher records key descriptive terms on the board and introduces them as scientific vocabulary used in mineral identification.</p> <p>This activity activates prior knowledge through hands-on observation, supports collaborative learning through pair discussion, and provides language scaffolding by highlighting descriptive mineralogy terms.</p> <p>The teacher presents images of common Philippine minerals and uses guiding questions to prompt learners to notice visible differences and think about how minerals are identified. Learners share ideas based on observation and prior experience. The teacher then clearly states the lesson objectives and emphasizes the transition from everyday observation to scientific investigation, preparing</p> </div>



Source: *Wikimedia Commons*. Accessed March 14, 2026.
https://commons.wikimedia.org/wiki/Main_Page.

Ask the learners:

1. Based on your observations, which physical property do you think is the most reliable for identifying a mineral, and why?
2. What differences do you notice in the color, shape, and texture of the gold nugget, chromite ore, and quartz crystal?
3. Which of the three minerals do you think is the most useful, and why?
4. If you found one of these minerals in the ground, how would you identify what it is?

After the discussion, state the lesson's purpose clearly:

Today, we will define minerals and rocks, distinguish the six physical properties that make each mineral unique, and learn the methods scientists use to identify minerals, including minerals found right here in the Philippines.

Then say to the class:

You've already used your senses and everyday language to observe minerals. You've made guesses about what makes them different. Now, let's do what geologists do. Let's move from observation to science. We are going to name and define the exact properties that scientists use, and learn how each one is tested.

learners to apply mineral properties in the next activity.

This segment uses Inquiry-Based Instruction to encourage learners to generate explanations based on evidence and observations. Scaffolding is provided by explicitly stating learning goals and outlining the next steps. The use of local Philippine mineral examples supports Contextualized Learning, making scientific concepts more relevant, engaging, and meaningful to learners.

	<p><i>Pay close attention, because in the next activity, you will use these properties to identify real minerals on your own.</i></p>	
<p>B. Instituting New Knowledge</p>	<p>1. Presenting Examples</p> <p>Option 1: The Mineral Detective</p> <p>Hold up a set of two to three mineral samples and say: <i>A geologist examines a mineral the same way a detective studies clues at a crime scene. Every observable feature tells a story.</i></p> <p>Introduce each physical property using a paired everyday analogy:</p> <ul style="list-style-type: none"> • Hardness: Like scratching a blackboard, harder objects scratch softer ones. Scientists use the Mohs Scale (1–10) to rank mineral hardness. • Streak: Similar to dragging a crayon across paper, the color of the powdered mineral is usually more consistent than the surface color. • Cleavage: Like breaking a chocolate bar along its scored lines — it snaps into flat, predictable pieces — compared to smashing a cookie randomly, which shows fracture. • Composition: The mineral’s chemical “ingredient,” or the elements and compounds it is made of. • Luster: Like comparing a mirror (metallic) to frosted glass (vitreous) to drywall (earthy). Luster describes how light reflects off a mineral’s surface. • Color: The most noticeable property, but often the least reliable, since impurities can alter a mineral’s color. <p>After presenting the properties, ask the class:</p> <ul style="list-style-type: none"> • Which of these properties do you think is the <i>most</i> reliable for identifying a mineral? Which is the <i>least</i> reliable? Why? <p>Elicit responses from learners and encourage justification before moving on to the discussion.</p>	<p>Option 1</p> <p>The teacher introduces mineral identification using the “detective” analogy to make abstract properties more concrete. Mineral samples or images are shown as each physical property is explained using familiar, everyday comparisons. The teacher pauses to check for understanding and invites learners to reason about which properties are most and least reliable. Learner responses are elicited before the discussion continues, allowing the teacher to surface misconceptions and reinforce correct scientific thinking.</p> <p>This task applies Analogical Teaching by linking new scientific concepts to everyday experiences. It uses Guided Instruction through teacher explanations and questioning, and Inquiry-Based Instruction as learners evaluate and justify which properties are most useful for mineral identification. The use of tangible samples or visuals provides Concrete and Visual Scaffolding, supporting learners as they transition from observation to scientific classification.</p>

	<p>Option 2: Mystery Object Set up four stations around the room. Each station should have a clearly labeled property card and a mineral sample.</p> <ul style="list-style-type: none"> • Station 1: Color and Streak Observe the mineral's surface color. Then scratch it on a white tile. What color is the powder (streak) left behind? • Station 2: Luster Hold the sample under a light source. Does it reflect light like metal, glass, or does it appear dull or earthy? • Station 3: Hardness Try to scratch the mineral using your fingernail, a coin, and a steel nail. Which tools leave a mark? Which do not? • Station 4: Cleavage Examine the mineral's edges and broken surfaces. Does it break along flat, smooth planes (cleavage) or into uneven, irregular surfaces (fracture)? <p>Learners rotate through the stations in groups, spending 2 minutes at each. After completing the rotation, reconvene the class and ask:</p> <p><i>What patterns did you notice across all four stations?</i></p> <p>Conclude by introducing the concept: <i>The observations you just made reflect the physical properties scientists use to identify minerals.</i></p> <p>2. Discussing New Concept Methods for Mineral Identification Using a projected summary table and actual mineral samples, discuss the six methods scientists use to identify minerals.</p> <p>Method 1: Mohs Hardness Test</p>	<p>Option 2 The teacher organizes four stations, each focusing on one physical property of minerals. Learners rotate in groups every 3-4 minutes, making observations and recording findings at each station. The teacher circulates to monitor engagement, clarify instructions, and prompt careful observation. After the rotation, the teacher reconvenes the class to discuss patterns observed across all stations and explicitly connects these observations to the physical properties scientists use to identify minerals.</p> <p>This activity applies Experiential Learning by engaging learners in hands-on investigation of mineral properties. It uses Process Differentiation through station work, allowing learners to actively explore concepts collaboratively. The stations function as Concrete and Visual Scaffolding, supporting understanding through direct observation. The concluding discussion promotes Conceptual Synthesis, helping learners connect individual observations to broader scientific principles.</p> <p>The teacher introduces the mineral identification methods using actual samples and a projected summary table. Each method is clearly</p>
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	<p>Scratch the mineral with objects of known hardness (fingernail = 2.5; copper coin = 3.5; steel nail/glass = 5.5). A mineral's hardness falls between the softest object that scratches it and the hardest object it can scratch.</p> <p>Method 2: Streak Test</p> <p>Rub the mineral on an unglazed porcelain tile. The color of the powder left behind is often more reliable than surface color. Pyrite, for example, looks gold but leaves a greenish-black streak.</p> <p>Method 3: Acid Test</p> <p>Place a drop of dilute HCl on the mineral. Fizzing indicates the release of CO₂, confirming the presence of carbonate minerals such as calcite.</p> <p>Method 4: Cleavage and Fracture</p> <p>Observe how the mineral breaks. Cleavage produces clean, flat breaks along repeating planes — like snapping a chocolate bar along its scored lines. Fracture produces irregular breaks, like snapping a dry twig. Mica shows cleavage; quartz shows fracture.</p> <p>Method 5: Luster</p> <p>Observe how light reflects off the surface. Luster is either metallic (galena, pyrite) or non-metallic, which includes vitreous (quartz), pearly (talc), silky (gypsum), and earthy (kaolinite).</p> <p>Method 6: Color</p> <p>Color is the most noticeable but least reliable property, as impurities can alter it. Quartz, for instance, can appear clear, white, purple, or black. Use color as a first clue, not a final identifier</p> <p>After discussing all six methods, display a summary table of physical properties and identification methods. Ask learners: <i>Which properties produce the most consistent results across different samples of the same mineral, and why?</i></p>	<p>explained and demonstrated, highlighting how scientists collect reliable evidence about minerals. Learners observe, compare methods, and discuss why some tests are more consistent than others. The teacher emphasizes safe handling, clarifies misconceptions, and guides learners in connecting identification methods to specific mineral properties.</p> <p>This applies Explicit Instruction by clearly modeling scientific identification methods and Evidence-Based Learning through hands-on testing and observation. The projected table provides Visual Scaffolding, helping learners organize information across methods and properties. Guided questions promote Conceptual Analysis, encouraging learners to evaluate the reliability and consistency of scientific investigations.</p>
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	<p>3. Developing Mastery</p> <p>Option 1: Mineral Property Matching</p> <p>Distribute a properties chart with six rows, one for each mineral property: hardness, luster, color, streak, cleavage, and composition. Learners work independently to complete the following three columns for each property:</p> <ol style="list-style-type: none"> 1. Definition — Write a clear scientific definition of the property using their own words. 2. How It Is Tested — Describe the specific method or tool used to observe or measure the property. 3. Example — Give a concrete example using one of the six minerals studied (quartz, feldspar, mica, calcite, pyrite, or halite). <p>After completing the chart, learners respond to the reflection question:</p> <ul style="list-style-type: none"> • If you could use only one test to identify an unknown mineral, which method would you choose and why? Justify your answer using at least two physical properties. <p>Invite a few volunteers to share their responses. Display a completed chart on the board as a reference for the class and to reinforce accurate understanding.</p> <p>Option 2: Hands-On Mineral Testing Lab</p> <p>Set up six testing stations around the classroom. Learners work in groups of three to four and rotate every five minutes, performing each test on the same mineral sample provided to ensure consistent comparison.</p> <ul style="list-style-type: none"> • Hardness Station Learners use a fingernail, a coin, a steel nail, and a glass to test the mineral's resistance to scratching. They record which tools leave marks and estimate the mineral's position on the Mohs Hardness Scale. • Streak Station Learners drag the mineral across an unglazed porcelain tile and record the streak color. They 	<p>Option 1</p> <p>In this activity, learners independently complete a properties chart that links definitions, testing methods, and real mineral examples. The teacher circulates to monitor understanding and clarify misconceptions. Afterward, learners justify which test they would rely on most for identifying an unknown mineral, reinforcing decision-making based on evidence.</p> <p>This task uses Process Differentiation by engaging learners in structured, individual written work. The chart serves as Graphic Scaffolding, helping learners systematically organize complex information. The reflection question promotes Conceptual Processing, requiring learners to evaluate the reliability of different mineral properties. Teacher feedback and sharing support Guided Instruction and consolidation of scientific understanding.</p> <p>Option 2</p> <p>In this lab activity, the teacher facilitates mineral-testing stations and organizes learners into small groups that rotate at fixed intervals. The teacher ensures safety, especially during the acid test, and circulates to guide observations and ask probing questions that connect results to mineral properties. After the rotations, the teacher leads a synthesis</p>
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	<p>compare the streak color with the mineral's surface color.</p> <ul style="list-style-type: none"> • Luster Station Using a hand lens, learners identify the mineral's luster as either metallic or non-metallic (vitreous, pearly, earthy, or silky) and record their observations. • Cleavage and Fracture Station Learners observe how the mineral breaks — along flat, smooth planes (cleavage) or into irregular surfaces (fracture). They sketch or describe the break pattern and note the number of cleavage directions if present. • Color Station Learners observe and record the overall surface color of the mineral. They note whether the color is consistent throughout the sample or varies, and discuss why color alone may not be a reliable identifier. Learners compare their color observations with the streak results from the previous station. • Acid Test Station (Teacher-Supervised) The teacher applies one drop of dilute hydrochloric acid (HCl) to the mineral. Learners observe and record whether effervescence occurs, indicating the presence of carbonate minerals. <p>Each group records observations in a Lab Observation Sheet. After completing all stations, groups compare their results and answer the following questions:</p> <ul style="list-style-type: none"> • Which of the six physical properties was easiest to observe? • Which property was most reliable for identifying the mineral, and why? <p>Conclude by saying to the class: <i>Excellent work. You have now learned the physical properties of minerals and the methods scientists use to identify them. You have practiced applying these skills through hands-on testing and evidence-based reasoning. Now comes the real challenge: using everything you have learned to independently identify</i></p>	<p>discussion, helping learners compare findings and evaluate which properties are most reliable for mineral identification. The closing statement reinforces skill application and prepares learners for independent mineral identification in the next phase.</p> <p>This task applies Experiential Learning through hands-on investigation and Process Differentiation by engaging learners in collaborative, station-based work. The testing stations provide Concrete and Sensory Scaffolding, allowing learners to construct understanding through direct evidence. Teacher prompts support Guided Instruction, while the comparison questions promote Conceptual Analysis and scientific reasoning. Overall, the activity strengthens learners' ability to apply abstract concepts to real materials.</p>
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	<p>unknown minerals. In the next phase, you will act as mineral scientists and put your knowledge into practice.</p>	
C. Demonstrating Knowledge and Skills	<p>1. Finding Practical Application</p> <p>Option 1: Who Am I? Provide each pair with a set of 4 unknown mineral samples (labeled A, B, C, D) drawn from the six common minerals: quartz, feldspar, mica, calcite, pyrite, halite. Learners use all available methods and tools to observe each sample and complete a Mineral Identification Chart:</p> <ul style="list-style-type: none"> • Hardness (Mohs test using fingernail, coin, steel nail) • Luster (metallic, vitreous, pearly, silky, earthy) • Color and Streak (observed and tested on porcelain tile) • Cleavage or Fracture (flat planes vs. irregular break) • Composition or special property (fizzes with acid?) <p>After completing observations for all four samples, each pair writes a one-sentence identification claim for each: <i>Sample A is [mineral] because [evidence from at least 3 properties].</i></p> <p>Pairs share identifications with the class. Teacher reveals the correct answers and facilitates discussion: <i>Which property was the most useful for each mineral? Which caused confusion, and why?</i></p> <p>Option 2: Photo-Based Mineral Identification Project or distribute a set of six high-quality photographs of common minerals (one each of quartz, feldspar, mica, calcite, pyrite, and halite). For each image, learners examine the visible features and respond to the following guide questions:</p> <ul style="list-style-type: none"> • What color and luster does the mineral appear to have based on the photograph? • Based on the visible surface texture and edge structure, does the mineral most likely show cleavage or fracture? 	<p>Option 1 In this activity, learners work in pairs to identify unknown mineral samples using multiple physical property tests. The teacher provides the samples and tools, then circulates to observe, guide discussions, and prompt evidence-based reasoning. Learners record observations in a Mineral Identification Chart and construct a one-sentence claim supported by at least two properties. During the class sharing, the teacher reveals the correct answers and leads a discussion on which properties were most helpful and which caused confusion, reinforcing accurate identification strategies and correcting misconceptions.</p> <p>This task applies Inquiry-Based Learning, as learners actively investigate, observe, and draw conclusions from evidence. The identification chart serves as Graphic Scaffolding, helping learners systematically organize their observations.</p> <p>Option 2 Learners analyze mineral photographs individually, focusing on visible properties such as color, luster, and surface structure. They estimate other</p>

	<ul style="list-style-type: none">• Which identification tests cannot be determined from a photograph alone? What results would you expect from those tests?• Using all visible evidence, identify the mineral and write a two-sentence justification citing at least two physical properties. <p>After completing the task individually, learners compare their answers in pairs. The teacher then facilitates a class discussion, emphasizing:</p> <p><i>Some mineral properties, such as color and luster, can be observed in photographs, while others, like hardness, streak, and acid reaction, require direct physical testing. This is why geologists work with actual samples whenever possible.</i></p> <p>2. Making Generalization Synthesis Exit Slip On a half-sheet of paper, each learner writes:</p> <ul style="list-style-type: none">• Key things they learned about minerals and their physical properties <p>Conclude by saying to the class: <i>Today, you became mineral scientists. You didn't just memorize the names of properties; you used them as tools to identify real minerals, just as geologists do. Before we move on to the assessment, take 30 seconds to reflect on the lesson question on the board:</i> <i>How do scientists identify minerals?</i> <i>Think about your answer, and let's see how clearly you can express it in the assessment.</i></p>	<p>properties based on prior knowledge and identify which tests require physical samples. After individual work, learners compare answers in pairs. The teacher leads a class discussion to emphasize the limitations of photo-based observation and reinforces the importance of hands-on testing in accurate mineral identification.</p> <p>This activity uses Visual Analysis and Inquiry-Based Instruction, encouraging learners to infer properties from evidence and recognize limitations in data.</p> <p>The teacher uses the exit slip to check learners' understanding at the end of the lesson. Learners independently reflect on what they learned about mineral properties, identify the most reliable testing methods, and connect their learning to a specific mineral of interest. The teacher reviews responses to assess mastery, identify misconceptions, and inform planning for the next lesson.</p> <p>This activity supports Metacognitive Reflection by prompting learners to synthesize and prioritize key concepts.</p>
VI. ASSESSMENT	<p>DIRECTIONS: Read each scenario and question carefully. Choose the BEST answer from the choices given. Write the letter of your answer on the blank provided before each number.</p> <p>1. During a field activity, a geology student collects a mineral sample and records the following observations:</p> <ul style="list-style-type: none">• Surface appearance: shiny with flat, layered sheets that peel apart easily	

- Hardness test: a fingernail leaves a scratch on the surface
- Streak test: produces a white mark on the streak plate

Based on these observations, which mineral did the student most likely collect?

- A. Quartz B. Pyrite C. Mica D. Calcite

2. A student tests two unknown minerals using common field tools and records the results below.

Mineral	Scratches Glass?	Scratched by Coin?	Scratched by a steel nail?
Mineral X	Yes	No	No
Mineral Y	No	Yes	No

Note: Hardness scale reference — fingernail $\approx$ 2.5, coin $\approx$ 3.5, steel nail $\approx$ 5.5, glass $\approx$ 5.5–6.0. Based on the data table, which statement correctly compares the hardness of the two minerals?

- A. Mineral X is softer — a mineral that scratches glass must have low hardness.
 B. Both minerals are equal — both resist being scratched by a steel nail.
 C. Mineral Y is harder — it can scratch a fingernail.
D. Mineral X is harder — it scratches glass and cannot be scratched by a steel nail.

3. A student applies a few drops of dilute hydrochloric acid (HCl) to two white mineral samples. The results are recorded in the table below.

Sample	Reaction to HCl	Observation
A	Fizzes vigorously	Bubbles form immediately upon contact
B	No reaction	Surface remains unchanged

What is the most reasonable conclusion the student can draw from the acid test results?

- A. Sample A is halite — halite is white and dissolves when acid is applied.
 B. Both samples are quartz — quartz is always white and never reacts.
 C. Sample B is calcite — harder minerals do not react with acid.
D. Sample A is calcite — carbonate minerals that react with HCl and release CO₂ gas.

4. A student examines two gold-colored mineral samples. To identify them, she performs a streak test on a porcelain plate and records the data below.

Mineral	Surface Color	Streak Color	Other Notes
Sample A	Gold / brassy yellow	Greenish-black	Metallic luster, hard
Sample B	Gold/yellow	Yellow	Soft, heavy, rare
Sample C	Yellow	White to yellow-white	Brittle, strong sulfur made

Based on the data, which mineral is Sample A, and what does this demonstrate about using color alone to identify minerals?

- A. Mica — luster is always the same as the streak color of a mineral.

Lesson Title/Topic	Mineral Resources (Mineral Resources and Their Economic Significance in the Philippines)	Lesson Exemplar	10
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I. OBJECTIVES	
A. Content Standard	<i>The learners learn that minerals are essential for industrial development, economic growth, and technological advancement, but should be managed sustainably</i>
B. Performance Standard	<i>By the end of the quarter, learners describe the origin of the solar system and Earth's historical evolution. They relate Earth's unique position in the solar system to its composition, structure, and the dynamic nature of its outer layers. Learners explain how scientists determine the nature of Earth's interior. They also collaboratively create detailed models and scientific analyses and use evidence-based findings to illustrate the nature and composition of the Earth.</i>
C. Learning Competencies	<i>The learners explain the uses of key mineral resources of the Philippines, highlighting their economic significance</i>
II. REFERENCES and MATERIALS	Department of Environment and Natural Resources (DENR). <i>Philippine Mineral Industry Statistical Bulletin</i> . Quezon City: DENR. https://www.denr.gov.ph/index.php/mineral-resources . Khan Academy. "Earth and Space Science." Accessed 2024. https://www.khanacademy.org/science/earth-and-space-science . <i>Mineral Resources of the Philippines</i> . Quezon City: Department of Environment and Natural Resources. https://www.mgb.gov.ph/ . Republic of the Philippines. <i>Republic Act No. 7942: Philippine Mining Act of 1995</i> . Manila: Official Gazette of the Republic of the Philippines, 1995. Soriano, A. <i>Mineral Resources and the Philippine Economy</i> . Quezon City: Ateneo de Manila University Press, 2020.
	Mineral Resources <ul style="list-style-type: none"> Mineral Resources and Their Economic Significance in the Philippines
III. CONTENT	At the end of the lesson, the students are expected to:
IV. OBJECTIVES	<ol style="list-style-type: none"> Identify the major mineral resources of the Philippines, such as gold, copper, nickel, chromite, coal, and limestone Describe the common uses of gold, copper, nickel, chromite, coal, and limestone in everyday, industrial, commercial, and technological applications Explain the uses of the Philippines' key mineral resources in relation to their economic significance in the context of national development, using a data-based reading material

	PROCEDURES	ANNOTATION
A. Activating Prior Knowledge	<p>1. Activating Prior Knowledge Conduct a brief activity to gauge students' existing knowledge about minerals and their uses. Select from the options below:</p> <p>Option 1: What Am I? – Riddle Game Procedure:</p> <ol style="list-style-type: none"> 1. Present 4–5 riddle clues about a mineral resource, one at a time 2. Students raise their hands or write their guesses on paper. 3. Reveal the answer after all clues are given. Discuss why the mineral resource is important. 4. Mineral resources to feature: gold, copper, nickel, chromite, coal, limestone. <p>Option 2: K-W-L Chart (Know – Want to Know – Learned) Procedure:</p> <ol style="list-style-type: none"> 1. Distribute a simple K-W-L chart to each student or draw it on the board. 2. Ask students to fill in the K column: What do you already know about mineral resource in the Philippines? 3. Ask students to fill in the W column: "What do you want to learn about mineral resources?" 4. Explain that the L column will be completed at the end of the lesson. 5. Call on 2–3 volunteers to share what they wrote. <p>As students guess each riddle, the teacher listens for correct and incorrect responses and uses these as real-time diagnostic feedback. Reveal the correct answer immediately and address any misconceptions before proceeding to the next riddle. This instant feedback loop ensures students do not carry incorrect mental models into the lesson proper.</p>	<p>As you begin the lesson, consider using Option 1 or Option 2 to activate students' prior knowledge and spark their curiosity about Philippine mineral resources. The riddle game (Option 1) is an engaging way to introduce mineral resources. Keep the atmosphere light and encouraging. This activity activates students' prior schema about mineral resources through a gamified, low-stakes guessing format that makes learning responsive to existing knowledge while sparking curiosity.</p> <p><i>Suggested Riddles</i></p> <p>1. Gold Riddle: I am a shiny yellow metal that stays beautiful without ever rusting. You can find me in expensive jewelry or hidden inside your smartphone's electronics.</p> <p>2. Copper Riddle: I have a reddish-brown color and am one of the best conductors of heat and electricity. I am most often found in the electrical wiring of your home or in plumbing pipes.</p> <p>3. Nickel Riddle: I am a hard, silvery metal used to make stainless steel and many types of coins. I am a key ingredient in rechargeable batteries, and the Philippines is one of my top producers.</p> <p>4. Chromite</p>

	<p>Option 3: Mineral Resources Charades</p> <p>Procedure:</p> <ol style="list-style-type: none"> 1. Prepare cards with the name of a mineral resource and a clue about its use (e.g., COPPER – used in electrical wiring). 2. Divide the class into 2 groups. One student from each group acts out the clue without speaking while teammates guess the mineral resource. 3. Award one point per correct guess. The team with the most points wins. 4. After the game, briefly discuss with the class: Where have you encountered these mineral resources in your everyday lives? <p>2. Establishing the Purpose of the Lesson</p> <p>Present the lesson objectives clearly to the students. You may display them on the board or projector:</p> <p>By the end of this lesson, you should be able to:</p> <ol style="list-style-type: none"> 1. Identify the major mineral resources of the Philippines. 2. Describe the uses of gold, copper, nickel, chromite, coal, and limestone. 3. Explain how these mineral resources contribute to the Philippine economy. <p>Guide Question (ask 2-3, volunteers):</p> <ol style="list-style-type: none"> 1. What mineral resources do you encounter daily? 2. Why do you think it is important for us as Filipinos to understand our country's mineral resources? <p>Now that students have recalled what they know about mineral resources, let us move on to presenting real-world examples and building a deeper understanding of the six key mineral resources of the Philippines and their economic significance.</p>	<p>Riddle: I am a dark, metallic ore that is used to give cars a shiny, mirror-like finish. I have added steel to make it extra hard and resistant to very high heat.</p> <p>5. Coal</p> <p>Riddle: I am a black "fossil fuel" rock formed from ancient plants. When I am burned, I release energy that power plants use to generate electricity.</p> <p>6. Limestone</p> <p>Riddle: I am a white or gray sedimentary rock often made from ancient seashells. I am the main ingredient in cement used to build houses and roads.</p> <p>The K-W-L chart (Option 2) helps you understand students' baseline knowledge and misconceptions. You can revisit the L column at the end of the session to assess learning. From an IDF perspective, the K-W-L chart makes learning responsive and reflective, allowing the teacher to adjust the lesson accordingly.</p> <p>Application of the IDF</p> <p>Both options apply the IDF's Relevant and Responsive principles: Option 1 (Riddle Game) activates prior schema through a gamified, low-stakes format that makes learning responsive to existing knowledge, while Option 2 (K-W-L Chart) makes learning reflective and metacognitive by allowing the teacher to adjust instruction based on</p>
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		<p>what students already know and want to learn.</p> <p>Feedback Mechanism</p> <p>As students respond during either activity, the teacher listens for correct and incorrect responses to identify misconceptions early; the K-W-L L column is revisited at the lesson's end to assess learning gains.</p> <p>For option 3: Mineral Resource Charades, a kinesthetic, team-based activity responsively engages diverse learners by connecting mineral concepts to prior experience through collaborative, embodied play.</p>
B. Instituting New Knowledge	<p>1. Presenting Examples</p> <p>Show students real-world examples that connect mineral resources to their everyday lives. Select from the options below:</p> <p>Option 1: Mineral Resources in My Bag – Show and Tell</p> <p>Procedure:</p> <ol style="list-style-type: none"> 1. Ask students to take out a personal item from their bags or pockets (e.g., phone, coin, key, bracelet, pen). 2. Guide students in identifying which mineral resources were used to make parts of that item. 3. Example mappings: <ul style="list-style-type: none"> • Smartphone → copper (wiring), nickel (battery), gold (circuit contacts) • Coin → copper and nickel alloy • Stainless water bottle → nickel and chromite (stainless steel) 4. After sharing, display a simple infographic showing: <i>Minerals We Use Every Day</i> https://tinyurl.com/mineralresourcesinfo 	<p>Option 1: Minerals in My Bag – Show and Tell</p> <p>From an IDF perspective, this approach grounds learning in personal experience. Students discover that mineral resources are already part of their lives, making the topic more relevant and relatable.</p> <p>Encourage creativity among students, for example, even a ballpen contains mineral resources such as a copper tip and carbon-based ink from coal derivatives</p>

	<p>Option 2: Mineral Resources Photo Gallery</p> <p>Procedure:</p> <ol style="list-style-type: none"> Display 6 photos or illustrations (projected or printed), each showing a mineral resource in its raw form and a product made from it: <ol style="list-style-type: none"> Gold nugget → gold jewelry / electronic chips Copper ore → copper wire/plumbing pipes Nickel ore → stainless steel pots / EV batteries Chromite → chrome bumpers / industrial machines Coal → power plants / industrial fuel Limestone → cement bags/construction roads <p>Guide Question:</p> <ol style="list-style-type: none"> Where do you think these materials come from? How do humans depend on these resources in everyday life? <p>2. Discussing New Concept</p> <p>Start with unlocking terms such as mineral resources, metallic minerals, non-metallic minerals, and energy minerals.</p> <p>Mineral Resources. It is a naturally occurring material found on Earth that has value and can be used by people.</p> <p>Metallic Minerals. These are minerals, such as gold, that contain metals and can be melted or processed to produce metal products.</p> <p>Non-Metallic Minerals. These are minerals, such as limestone, that do not contain metal but are still very useful.</p> <p>Energy Minerals (Fuel Minerals). These are minerals, such as coal, used to generate energy. They are burned or processed to generate power.</p> <p>After presenting the definition, proceed with the suggested activities below:</p> <p>Option 1: Jigsaw Expert Group Discussion</p> <p>Procedure:</p>	<p>Option 2: Mineral Photo Gallery</p> <p>Visual learning bridges the abstract concept of 'mineral resources' with tangible, everyday objects.</p> <p>If a projector is unavailable, printed photo cards placed around the room can serve as a gallery walk — students move from station to station and record their observations.</p> <p>Application of the IDF</p> <p>Both options apply the IDF's Relevant principle: Option 1 grounds learning in personal experience by using students' own everyday objects, while Option 2 bridges the abstract concept of 'mineral resources' to tangible products through visual evidence, helping students discover that Philippine minerals are already part of their lives.</p> <p>Feedback Mechanism</p> <p>As students share items or respond to photo prompts, the teacher notes which mineral-use connections are correct or missing, providing immediate verbal clarification to prevent misconceptions from carrying into the formal discussion.</p> <p>Key Insight to Emphasize: The Philippines is one of the most mineral-rich countries in the world. These resources surround us and drive our economy.</p>
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1. Divide the class into 6 expert groups, each assigned one mineral resources: gold, copper, nickel, chromite, coal, and limestone.
2. Each group receives a short reading material about their assigned mineral, covering: where it is found in the Philippines, its everyday, industrial, commercial, and technological uses, and its contribution to the Philippine economy
3. Groups study their material for 10 minutes, then reform into mixed groups of 6 (one expert per mineral resource). Each expert teaches their mineral resource to the new group (3 minutes per mineral). The teacher synthesizes key points at the end with a summary table on the board.

Summary Table Structure (draw on board):

Mineral Resources	Where it is found in the Philippines	Common Uses	Economic Importance
Gold			
Copper			
Nickel			
Chromite			
Coal			
Limestone			

Option 2: Teacher-Led Discussion

Procedure:

1. Distribute a structured note-taking worksheet, particularly using the Cornell Note Taking strategy. Refer to the template below:

The teacher must emphasize that a true mineral must be a naturally occurring, solid, inorganic substance with a definite chemical composition and a crystalline structure. Coal and limestone are considered mineral resources because, in geography and economics, the term broadly includes any naturally occurring material with economic value

Option 1: Jigsaw Expert Group Discussion

The jigsaw strategy promotes peer teaching, deepens understanding by having students teach others, and develops communication skills. It is particularly effective for content-heavy topics.

Monitor group discussions and clarify misconceptions, especially on economic data. Provide simplified reading materials appropriate for the Grade 11 level.

Simplified Reading Material for Option 1

Gold: Found in Masbate, Compostela Valley. Uses: jewelry, electronics (circuit boards), currency reserves. PH is a top 6 gold producer in SE Asia.

Copper: Found in Cebu and Marinduque. Uses: electrical wiring, plumbing, construction. Major export product.

Cornell Notes Example

	Title	Date
Questions		
or	Regular Notes	
Keywords		
	Summary	

2. Discuss each mineral resource.

3. Ask a comprehension check question before proceeding to the next.

3. Developing Mastery (Formative Assessment)

Allow students to practice and consolidate their understanding through guided and collaborative tasks.

Option 1: Mineral Resource Impact Web- Industry Connection Mapping

Procedures.

1. Read the question below and discuss it with your seatmate:

"If the Philippines had no mineral resources, which industries would be most affected?"

2. Your group will receive one Data Card. Each card shows an industry and a key fact about it.

Together, discuss and answer the question on each card:

"This industry depends on _____ mineral resource because _____."

3. On your manila paper:

- Write the **6 mineral resources** in the middle
- Draw a line from each mineral to the industry it supports
- Write **one benefit** at the end of each line (*Example: "creates jobs," "builds roads," "powers homes"*)
- Use colors: ● Red = economic benefit | ● Blue = infrastructure ● Green = environment/agriculture

Nickel: Found in Surigao del Norte, Palawan, and Davao Oriental. Uses: stainless steel, rechargeable batteries (EV industry). PH is a top-5 global nickel producer.

Chromite: Found in Zambales, Eastern Samar. Uses: chrome plating, stainless steel alloys, and refractory bricks. Strategic industrial mineral.

Coal: Found in Semirara (Antique), Cebu, and Mindanao. Uses: power generation, industrial fuel. Key energy source for PH power plants.

Limestone: Found across the Philippines (Cebu, Rizal, Mindanao). Uses: cement production, agriculture (soil pH), and construction material. Backbone of the construction industry

Option 2: Teacher-Led Discussion:

Ideal for classes where guided instruction is more appropriate. The structured worksheet keeps students engaged and ensures all key content is recorded. Use the question-and-answer format to maintain engagement. Call on volunteers and affirm all reasonable answers before providing the correct or complete information.

Key Point to Emphasize:

The Philippines holds an estimated \$1 trillion worth of untapped mineral wealth (MGB data — updated estimate). This positions the PH as the

4. Post your output on the board. One member stays to explain it. The rest of the group visits other webs and writes one question or comment on a sticky note

Data Card

Industry	Key Fact	Mineral Used
Construction	PH cement production: 32M metric tons/year	Limestone
Power & Energy	Coal provides ~57% of PH electricity (DOE, 2023)	Coal
Electronics	PH electronics exports: \$39.5B in 2022 (PSA)	Copper, Gold
Transportation	Stainless steel is used in buses, ships, and bridges	Nickel, Chromite
Jewelry & Trade	Gold jewelry is among PH's top export products	Gold
Agriculture	Lime is applied to 2.4M hectares of farmland yearly	Limestone

Guide Questions:

1. Which mineral resource helps the most industries? Why do you think so?
2. What would happen if one mineral resource suddenly ran out?
3. Why is it important to use mineral resources responsibly?

Rubric for Mineral Resource Impact Web

Criteria	Excellent (5 pts)	Proficient (4 pts)	Developing (2-3 pts)	Beginning (1 pt)
Accuracy of Connections	All mineral resources are correctly linked to their respective industries with clear, factual justifications.	Most mineral resources are correctly linked; justifications are mostly accurate.	Some mineral resources are incorrectly linked, or justifications are vague.	Connections are missing or largely incorrect.
Visual Mapping (Color Coding)	Excellent use of Red, Blue, and Green; the web is highly organized and easy to read.	Color coding is followed; the web is organized.	Color coding is inconsistent, or the web is difficult to follow.	No color coding used; the web is messy.

5th most mineralized nation on Earth. However, only 5% of reserves have been explored, making sustainable and responsible management critical for long-term national benefit.

Option 1: Mineral Resource Impact Web- Industry Connection Mapping

This activity builds on students' prior knowledge of Philippine minerals by shifting the focus from identification to analysis. Instead of simply recalling what minerals are, students are now asked to examine how minerals drive industries and support national development — a progression aligned with higher-order thinking skills (HOTS). The use of real economic data makes learning more meaningful and prepares students for evidence-based discussion.

Application of Benefits	Benefits (Jobs, Infrastructure, etc.) are specific and clearly stated for every industry.	Most benefits are stated clearly.	Benefits are repetitive or too general (e.g., "it is good").	Benefits are missing.
Collaboration & Defense	All members participated; the "staying" member can confidently answer peers' questions.	Most members participated; the representative can answer basic questions.	Participation was uneven; the representative struggled to explain.	The group did not work together well; unable to explain the web.

Option 2: Philippine Mineral Resources Map Activity

Procedure:

1. Divide the class into groups of 5–6 students.
2. Provide each group with an outline map of the Philippines.
3. Using the concepts learned in the previous discussion, students will mark and label the location of each major mineral resource (gold, copper, nickel, chromite, coal, and limestone) on the map using different colors or symbols.
4. Using your device, search for the major mining areas of each mineral in the Philippines, mark them on an outline map, and write the mineral name and draw a symbol for the industry it supports. Use credible sources such as the Mines and Geosciences Bureau website (mgb.gov.ph) or the Philippine Statistics Authority (psa.gov.ph) to verify the locations before plotting.
5. Below the map, students write 1–2 sentences describing each mineral resource they plotted.
6. Groups present their maps to the class and explain their answers.

Guide Questions:

- Which regions of the Philippines are richest in mineral resources?

Option 2: Philippine Mineral Resources Map Activity

Organize students into groups and distribute pre-printed outline maps, or ask them to sketch a simple map. Encourage creativity in using colored markers or symbols to differentiate minerals. During the group presentations, listen for accurate location identification. Correct misconceptions gently and affirm correct answers to build student confidence. This mapping activity reinforces geographic literacy alongside science content and promotes collaborative learning.

Application of the IDF

Both options shift the IDF's learning progression from identification to analysis: Option 1 (Industry Web) asks students to examine how minerals drive industries using real economic data, applying higher-order thinking skills, while Option 2 (Mineral Map) reinforces geographic literacy alongside content mastery and promotes collaborative learning.

Feedback Mechanism

In Option 1, the teacher observes sticky-note comments during the

	<ul style="list-style-type: none"> • Why do you think some areas have more mineral resources than others? • Which mineral resource do you think is most important for the Philippines? Why? <p>With a clearer understanding of the six key mineral resources and their industrial connections, students are now ready to apply their learning by analyzing real data and demonstrating their knowledge through authentic tasks.</p>	<p>gallery to identify which industry-mineral links are unclear; in Option 2, the teacher monitors map presentations and gently corrects location or classification errors to build student confidence.</p>
C. Demonstrating Knowledge and Skills	<p>1. Finding Practical Application Option 1: Mineral Resources Economy News Report Procedure: 1. Divide the class into groups of 4–5 students. 2. Provide each group with a data-based reading material (e.g., an excerpt from the DENR Philippine Mineral Industry Statistical Bulletin or a simplified infographic showing PH mineral export data by year and type, or you may access the suggested file at https://tinyurl.com/MineralsNewsReport). 3. Each group presents their findings in a 2–3 minute 'news report' format to the class. 4. Class evaluates presentations using a simple peer assessment rubric (Content Accuracy, Clarity, Use of Evidence). Guide Questions: 1. Which mineral resource generates the most export revenue for the Philippines? 2. How do mining revenues contribute to national development? Cite data. 2. Making Generalizations Help students consolidate their learning by drawing key conclusions from the lesson. Option 1: Exit Ticket – Three-Two-One Strategy Procedure: 1. Distribute a half-sheet exit ticket to each student. 2. Students complete the following independently: Three (3) mineral resources of the Philippines I learned today, two (2) ways these minerals are important to the Philippine economy, and one (1) question I still have about mineral resources in the Philippines</p>	<p>Option 1: Mineral Economy News Report Using real industry data builds data literacy and connects academic content to current events in the Philippines. The news report format adds an authentic communication task, making the activity more meaningful. Scaffold the reading material for different learner levels — provide a simplified version for students who may struggle with technical language.</p> <p>Option 1: Exit Ticket – Three-Two-One Strategy The 3-2-1 exit ticket is a quick, structured reflection tool that provides both teacher and learner with a clear snapshot of learning. The 'question'</p>

	<p>3. Call on 3–4 volunteers to share their entries, particularly their question (#1). Address unresolved questions immediately or promise to revisit them in the next session.</p> <p>4. Collect exit tickets as formative data.</p> <p>Closing Statement (use for either option)</p> <p>The Philippines is one of the most mineralized countries in the world. Gold, copper, nickel, chromite, coal, and limestone are not just rocks; they are part of our national identity, our economy, and our future. As informed citizens, it is your responsibility to understand how these resources should be used wisely and sustainably for national development.</p>	<p>component is particularly valuable as it surfaces misconceptions and gaps.</p> <p>Review the exit tickets before the next session to inform your instruction. If multiple students ask the same question, address it on Day 3.</p> <p>Application of the IDF</p> <p>Both options apply the IDF’s Reflective and Relevant principles: Option 1 (News Report) uses authentic industry data to build data literacy and connects academic content to current national economic events, while the Exit Ticket (Option 1)</p>
<p>V. ASSESSMENT <i>(Assessing Learnings)</i></p>	<p>OPTION 1 ASSESSMENT</p> <p>Part A – Multiple Choice. Directions: Choose the letter of the BEST answer. Write your answer on the blank before each number (5 points).</p> <p>1. Maria, a Grade 11 student from Zambales, noticed that the electrical wires in her house are made of a reddish-brown metal. Her father told her that this metal is mined not far from their province. Which mineral resource is most likely used in making these wires, and what property makes it suitable for this use?</p> <p>A. Iron — because it is magnetic and strong</p> <p>B. Aluminum — because it is lightweight and silvery</p> <p>C. Copper — because it is ductile and highly conductive</p> <p>D. Gold — because it is shiny and does not tarnish</p> <p>2. The local government of a town in Antique announced that a power plant in their area generates electricity for thousands of homes. A student researched that this plant uses a black fossil-fuel rock mined from Semirara Island. Which mineral resource is being used, and how is it classified?</p> <p>A. Nickel: a metallic mineral used in rechargeable batteries.</p> <p>B. Chromite, a non-metallic mineral used in industrial heat processes.</p> <p>C. Limestone; an energy mineral that is burned to produce electricity.</p> <p>D. Coal: an energy mineral that is burned to generate power.</p> <p>3. A classmate argues that limestone is the least economically important of the six Philippine minerals because it is not a metal. How would you best respond to this?</p> <p>A. Agree, because non-metallic minerals have lower economic value than metals.</p>	

B. Disagree, because limestone is the main raw material used in making cement.

C. Agree, because limestone has fewer industrial uses than gold or nickel.

D. Disagree, because limestone can be used to adjust soil pH in farming.

4. The Philippines holds an estimated ₱50 trillion worth of untapped mineral wealth, yet only about 5% of its mineral reserves have been fully explored. A Grade 11 student from Palawan asks: “Does this mean that future generations of Filipinos will benefit even more from our minerals?” What is the most logical conclusion that supports this student’s question?

A. Mineral exploration in the country has been fully completed and documented.

B. The remaining reserves are too deep or scattered to be worth exploring further.

C. The country still has significant mineral potential that can be developed responsibly.

D. Most of the remaining reserves are located in areas that cannot be accessed legally.

5. A mining company in Surigao del Norte pays taxes and royalties to the local government from its nickel operations. The local government uses these funds to build new classrooms and repair farm-to-market roads. Which statement BEST illustrates the direct link between mineral resources and national development shown in this scenario?

A. Mining companies are required to hire only workers from the local mining province.

B. Taxes and royalties from mining help fund the construction of schools and roads.

C. The government ensures that all mined minerals remain within the country for local use.

D. Mining revenues are used only to support further exploration of mineral reserves only.

Part B– Reflection (10 points)

In 3–5 sentences, explain: How can the Philippines benefit from its mineral resources while ensuring sustainable use for future generations?

OPTION 2: Group Performance Task – Mineral Resource Advocacy Poster

1. Group the class into six.

2. Each group will create an advocacy poster about Philippine mineral resources.

3. The poster must feature at least three minerals, show each mineral's economic importance using data or real-life examples, and include a key message about using minerals responsibly.

4. Once the posters are done, have each group present their work to the class in 3 minutes.

CRITERIA	5– Excellent	4– Proficient	3 – Developing	2– Beginning
Content & Accuracy	Features 3+ Philippine mineral resources with accurate, detailed economic data, specific statistics, and real-world examples for each.	Features 3 mineral resources with mostly accurate data and economic examples; minor gaps or inaccuracies.	Features 2–3 minerals; economic data is limited, vague, or contains some inaccuracies.	Fewer than 2 minerals featured; data is missing, inaccurate, or irrelevant.

	Economic Importance	The economic importance of all minerals is clearly shown with compelling data (e.g., export values, employment figures, GDP contributions).	The economic importance of most minerals is shown, with supporting data or examples.	Economic importance is mentioned but weakly supported; data or examples are minimal.	Little to no evidence of economic importance; connection to the Seconomy is unclear.
	Sustainability Message	A clear, specific, and compelling key message about sustainable mineral use is prominently featured and well-integrated into the poster.	A sustainability message is present and relevant, though it could be more specific or prominent.	Sustainability is mentioned, but the message is vague, generic, or not clearly visible.	No sustainability message, or it is entirely off-topic.
	Visual Design & Organization	Poster is highly organized, visually appealing, and uses color, layout, and labels effectively. Easy to read and navigate at a glance.	Poster is organized and mostly clear; design is functional with minor layout or labeling issues.	The poster shows some organization but is cluttered, hard to read, or inconsistently labeled.	The poster is disorganized, unclear, or difficult to read; labels are missing or confusing.
	Oral Presentation	All members speak confidently and clearly; ideas are well-explained; time (3 min) is well-managed; the group presents as a cohesive team.	All members speak; most ideas are clear; time is mostly managed; minor gaps in delivery.	Not all members speak, or delivery is unclear/rushed; some ideas are not well-explained.	Only one or two members speak; delivery is unclear or very disorganized; time is significantly over- or under-estimated.
	Collaboration & Teamwork	All members clearly contribute to both the poster and the presentation; roles seem balanced and well-coordinated.	Most members contribute meaningfully; minor imbalance in roles or participation.	Some members dominate while others contribute little; coordination is uneven.	Little evidence of teamwork; work appears to be done by one or two members only.
	TOTAL SCORE	_____/ 30			
VI. REFLECTION	<i>This section presents the key highlights and challenges encountered by both teachers and learners throughout the unit. It also includes the teacher's adjustments to improve instruction.</i>				
VII. USE OF GENERATIVE AI	In preparing this Learning Exemplar (LE), the author(s) used Claude.ai only to assist in drafting selected learning activities. The author(s) reviewed and finalized the writing of the content. The author(s) take full responsibility for the content of this LE.				

Lesson Title/Topic	Mineral Resources (Mitigating Environmental Impacts of Mineral Resource Extraction and Misuse)	Lesson Exemplar	11
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A. Content Standard	<i>The learners learn that minerals are essential for industrial development, economic growth, and technological advancement, but should be managed sustainably</i>
B. Performance Standard	<i>By the end of the quarter, learners describe the origin of the solar system and Earth's historical evolution. They relate Earth's unique position in the solar system to its composition, structure, and the dynamic nature of its outer layers. Learners explain how scientists determine the nature of Earth's interior. They also collaboratively create detailed models and scientific analyses and use evidence-based findings to illustrate the nature and composition of the Earth.</i>
C. Learning Competencies	<i>The learners can identify strategies to prevent and mitigate environmental impacts associated with the exploitation, overextraction, and misuse of mineral resources.</i>
II. REFERENCES and MATERIALS	<p>Environmental Management Bureau. Accessed 2026. https://emb.gov.ph/.</p> <p>Holden, William, and R. D. Jacobson. Mining and Natural Hazard Vulnerability in the Philippines. London: Anthem Press, 2012.</p> <p>Mines and Geosciences Bureau. Accessed 2026. https://www.mgb.gov.ph/.</p> <p>Official Gazette of the Republic of the Philippines. Accessed 2024. https://www.officialgazette.gov.ph/.</p> <p>Republic of the Philippines. Department of Environment and Natural Resources. DENR Administrative Order No. 2010-21: Revised Implementing Rules and Regulations of Republic Act No. 7942. Quezon City: DENR, 2010.</p>
III. CONTENT	<p>Mineral Resources</p> <ul style="list-style-type: none"> • Mitigating Environmental Impacts of Mineral Resource Extraction and Misuse
IV. OBJECTIVES	<p><i>At the end of the lesson, the students are expected to:</i></p> <ol style="list-style-type: none"> 1. Determine the common environmental impacts caused by the exploitation, over-extraction, and misuse of mineral resources in the Philippines 2. Describe the existing laws, policies, and government regulations in the Philippines that address the environmental impacts of mineral resource extraction 3. Identify practical strategies used by mining companies and communities to prevent and reduce the environmental impacts of mineral resource exploitation, over-extraction, and misuse of mineral resources in the Philippines.

V. PROCEDURES

ANNOTATION

A. Activating Prior Knowledge

Activating Prior Knowledge

Before we dive into the technicalities of mining laws, let's look at the visual reality of mineral extraction in our country. Begin the lesson by connecting students' prior knowledge about mineral resources to the concept of environmental impact. Select from the options below:

Option 1: Mining the Evidence: A Photo Analysis

Procedure:

1. Display two sets of side-by-side photos (projected or printed):

Photo Set A: A lush, forested mountainside in Mindanao vs. the open-pit mining (bare, scarred earth with tailings ponds)



Image 1: <https://ubyssey.ca/features/mindanao-philippines/>

Image 2: <https://www.philstar.com/headlines/climate-and-environment/2024/05/12/2354537/denr-probes-tailings-facility-failure-surigao-mine>

Photo Set B: A clean river vs. the Boac River after the 1996 Marcopper tailings spill (orange, contaminated water)

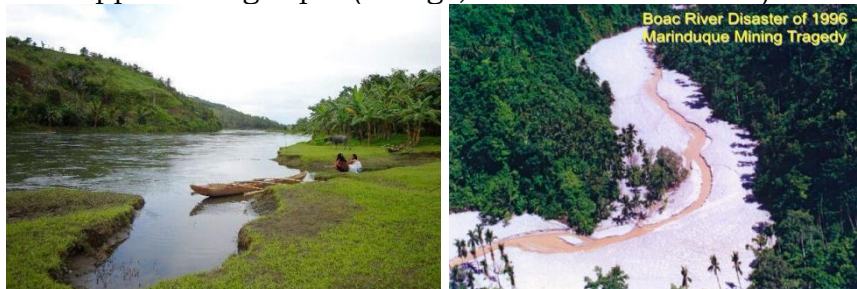


Image 1: <https://www.philstar.com/the-freeman/cebu-news/2018/10/27/1863634/summit-restore-beauty-rivers>

Image 2: <https://miningwatch.ca/blog/2020/3/24/still-no-justice-marinduques-mining-victims>

Photo Set C: A thriving coral reef in Palawan vs. a sedimented, bleached reef

Option 1: Mining the Evidence: A Photo Analysis

Visual evidence is powerful for developing empathy and grounding abstract concepts. Real Philippine case photos (e.g., Marcopper, Benguet) make the issue tangible and personally relevant to students.

Source suggestion: MGB photo library, news archives from the Philippine Daily Inquirer, or documentary stills. Ensure photos are age-appropriate.

Application of the IDF

This section applies the Responsive and Relevant dimensions of the IDF by using real-world Philippine mining cases, such as the Marcopper incident, to ground abstract concepts in tangible, local history. By allowing students to voice their own observations through a photo analysis, the instruction adapts to their current level of environmental awareness, making the learning process a two-way interaction between the learner's experience and the curriculum content.

Feedback Mechanism

To ensure our initial observations are accurate, we will use a collaborative feedback approach. By combining Think-Pair-Share with Board



Image 1: <https://marine-conservation.org/blueparks/awardees/tubbataha/>

Image 2: <https://catalystmcgill.com/bleaching-of-the-coral-triangle-what-does-this-mean-for-the-philippines/>

2. Ask students to observe silently for 1 minute, then respond in pairs:

- What do you see in each photo?
- What do you think caused the change in the second photo?

3. Call on 3–4 pairs to share. Write key words on the board: deforestation, water pollution, bleaching and, loss of biodiversity.

Option 2: Environmental Impact Quick Write

Procedure:

1. Ask students the guide question below:

Guide Question: Think of a place in the Philippines where mining happens. What do you think happens to the environment, such as the land, water, air, and animals, because of that mining activity?

2. Students share responses with a seatmate, then 3–4 volunteers share with the class. The teacher records key ideas on the board under two columns:

Environmental Impact We Already Know	Things We Want to Understand Better

4. These columns remain visible throughout the lesson for reference and updating.

Categorization, students receive immediate peer validation on their photo observations while the teacher organizes these ideas into "Known Impacts" and "Learning Gaps" on the board. This dual-layered feedback ensures that students correct misconceptions early while the teacher gains a clear map of the class's current understanding to guide the rest of the session. With our collective knowledge organized, we can now define our specific goals for the day.

Option 2: Environmental Impact Quick Write

This activates prior knowledge and gives the teacher immediate insight into what students already understand about mining's environmental effects.

Both options set an emotional and intellectual context for the lesson. Students with family or community connections to mining areas may share personal experiences and welcome them as valuable contributions.

Key Bridge Statement: Today, we will go deeper, we will name these impacts precisely, learn about the laws

	<p>2. Establishing the Purpose of the Lesson Present the lesson objectives and connect them to real-world importance: <i>By the end of this lesson, you will be able to:</i></p> <ol style="list-style-type: none"> 1. Determine the common environmental impacts caused by the exploitation, over-extraction, and misuse of mineral resources in the Philippines 2. Describe the existing laws, policies, and government regulations in the Philippines that address the environmental impacts of mineral resource extraction 3. Identify practical strategies used by mining companies and communities to prevent and reduce the environmental impacts of mineral resource exploitation, over-extraction, and misuse of mineral resources in the Philippines <p>Guide Question: How do we balance the economic benefits of mining with the responsibility to protect our environment and communities?</p> <p>To bridge the gap between the visual evidence of environmental damage and the legal frameworks designed to prevent it, we must evaluate whether our current regulations are robust enough to protect our nation's future. We will now move on to examine specific real-world examples and the concrete strategies used to balance mineral extraction with environmental preservation.</p>	<p>designed to prevent them, and explore what responsible mining actually looks like in the Philippines.</p> <p>Explicitly setting objectives helps students monitor their own learning throughout the lesson. The Guide Question is deliberately open-ended and will resurface during the role-play activity and generalization phase.</p> <p>For students from mining communities (especially in Mindanao, Cordillera, or Eastern Visayas), this lesson may be personally meaningful. Create a safe and respectful space for diverse perspectives. Some families may depend on mining for livelihood, while others may have experienced its harms.</p>
<p>B. Instituting New Knowledge</p>	<p>1. Presenting Examples Introduce concrete Philippine cases that illustrate the environmental impacts of mining. Select from the options below: Option 1: Case Files: Philippine Mining Incidents Procedures: 1. Divide the class into four groups and give each group a Case File briefing card available at https://tinyurl.com/Option1Casefiles. It contains details of a real Philippine mining-related environmental incident.</p>	<p>Option 1: Case Files: Philippine Mining Incidents Real Philippine cases make the environmental impacts undeniably concrete. Students see that these are not hypothetical, to Filipino communities, involving the same minerals discussed in the previous lesson.</p>

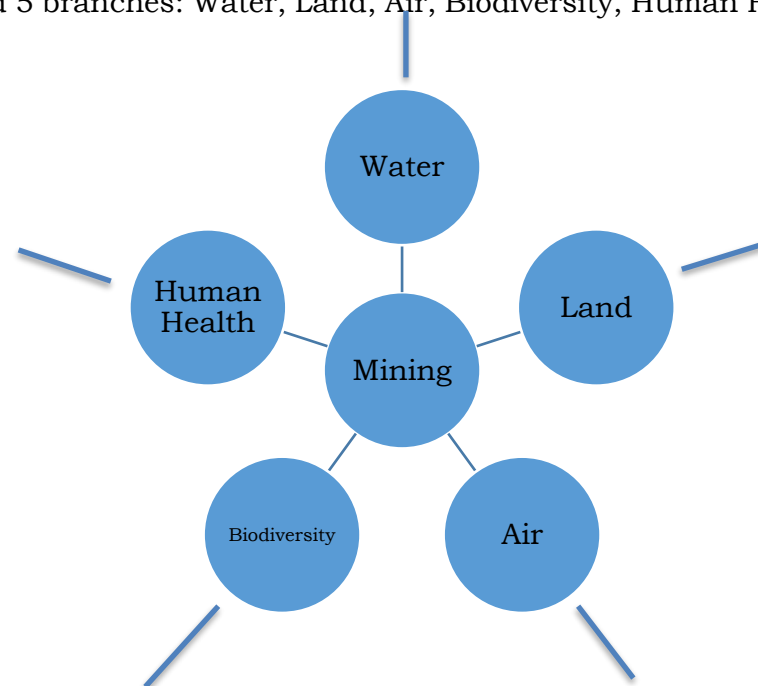
2. Each group identifies the type of environmental impact (water, land, air, or biodiversity), the mineral being extracted, the communities affected, and what could have been done to prevent the damage.

3. Each group presents its findings to the class in a 2-minute briefing.

Option 2: Environmental Impact Web

Procedure:

1. Draw a large web on the board with 'MINING' at the center. Add 5 branches: Water, Land, Air, Biodiversity, Human Health.



2. Through guided questioning, build the web together with students, filling in specific impacts for each branch:

Water: Acid mine drainage (sulfide minerals react with water and air to produce sulfuric acid), cyanide leaching contamination, sedimentation of rivers and coastal areas, tailings spills

Prepare simplified one-page briefing cards in advance. Include a small map showing the affected area. You may source case data from MGB reports, DENR bulletins, or academic references.

Suggested Rubric: Case File Group Briefing (10 points)

Criterion	3	2	1
Identification of environmental impacts	Correctly identifies all impact types	Identifies most impacts; minor gaps	Identifies one or no impact type
Identification of the mineral and the affected community	Both correctly named	One correctly named	Neither identified
Prevention recommendation	Specific and grounded in lesson content	General but relevant	Vague or absent
Total	____ / 9 points		

Option 2: Environmental Impact Web

This approach systematically covers all categories of environmental impact, ensuring no key concept is missed. It also provides a visual reference for students during the role-play activity. Emphasize the interconnectedness of impacts: deforestation (land impact) leads to increased siltation (water impact), which destroys coral reefs

	<p>Land: Deforestation and vegetation removal, soil erosion, mine subsidence (ground collapse), destruction of agricultural land, tailings dam failures</p> <p>Air: Dust pollution from blasting and hauling, emission of toxic gases (sulfur dioxide from smelting), noise pollution</p> <p>Biodiversity: Habitat destruction, loss of endemic species, disruption of migration corridors, and coral reef sedimentation</p> <p>Human Health: Respiratory diseases from dust, heavy metal poisoning (mercury, lead, arsenic), and displacement of indigenous communities. Small-scale miners use mercury amalgamation, a process that releases toxic mercury into water systems.</p> <p>Students copy the completed web into their notebooks.</p> <p>2. Discussing New Concept: Philippine Laws and Regulations on Mining The Philippine government has created laws specifically to prevent and address these environmental problems. Let us examine the key ones. Present the following laws through structured discussion. Select from the options below: Option 1: Law Decoder Jigsaw Procedure 1. Divide the class into five groups and provide each with a specific legal excerpt and summary to analyze. 2. After five minutes of internal study, regroup into mixed teams where each "expert" takes three minutes to explain their law to the others. Present each law using the following guide questions per law: <ul style="list-style-type: none"> • What environmental problem does this law try to solve? • What does a mining company need to DO to comply? • What happens if they do NOT comply? 3. Collaborate as a mixed team to fill out the Law Summary Matrix worksheet using the information gathered from every expert.</p>	<p>(biodiversity impact), which in turn affects fisherfolk's income (human health/livelihood).</p> <p>Key Vocabulary to Define on Board:</p> <ul style="list-style-type: none"> • Exploitation - extracting and using mineral resources to produce goods, generate income, and support development. • Overextraction - taking out minerals faster than is sustainable, essentially using up what cannot be replaced. • Misuse - using mineral resources in ways that are wasteful, harmful, or irresponsible, such as illegal mining, dumping mine waste into rivers, or prioritizing profit over community welfare and environmental protection. • Acid Mine Drainage (AMD) • Tailings - waste material remaining after ore has been processed • Siltation - accumulation of fine soil particles in water bodies • Mercury amalgamation - a process used in artisanal gold mining • Cyanide leaching - a chemical process used in gold extraction <p>Option 1: Law Decoder Jigsaw Legal texts can feel inaccessible to Grade 11 students. Simplified</p>
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Law	Year Enacted	Key Requirement	Penalty for Violation	Enforcing Agency

3. Developing Mastery (Formative Assessment)

Consolidate students' understanding through guided collaborative tasks. Select from the options below:

Option 1: Law-Impact Matching Matrix – Group Worksheet

Procedure:

1. Distribute a matrix worksheet to groups of 4–5 students.

Environmental/ Social Impact	RA 7942 (Mining Act)	DAO 2010- 21 (Rehab)	RA 9275 (Clean Water)	RA 8749 (Clean Air)	RA 8371 (IPRA)	Specific Provision / Note
Acid Mine Drainage						
Deforestation						
Air Pollution						
Mercury Contamination						
Loss of Ancestral Land						

2. Students place a checkmark in the appropriate column(s) for each environmental impact and write a brief note explaining which specific provision of the law applies.

3. Groups compare their matrices with those of another group and discuss discrepancies.

4. Teacher reviews answers and clarifies misconceptions.

Option 2: Compliant or Not?

Procedure:

1. Present 8 scenario cards, each describing a mining company's action. Students (in pairs) decide: COMPLIANT or NON-COMPLIANT with Philippine mining laws, and identify which specific law is involved.

Guide Question: What should the penalty be for each non-compliant scenario?

excerpts and peer teaching make this content approachable while developing legal literacy, a critical civic skill.

Prepare the simplified one-page summaries in advance, or you may access the suggested file at <https://tinyurl.com/lawsummarycard>. Highlight the most important provisions using bold text or color coding. Focus on: What must mining companies DO? What are they PROHIBITED from doing? What happens if they VIOLATE the law?

Option 2: Teacher-Led Discussion with Interactive Law Profile Cards

The structured Law Profile Card format breaks down complex legislation into digestible components and allows direct comparison across laws.

Application of the IDF

The Teaching process of the IDF is highlighted here through the Activation → Institution flow, where students move from general ideas to specific legal and scientific data. The use of the Jigsaw method ensures the lesson is Responsive by breaking down dense legal texts into manageable, student-led "expert" sessions, fostering a collaborative environment where every learner is responsible for the group's success.

	<p>Scenario A: MineX Corp. discharged untreated wastewater directly into the Tagoloan River. → Non-Compliant: RA 9275 (Clean Water Act)</p> <p>Scenario B: Greenmine Inc. conducted an Environmental Impact Assessment and received an Environmental Compliance Certificate before starting operations. → Compliant: RA 7942</p> <p>Scenario C: AurumPH Mining began operations inside a Manobo ancestral domain without consulting the community. → Non-Compliant: RA 8371 (IPRA – no FPIC)</p> <p>Scenario D: CopperStar Corp. installed dust suppression systems on all hauling roads and submitted quarterly air quality monitoring reports. → Compliant: RA 8749</p> <p>Scenario E: NickelPro Ltd. failed to deposit the required annual contribution to the Mine Rehabilitation Fund. → Non-Compliant: RA 7942</p> <p>Scenario F: GoldPath Inc. set up a Multipartite Monitoring Team with DENR, LGU, and community representatives to oversee its environmental programs. → Compliant: DAO 2010-21</p> <p>Scenario G: A mining company used cyanide in gold processing and failed to contain the solution, causing a spill into a nearby creek. → Non-Compliant: RA 9275 and RA 7942</p> <p>Scenario H: EcoMine Corp. conducted FPIC consultations with local indigenous communities for 6 months before applying for a mining permit in their ancestral domain. → Compliant: RA 8371</p> <p>2. After individual pair answers, review as a class.</p> <p>Having analyzed the legal requirements and tested our ability to identify compliance in real-world scenarios, we must now look beyond the "what" of the law to the "how" of daily</p>	<p>Critical Point to Emphasize The Environmental Impact Assessment (EIA) under RA 7942 is required BEFORE mining begins, it predicts and plans for environmental impacts. The Multipartite Monitoring Team (MMT) then monitors compliance DURING mining operations. Both mechanisms are community-participatory, meaning citizens can be involved.</p> <p>Option 1: Law-Impact Matching Matrix – Group Worksheet The matching matrix requires students to think analytically, not just recall what each law says, but apply it to specific impacts. This is a higher-order thinking task that bridges knowledge and application.</p> <p>Option 2: Compliant or Not? Scenario-based learning bridges legal knowledge with real-world application and directly prepares students for the role-play activity that follows.</p> <p>These scenarios may also be used as review material during the role-play briefing. The 'Compliant vs. Non-Compliant' framework will be central to the role-play exercise. Note: Save student outputs from this activity; they will serve as a reference during the role-play in the Demonstrating Knowledge and Skills phase.</p>
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	<p>operations. We will now explore the practical applications and strategies that mining companies and local communities use to turn these legal mandates into effective environmental protection on the ground.</p>	<p>The company's actions are "Compliant" or "Non-Compliant".</p> <p>Application of the IDF This stage addresses the Demonstration phase of the IDF, requiring higher-order thinking to bridge the gap between knowing a law and applying it to a complex environmental scenario. It promotes Continuous Improvement by using student outputs as reference materials for future role-plays, ensuring that the learning is iterative and builds upon previous successes.</p>
C. Demonstrating Knowledge and Skills	<p>1. Finding Practical Application Students apply their learning to real-life contexts using authentic materials. This also serves as scaffolding for the performance task.</p> <p>Option 1: Minahan at Batas A short (20–25 minute) role-play where students act as key stakeholders responding to two contrasting non-compliant mining scenarios. The class acts as a mini-panel of the enforcing agency (DENR–MGB, EMB, and NCIP), tasked with hearing the case, evaluating compliance, and issuing recommendations.</p> <p>Scenario A: "The Silent River" Location: A small-scale gold mining operation in the Cordillera region. Violation: The company has been discharging untreated wastewater containing mercury into a nearby river used by downstream farming communities. Fish kills have been reported, and residents show early signs of mercury poisoning. The company operates without a Discharge Permit. Key Issues: Mercury Contamination, Acid Mine Drainage, potential illegal operation.</p>	<p>Option 1: Minahan at Batas The role-play is the centerpiece activity. It requires students to apply all four lesson objectives simultaneously: its impacts, laws, compliance, and mitigation</p> <p>Option 2: Gallery Walk – 5 Strategy Stations Students encounter mitigation strategies in a self-directed, exploratory way. Each strategy should be linked back to a specific environmental impact from the lesson. The teacher may access the station cards at https://tinyurl.com/StationsCard</p>

	<p>Scenario B: "The Vanishing Forest" Location: A large-scale open-pit mining concession overlapping an Ancestral Domain. Violation: The company began clearing 200 hectares of old-growth forest without securing Free and Prior Informed Consent (FPIC) from the affected Indigenous community. Dust and particulate emissions from blasting have also triggered respiratory complaints in nearby barangays, and the company has no updated Permit to Operate for its air pollution sources. Key Issues: Loss of Ancestral Land, Deforestation, Air Pollution.</p> <p>After the two hearings conclude, the teacher leads a 5-minute synthesis discussion to consolidate the lesson.</p> <p>Option 2: Gallery Walk – 5 Strategy Stations Procedure:</p> <ol style="list-style-type: none"> 1. Post 5 station cards around the room. Groups rotate (2–3 minutes per station) and record the strategy, the environmental impact it addresses, and the supporting law. <p>Guide Question: Which strategy is most effective? Which is hardest to enforce?</p> <p>2. Making Generalizations Help students consolidate their learning by drawing key conclusions from the lesson.</p> <p>Option 1: Mining Ethics Spectrum – Stand and Share Procedure:</p> <ol style="list-style-type: none"> 1. Students position themselves for each statement, then explain using facts from the lesson. One wall = STRONGLY AGREE; opposite wall = STRONGLY DISAGREE. <p>Suggested statements:</p> <ul style="list-style-type: none"> • The Philippines should ban all large-scale mining to protect the environment. 	<p>Option 1: Mining Ethics Spectrum – Stand and Share Develops critical thinking through physical commitment to a position and evidence-based defense. There are no wrong positions, only well-reasoned and poorly reasoned ones.</p> <p>Option 2: Synthesis Card – Individual Reflection (5 minutes) Gives quiet, individual processing time after the active role-play. Ensures that all students, not just the vocal ones, consolidate their learning.</p> <p>Closing Statement: The Philippines has the laws. The challenge is collective will, from government, industry, and us as citizens, to ensure they are followed. Science equips you to understand the impacts. Civic knowledge equips you to demand accountability.</p>
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	<ul style="list-style-type: none">• The problem is not the laws — it is the lack of enforcement.• Economic growth from mining and environmental protection can coexist. <p>2. Call on 2–3 students from different positions per statement. What values should guide our country's approach to mineral resources?</p> <p>To ensure that our insights on mining ethics and practical strategies have truly taken root, we will now transition from our group discussions to an individual assessment. This final stage allows you to demonstrate your mastery of mitigating the environmental impacts of mineral resource extraction and misuse that we have explored this week.</p>																	
VI. ASSESSMENT <i>(Assessing Lea</i>	ASSESSMENT Option 1: Multiple Choice. Directions: Choose the letter of the best answer. Write your answer on the blank before each number (5 points). 1. A nickel mining company in Surigao del Norte planted native tree species on abandoned mine slopes as extraction moved to a new area. The company also reinforced river banks with native vegetation within the mine's watershed. Which combination of environmental impacts do these actions MOST directly prevent? A. Air pollution from blasting operations and mercury contamination from processing tailings ponds B. Soil erosion from exposed slopes and river siltation affecting downstream fisheries and farmland C. Acid mine drainage from sulfide ores and cyanide leaching into groundwater aquifers nearby D. Noise pollution from heavy equipment and greenhouse gas emissions from diesel-powered machinery ___2. The table below shows the environmental violations recorded in a Philippine mining province from 2019 to 2023: <table><tr><th>Type of Violation</th><th>2019</th><th>2021</th><th>2023</th></tr><tr><td>Untreated effluent discharge</td><td>3</td><td>7</td><td>12</td></tr><tr><td>Failure to submit the air quality report</td><td>1</td><td>2</td><td>5</td></tr><tr><td>No FPIC certification in the ancestral domain</td><td>0</td><td>2</td><td>4</td></tr></table> <p>Based on the data, which conclusion is BEST supported by the trend shown? A. Mining companies are increasingly complying with environmental laws. B. Environmental violations are increasing, suggesting a growing gap C. Indigenous Peoples’ rights violations are decreasing over time.</p>		Type of Violation	2019	2021	2023	Untreated effluent discharge	3	7	12	Failure to submit the air quality report	1	2	5	No FPIC certification in the ancestral domain	0	2	4
Type of Violation	2019	2021	2023															
Untreated effluent discharge	3	7	12															
Failure to submit the air quality report	1	2	5															
No FPIC certification in the ancestral domain	0	2	4															

- D. Water violations are less serious than air violations, as they occur less frequently.
- ___3. A small-scale gold miner in Camarines Norte uses mercury amalgamation and dumps the resulting toxic tailings into a nearby creek. A local environmental group files a complaint. Under which combination of Philippine laws can the miner be held legally accountable?
- A. RA 7942 and RA 8371 only
 - B. RA 9275 (water pollution) and RA 8749 (mercury vapor from burning)**
 - C. DAO 2010-21 only, as it governs small-scale mining operations
 - D. RA 8371 and RA 9275 only, because the creek is near an ancestral domain
- ___4. The 1996 Marcopper mining disaster in Marinduque released approximately 1.6 million cubic meters of copper tailings into the Boac River, which was declared biologically dead. Twenty years later, the river is still contaminated. Which statement BEST explains why environmental damage from mining is often difficult to reverse?
- A. Affected communities often lack the legal resources and technical expertise to pursue long-term environmental claims against large mining corporations.
 - B. Heavy metal contamination bioaccumulates in soil and sediments, and the physical transformation of river ecosystems cannot be easily undone through standard rehabilitation.**
 - C. Philippine courts generally lack the technical jurisdiction and enforcement mechanisms to compel mining companies to fully restore damaged river systems.
 - D. Mining companies that cease operations are frequently released from long-term environmental obligations once their final mine closure plans are approved.
- ___5. Under Republic Act No. 7942 (Philippine Mining Act of 1995), which of the following correctly identifies THREE environmental protection requirements that a mining company must fulfill during its operations?
- A. FPIC certification, Environmental Work Program (EWP), and Mercury-Free Mining Certification
 - B. Environmental Impact Assessment (EIA) and Environmental Clearance Certificate (ECC), Environmental Protection and Enhancement Program (EPEP), and Mine Rehabilitation Fund (MRF)**
 - C. Watershed Buffer Zone compliance, Tailings Pond Inspection Report, and Borax Method Certification
 - D. Annual Tax Filing, Social Development Plan, and Community Resettlement Program

Option 2: BANTAY KALIKASAN: Sustainable Mining Action Plan for the Philippines

You are a team of environmental scientists and policy advocates hired by the Philippine Senate Committee on Environment and Natural Resources. A bill is being deliberated that will determine the future of large-scale mining in a proposed mining site in your assigned province. Your team must prepare and present a SUSTAINABLE MINING ACTION PLAN that evaluates the environmental risks, examines legal compliance requirements, and proposes concrete mitigation strategies, all grounded in science and Philippine law. A 1–2-page written report identifying at least 4 specific environmental impacts (land, water, air, biodiversity) that the proposed mining operation may cause, using correct

scientific terminology (e.g., acid mine drainage, siltation, mercury amalgamation). Each impact must cite a real Philippine case as evidence.

CRITERIA	EXCELLENT (4 pts)	PROFICIENT (3 pts)	DEVELOPING (2 pts)	BEGINNING (1 pt)
Scientific Content Accuracy	Correctly identifies 4+ environmental impacts with scientific terms (AMD, siltation, mercury contamination); data is accurate and sourced	Correctly identifies 3 environmental impacts with mostly accurate scientific terminology	Identifies 2 impacts; some scientific terms are used, but with minor inaccuracies	Identifies 1 or vague impacts; little or no scientific terminology used
Legal Knowledge & Application	Accurately cites 3+ Philippine laws (RA 7942, RA 9275, RA 8749, RA 8371, DAO 2010-21) with specific provisions and penalties applied to real cases	Accurately cites 2–3 laws with correct provisions; minor gaps in penalty details	Cites 1–2 laws; provisions partially accurate; some misapplication to scenarios	Unable to cite relevant laws accurately; legal basis missing or incorrect
Mitigation Strategy Proposal	Proposes 3+ specific, practical, and evidence-based strategies clearly linked to identified impacts and relevant Philippine laws	Proposes 2–3 mitigation strategies; most are specific and linked to impacts	Proposes 1–2 strategies; strategies are general or only loosely connected to impacts	Strategies are vague, unrealistic, or absent
Critical Thinking & Argumentation	Position is well-argued with evidence; addresses counterarguments; demonstrates analysis of the balance between economic development and environmental protection	Position is clear and supported with evidence; limited engagement with opposing views	Position stated, but reasoning is weak or inconsistently supported by evidence	No clear position; argument is absent or unsupported
Presentation & Communication	Organized, clear, and persuasive; uses visual aids effectively; all group members actively contribute and present confidently	Mostly organized and clear; some group members lead the presentation; visual aids are present	Partially organized; some confusion in delivery; uneven group participation	Disorganized or largely read from notes; minimal or one-sided participation
TOTAL SCORE (out of 20 points):				____ / 20

VII. REFLECTION

(Feedback and Continuous Improvement)

This section presents the key highlights and challenges encountered by both teachers and learners throughout the unit. It also includes the teacher's adjustments to improve instruction.

VIII. USE OF GENERATIVE AI

In preparing this Learning Exemplar (LE), the author(s) used Claude.ai to help develop the role-play scenarios, activity descriptions, and assessment components. All legal content was cross-referenced with official texts of Philippine laws (RA 7942, RA 9275, RA 8749, RA 8371, DAO 2010-21). The author(s) reviewed and finalized all content to ensure alignment with DepEd curriculum standards and Grade 11 learner needs. The author(s) take full responsibility for the content of this LE.

Lesson Title/Topic	Rocks and Soils	Lesson Exemplar	12
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I. OBJECTIVES	
A. Content Standard	<p>The learners learn that:</p> <ul style="list-style-type: none"> the rock cycle is a dynamic system that forms, alters, and reforms rocks over geological time; and various environmental factors influence the characteristics of soil.
B. Performance Standard	<p>By the end of the quarter, learners identify, describe, and classify a range of minerals, rocks, and soils using appropriate scientific techniques. They explain the formation and economic significance of the Philippines' earth materials and energy sources, emphasizing the importance of sustainable management of mineral resources. Learners differentiate renewable and non-renewable energy sources and develop campaigns focused on energy conservation and sustainability.</p>
C. Learning Competencies	<p>The learners:</p> <ul style="list-style-type: none"> Explain the rock cycle and its significance in the formation and transformation of rocks, particularly those found in the Philippine archipelago.
II. REFERENCES and MATERIALS (Selecting Resources and Materials)	<p>EliaSchool. "Erosion over Time: 10, 20, and 50 Years of Incredible Transformation! #Erosion #Nature #Timelapse." <i>Www.youtube.com</i>, 17 Dec. 2025, www.youtube.com/shorts/ewQjjip0iD0. Accessed 12 Mar. 2026.</p> <p>Professor Dave Explains. "The Rock Cycle." <i>Www.youtube.com</i>, 10 July 2013, www.youtube.com/watch?v=VByCLpj-I_s. Accessed 13 Nov. 2023.</p> <p>Geological Society of London. "The Rock Cycle." https://www.geolsoc.org.uk/~media/shared/documents/education%20and%20careers/Resources/FactSheets/Rock%20cycle%20factsheet%20draft%20KS2%20v2/Rock%20cycle%20factsheet%20FINAL.pdf</p> <p>OpenAI. ChatGPT (GPT-5.3). Used for idea generation and instructional design support. Content reviewed and validated by the author.</p> <p>Raymundo, J.P. (2026). <i>The Rock Cycle in the Philippines: From Volcanoes to Mountains and Hills</i> (Original instructional material developed by the author).</p>

	Microsoft Copilot, response to the author's prompt to arrange and refine the passage "The Rock Cycle in the Philippines: From Volcanoes to Mountains and Hills," March 2026, Microsoft, https://copilot.microsoft.com	
III. CONTENT <i>(Sequencing Content)</i>	Rocks and Soils	
IV. OBJECTIVES <i>(Setting Clear Objectives and Analyzing the Tasks)</i>	<p>At the end of the session, the learners will be able to:</p> <ul style="list-style-type: none"> • Describe how rocks transform from one type to another through geological processes such as melting, cooling, weathering, erosion, deposition, heat, and pressure. • Demonstrate the formation of: <ul style="list-style-type: none"> ○ igneous rocks through the processes of melting and cooling; ○ sedimentary rocks through weathering, erosion, and deposition; and ○ metamorphic rocks through the processes of heat and pressure. 	
IV. PROCEDURES <i>(Selecting Strategies, Making Meaningful Content, Delivering Lesson and Assessing Learning)</i>	ANNOTATIONS	
A. Activating Prior Knowledge	<p>1. Activating Prior Knowledge Kahoot!</p> <ul style="list-style-type: none"> • The learners will be grouped into 4. They will join a Kahoot link using just one (1) mobile phone. • They are tasked with answering questions about which term matches the given definitions: <ul style="list-style-type: none"> ○ Melting ○ Magma ○ Lava ○ Rocks ○ Sediments <p>2. Establishing the Purpose of the Lesson Option A. Present a video short of erosion on rocks for 15, 25, and 50 years.</p> <p>Link: https://youtube.com/shorts/ewQjjp0iD0?si=S0vaMmuoCVZ-BvUw</p> <p>Option B. Picture analysis</p>	Use this activity to review pre-requisite terms as you see fit. Feel free to change the terms based on the students' needs.



Based on your observations, answer the following guide questions.

Guide Questions:

1. What changes did you observe in the rock surface as water continuously dropped over time (10, 20, and 50 years)?
2. How can small amounts of water cause large changes in rocks and landscapes over a long period of time?

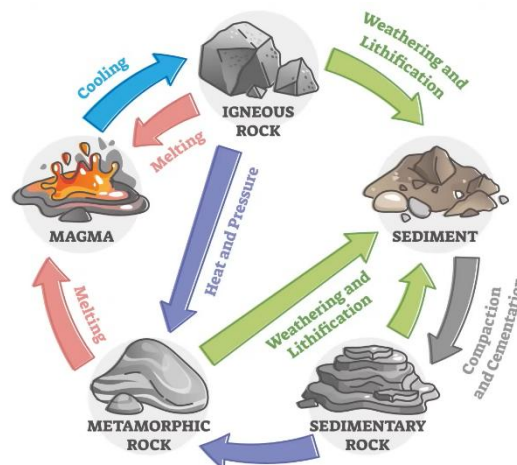
B. Instituting New Knowledge

1. Presenting Examples

Session 1

Activity 1 Guided Diagram Analysis

- The students will study the diagram and define the key terms shown.



	<p>2. Discussing New Concept Activity 2 Video analysis (Rock Cycle Processes)</p> <ul style="list-style-type: none"> - Video link: https://www.youtube.com/watch?v=VByCLpj-I_s&t=76s <p>Guide Questions</p> <ul style="list-style-type: none"> - In the video, how does magma form igneous rocks? - How is this similar to the formation of rocks at Mayon Volcano? - In the video, what happens to sediments after they are transported by water or wind? - How is this similar to the formation of rocks at Boracay Beach? - In the video, how do existing rocks transform into metamorphic rocks? - How is this similar to the formation of marble found in Romblon or Mindoro? <p>3. Developing Mastery Session 2 Demonstrating and describing geological processes involved in rock transformation.</p> <p>Review</p> <ul style="list-style-type: none"> - Review the concepts of the rock cycle from the previous session <p>Laboratory Time</p> <ul style="list-style-type: none"> - The students will conduct experiments to demonstrate the process of weathering and erosion - The students will answer the questions posed on their activity sheets. <p>Experiment 1: Demonstrating Melting and Cooling Materials</p> <ul style="list-style-type: none"> - 2 pieces of 10 ml beaker 	<p>Accomplish the LAS</p> <p>Use the video to validate the information discussed in earlier outputs. This will serve as your main discussion point for the day.</p> <p>Ensure that safety precautions, rules, and regulations are presented prior to conducting experiments.</p>
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	<ul style="list-style-type: none"> - 2 tablespoons of sugar of any type. - Alcohol lamp or candle - Tripod - Match or lighter <p>Procedure</p> <ol style="list-style-type: none"> 1. Setup the alcohol lamp and tripod. 2. Heat 2 tablespoons of sugar in a beaker. Record observations. 3. Allow to cool down and record observations. <p>Guide Questions</p> <ul style="list-style-type: none"> - What happened to the sugar when exposed to heat? - How is this similar to what happens to rocks beneath the Earth's surface? - What changes did you observe after the molten sugar is cooled for some time? - How is this similar to what happens to molten rocks exposed at the Earth's surface? <p>Experiment 2: Demonstrating Weathering, Erosion, and Deposition</p> <p>Materials</p> <ul style="list-style-type: none"> - Clear glass jar with tight lid (~500 mL) - Jagged rock pieces (1 cup / 150–200 g) - Water (250 mL) - Face towel (for safety) - Tray or Tupperware <p>Procedure Part 1</p> <ol style="list-style-type: none"> 1. Place the jagged rock pieces inside the jar. 2. Fill the jar halfway with water. 3. Observe the edges and shapes of the rocks before shaking. 4. Close the lid tightly and wrap the jar with a face towel to ensure safety while shaking. 5. Shake the jar vigorously for 2–5 minutes. 	<p>If laboratory apparatuses are available, use a hotplate, a beaker, and a stirring rod instead of hot water and a container.</p> <p>Safety Precautions</p> <ul style="list-style-type: none"> • Handle flame carefully to avoid burns • Do not touch or taste the sugar during the experiment • Wear basic PPE if available (apron, gloves) <p>NOTE: Conduct the experiment. But the Guide Questions for this procedure will be processed in the next session.</p> <p>Note: Explain how weathering makes the jagged rocks smoother</p>
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	<ul style="list-style-type: none"> - What layers formed at the bottom of the jar? - How does this settling process represent deposition in nature? - How can these layers eventually form sedimentary rocks over time? <p>Experiment 3: Crayon Rocks</p> <p>Materials</p> <ul style="list-style-type: none"> - Crayons (3 colors) - Pencil Sharpener, Knife or Scissors - 3 Small Containers - 2 Aluminum Foils - Flat Iron - Stable Surface - Timer or Watch - Mittens or tongs <p>Procedure for Heat and Pressure Process Inside the Earth</p> <ol style="list-style-type: none"> 1. Remove the paper wrappers from the crayons. 2. Using a knife, cut or shave the crayons into small filings and put each color in separate containers. 3. Prepare two sheets of aluminum foil, about bond paper size. 4. Using your hand, stack the colors in layers in the middle of one foil. 5. On the other foil, mix another set of crayon filings randomly. 6. Observe the appearances of the crayon filings in each foil. 7. Fold each aluminum foils securely to form a compact packet like an envelope. 8. Preheat the flat iron to a low to medium setting. 9. Place the foil packet under the flat iron. 10. Apply gentle, even pressure for about 30–60 seconds. 11. Carefully remove the flat iron. 12. Allow the foils to cool completely for 1–2 minutes. 13. Open each foil and observe the formed rock from side view. 	<p>NOTE: Crayons need to be pressed and soften. DO NOT let the crayons totally melt.</p>
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	<p>Guide Questions</p> <ol style="list-style-type: none"> 1. After opening each foil, what changes did you observe in the crayons after applying heat and pressure? 2. What role did heat play in changing the crayons during the activity? 3. What role did pressure play in changing the crayons during the activity? 4. How do heat and pressure work together to form metamorphic rocks in nature? 	
<p>C. Demonstrating Knowledge and Skills</p>	<p>Session 5</p> <p>1. Finding Practical Application</p> <p>The Philippines is a country rich in diverse geological landscapes shaped by the continuous processes of the rock cycle.</p> <p>Active volcanoes such as Mayon and Taal produce igneous rocks through volcanic eruptions, while unique formations like the Chocolate Hills of Bohol were formed from ancient marine sediments that later consolidated into sedimentary rock. In the Cordillera Mountains of Northern Luzon, intense heat and pressure beneath the Earth's surface have transformed rocks into metamorphic rocks.</p> <p>These natural features show how melting, cooling, weathering, erosion, deposition, and heat and pressure work together to change rocks over time. As young geologists, you are tasked with explaining how these rock transformations occur in different Philippine landforms.</p> <p>The students are expected to construct a Rock Cycle Concept Map that explains how rocks are possibly transformed in their assigned Philippine landform. The students will present their works as a group.</p>	

Rubrics:

	3	2	1
Accuracy of Rock Cycle	All rock types and processes are correct and	Minor errors or missing one part	Many errors or incomplete
Application to Philippine Landform	Clearly explains how the rock cycle occurs in	Some connection to the landform	Weak or no connection
Concept Map Organization	Well-organized, clear flow, easy	Some organization but	Disorganized and hard to
Use of Scientific Group	Uses correct	Uses few correct	Little or no
Presentation	All members participate; explanation is	Some members participate; explanation	Few members present; unclear explanation

2. Making Generalization

Read the passage:

The Rock Cycle in the Philippines: From Volcanoes to Mountains and Hills

In the Philippines, the rock cycle is clearly evident across different landscapes. At Mayon Volcano in Albay, molten magma erupts and cools into igneous rocks like basalt and andesite. Over time, these rocks undergo weathering and erosion, with rivers carrying sediments downhill. These sediments are deposited in valleys and coastal areas, eventually compacting into sedimentary rocks.

A similar process is visible in the Chocolate Hills of Bohol, where ancient marine sediments formed limestone, a sedimentary rock, which was uplifted and weathered into the iconic hills. If limestone is buried deeper underground, heat and pressure can transform it into marble, a metamorphic rock. In the Cordillera Mountains of Northern Luzon, tectonic forces uplift ancient metamorphic rocks, while rivers erode them, depositing new sediments that form fresh sedimentary layers.

Meanwhile, volcanic activity in places like Taal Volcano in Batangas continues to produce igneous rocks, which also enter the cycle through weathering, erosion, and deposition.

	<p>These examples show how rocks in the Philippines continuously transform through melting, cooling, weathering, erosion, deposition, heat, and pressure, completing the rock cycle.</p> <p>Answer the questions provided in the activity sheet</p>	
<p>V. ASSESSMENT (Assessing Learnings)</p>	<p>Read each situation carefully. Answer the questions by choosing the best answer.</p> <p>For Items 1 to 5.</p> <p>After an eruption at Mayon Volcano, molten lava flowed down the slopes and cooled, forming dark igneous rocks. Over time, heavy rainfall and strong winds slowly broke these rocks into smaller fragments. During rainy seasons, rivers carried these fragments down the mountain and deposited them in nearby valleys. Over a long period, sediments piled up in layers and were compressed into sedimentary rocks.</p> <ol style="list-style-type: none"> 1. Which process changed the lava from Mayon Volcano into igneous rock? <ol style="list-style-type: none"> a. <u>Cooling of molten lava on the slopes</u> b. Weathering caused by rainfall c. Erosion by river water d. Deposition in the valley 2. Which of the following will most likely occur if rainfall and wind act over time on the igneous rocks formed on the slopes of Mayon Volcano? <ol style="list-style-type: none"> a. <u>The rocks broke into smaller fragments.</u> b. The rocks melted and became magma again. c. The rocks formed crystal layers underground. d. The rocks immediately became sedimentary rocks. 3. and 4. Which two processes occurred when rivers carried the rock fragments from the mountain to the valley and dropped them there? <ol style="list-style-type: none"> a. cooling b. <u>deposition</u> c. <u>erosion</u> d. heat e. melting f. pressure g. weathering 	

	<p>5. Which explanation shows how the fragments from Mayon Volcano eventually formed sedimentary rocks?</p> <ol style="list-style-type: none"> Rocks melted immediately due to volcanic heat. Lava cooled down into hard rocks → residual sediments melted → magma formed into new sedimentary rocks <u>Igneous rocks weathered → sediments transported and deposited → layers compacted into sedimentary rocks</u> Sediments were melted into higher temperatures → lava formed → lava hardened into rocks → new sedimentary rocks are formed.
VI. REFLECTION <i>(Feedback and Continuous Improvement)</i>	<p><i>This section presents the key highlights and challenges encountered by both teachers and learners throughout the unit. It also includes the teacher's adjustments to improve instruction.</i></p>
VII. USE OF GENERATIVE AI	<p>In preparing this Learning Exemplar (LE), the author(s) used ChatGPT to organize ideas and check basic grammar. Moreover, CoPilot was used to synthesize the author's content to produce a textual passage. The author(s) reviewed and finalized the writing of the content. The author(s) take full responsibility for the content of this LE.</p>

Lesson Title/Topic	Rocks and Soils	Lesson Exemplar	13
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I. OBJECTIVES	
A. Content Standard	<p>The learners learn that:</p> <ul style="list-style-type: none"> the rock cycle is a dynamic system that forms, alters, and reforms rocks over geological time; and various environmental factors influence the characteristics of soil.
B. Performance Standard	<p>By the end of the quarter, learners identify, describe, and classify a range of minerals, rocks, and soils using appropriate scientific techniques. They explain the formation and economic significance of the Philippines' earth materials and energy sources, emphasizing the importance of sustainable management of mineral resources. Learners differentiate renewable and non-renewable energy sources and develop campaigns focused on energy conservation and sustainability.</p>
C. Learning Competencies	<p>The learners:</p> <ul style="list-style-type: none"> Classify rocks into igneous, sedimentary, and metamorphic based on their characteristics and formation, and identify the dominant type of rock in the locality
II. REFERENCES and MATERIALS (Selecting Resources and Materials)	<p>LaFountaine of Knowledge. "Igneous Rocks." <i>YouTube</i>, 13 Feb. 2024, www.youtube.com/watch?v=Vcj9GwCejoM. Accessed 13 Mar. 2026.</p> <p>---. "Sedimentary Rocks." <i>YouTube</i>, 12 Feb. 2024, www.youtube.com/watch?v=XGhtPq1a0qg. Accessed 12 Mar. 2026.</p> <p>---. "Metamorphic Rocks." <i>YouTube</i>, 14 Feb. 2024, www.youtube.com/watch?v=i8sLHWCNPJQ. Accessed 12 Mar. 2026.</p> <p>Geological Society of London. "The Rock Cycle." https://www.geolsoc.org.uk/~media/shared/documents/education%20and%20careers/Resources/FactSheets/Rock%20cycle%20factsheet%20draft%20KS2%20v2/Rock%20cycle%20factsheet%20FINAL.pdf</p> <p>OpenAI. <i>ChatGPT (GPT-5.3)</i>. Conversation with the author about rock cycle lesson design, experiments, and instructional materials. March 11–12, 2026. https://chatgpt.com/c/69b185b3-6474-8398-a87d-80df3c5e19aa</p> <p>Microsoft Copilot, response to the author's prompt to arrange and refine the passage "The Rock Cycle in the Philippines: From Volcanoes to Mountains and Hills," March 2026, Microsoft, https://copilot.microsoft.com</p>

	What will most likely happen if an engineer doesn't have knowledge of what type of rock/s is/are present in the construction site?	Allow students to answer. Encourage students to think about whether they answered correctly or incorrectly.
B. Instituting New Knowledge	<p>1. Presenting Examples</p> <p>Session 1</p> <p>Activity 1: Rock Observation</p> <p>Materials: Magnifying glass, rocks, activity sheet, and rock identification cheat sheet.</p> <p>Procedure</p> <ol style="list-style-type: none"> 1. Group the class into four groups. Each group will receive the following rocks: <div> <p>The image shows six rock samples arranged in two columns. The left column contains Basalt (dark, porous), Diorite (light gray, crystalline), and Limestone (tan, layered). The right column contains Sandstone (orange, granular), Marble (white with gray veins), and Slate (dark gray, flat).</p> </div> <ol style="list-style-type: none"> 2. The learners will observe the igneous rocks according to their color, texture, grain size, layering, and mineral composition. 3. The learners will observe the sedimentary rocks according to their color, texture, grain size, layering, and mineral composition. 4. The learners will observe the metamorphic rocks according to their color, texture, grain size, layering, and mineral composition. 5. Write your answers in the activity sheet provided by your teacher. 	<p>See attachment [Activity_1_Rock_Observation]</p> <p>Note: Use pictures if actual rocks are unavailable. Most rocks are available in the science laboratory.</p> <p>Add other characteristics like color, pore size, fossils, etc. if necessary.</p>

	<p>Guide Questions:</p> <ul style="list-style-type: none"> - Look closely at the surface: what is the specific overall color of each rock (e.g., solid black, red-brown, white with grey veins), and are there variations like speckles or bands? - Examine the feel of the rock: does it feel smooth and polished, or rough and abrasive? - Are there distinct, open pores or visible holes on the surface, or is the rock's mass continuous? - Can you see the individual components (crystals or grains) that make up the rock without a magnifying tool? - Look for the small visible components again: are they interlocked with smooth, flat crystal faces, or are they fragmented pieces (like sand or shells) cemented together? - Does the rock have a coarse-grained texture (visible large grains) or a fine-grained texture (smooth, glass-like, or uniform look with no visible grains)? - Is the rock composed of distinct, parallel sheets or stacked layers, and if so, are they perfectly flat, wavy, or bent? - Based on color and composition: compare Basalt to Marble. What do these differences suggest about the types of elements or minerals present? <p>Session 2</p> <p>2. Discussing New Concept</p> <p>Activity 2: Expert Group Discussion</p> <ol style="list-style-type: none"> 1. The class will be divided into 3 groups. 2. Each group will be presented with a video for each rock type and analyze it. <p>Group 1 – https://www.youtube.com/watch?v=Vcj9GwCejoM</p> <p>Group 2 – https://www.youtube.com/watch?v=XGhtPq1a0qg</p> <p>Group 3 – https://www.youtube.com/watch?v=i8sLHWCNPJQ</p>	<p>NOTE: Allot at least 5 minutes per rotation.</p>
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3. Each group should answer the following questions:
 - How is this rock type formed?
 - What are the observable characteristics of the rock types assigned to you?
 - What are examples of this rock type?
4. After answering, each group organizes its responses using a structured summary table (formation, characteristics, examples).
5. Groups prepare a clear explanation of their assigned rock type for sharing.

Activity 3: Messenger Rotation

1. Each group selects one representative (messenger).
2. The messenger visits another group.
3. The messenger clearly and systematically explains their assigned rock type.
4. The host group listens and asks at least one clarifying question.
5. The host group then shares its own rock type.
6. The messenger records at least one new idea learned from each group visited.
7. The process continues until all groups have shared and received information.

Synthesis

1. All members return to their original group.
2. Each group reviews all the information gathered during the rotation.
3. Groups compare, verify, and refine their answers to ensure accuracy.
4. Using the collected data, the group organizes its ideas into a complete and cohesive explanation of all three rock types.
5. Groups prepare a final summarized output showing:
 - a. Comparison of rock types
 - b. Connection through the rock cycle
 - c. Real-life application
6. Each group presents its final conclusions to the class.

Use pictures if rocks are unavailable. Most rock samples are available in the science laboratory.

Use these photos as a guide



Note: During the synthesis, integrate information to comply with session 3's situation.

	<p>3. Developing Mastery</p> <p>Activity 4: Rock Classification</p> <ul style="list-style-type: none"> - Students will classify rocks based on their characteristics. <p>Procedure:</p> <ol style="list-style-type: none"> 1. The teacher will distribute rock samples (or assign image links if samples are unavailable). 2. Students will use a hand lens to closely observe each rock. 3. For each sample, students will record the following in their worksheet: <ul style="list-style-type: none"> o Color o Texture o Grain size o Presence of crystals or layers o Mineral Composition 4. Students will compare their observations with the provided rock samples or reference images. 5. Based on the observed characteristics, students will classify each rock as: <ul style="list-style-type: none"> o Igneous o Sedimentary o Metamorphic 6. Students will justify their classification. <p>Guide Questions:</p> <ul style="list-style-type: none"> - Why did you classify basalt and diorite as igneous rocks? - Why did you classify limestone and sandstone as sedimentary rocks? - Why did you classify marble and slate as metamorphic rocks? - Why is it important to observe rock characteristics before classifying them? <p>Activity 5: Mystery Rock Description</p>	
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	<ul style="list-style-type: none"> - The teacher reads a description of a rock, then students identify the correct classification. <p>Guide Questions</p> <ul style="list-style-type: none"> - Which characteristics indicate that a rock is igneous? - What characteristic is commonly found in sedimentary rocks? - Which characteristic suggests a rock is metamorphic? - How do these characteristics help you determine the rock type? - Why do different rock types have different observable features? 	
C. Demonstrating Knowledge and Skills	<p>Session 3</p> <p>Situation: The local government plans to build a road and several houses in Morong, Rizal. Before construction begins, engineers and geologists examine the rocks in the area. They need to determine whether the rocks are igneous, sedimentary, or metamorphic because each type has different strengths and uses. Some rocks are strong enough for construction, while others may break easily or dissolve in water. As geology consultants helping engineers decide whether the rocks in the area are suitable for construction and identify the rock type and its suitability.</p> <p>Guide Questions:</p> <ul style="list-style-type: none"> - What rock types might an engineer encounter at a construction site? - Which rock type would likely be strongest for building roads or houses? Why? - Which rock type might be weaker or more easily broken? - Why is it important for engineers to identify the rock type before construction begins? - How can understanding rock characteristics help prevent structural problems in buildings or roads? 	

	<div>2. Making Generalization</div> <div>The students will complete the summary table.</div> <table><tr><th>Rock Type</th><th>Formation Process</th><th>Key Characteristics</th><th>Example</th></tr><tr><td>Igneous</td><td></td><td></td><td></td></tr><tr><td>Sedimentary</td><td></td><td></td><td></td></tr><tr><td>Metamorphic</td><td></td><td></td><td></td></tr></table>	Rock Type	Formation Process	Key Characteristics	Example	Igneous				Sedimentary				Metamorphic				
Rock Type	Formation Process	Key Characteristics	Example															
Igneous																		
Sedimentary																		
Metamorphic																		
<div>V. ASSESSMENT</div> <div>(Assessing Learnings)</div>	<div>Read each situation carefully. Answer the questions by choosing the best answer.</div> <div>For Items 1 to 5.</div> <div>In a community near a river in the Philippines, different rock samples were collected after a flood. Scientists analyzed the rocks and described them as follows:</div> <table><tr><th>Rock Sample</th><th>Description</th></tr><tr><td>Rock A</td><td>Dark-colored rock with visible crystals formed when magma cooled slowly underground</td></tr><tr><td>Rock B</td><td>Rock with visible layers formed from compacted sand and sediments</td></tr><tr><td>Rock C</td><td>Rock with shiny mineral bands formed when heat and pressure changed an existing rock</td></tr></table> <div><div>1. After the flood, which rock sample likely came from areas where sediments were deposited over time?</div><div><div>a. Rock A</div><div>b. <u>Rock B</u></div><div>c. Rock C</div><div>d. Rock B and C</div></div><div>2. A construction worker found a rock formed from cooled magma beneath the Earth’s surface. Which sample is this?</div><div><div>a. <u>Rock A</u></div><div>b. Rock B</div><div>c. Rock C</div></div></div>	Rock Sample	Description	Rock A	Dark-colored rock with visible crystals formed when magma cooled slowly underground	Rock B	Rock with visible layers formed from compacted sand and sediments	Rock C	Rock with shiny mineral bands formed when heat and pressure changed an existing rock									
Rock Sample	Description																	
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	<p>d. Rock B and C</p> <p>3. Which classification correctly identifies the rock types found in the area?</p> <ol style="list-style-type: none"> A–Sedimentary, B–Igneous, C–Metamorphic <u>A–Igneous, B–Sedimentary, C–Metamorphic</u> A–Metamorphic, B–Sedimentary, C–Igneous A–Igneous, B–Metamorphic, C–Sedimentary <p>4. Farmers observed that Rock B is common in riverbanks after flooding. Why does this rock have visible layers?</p> <ol style="list-style-type: none"> Minerals melted inside the Earth. Heat changed the rock's structure by melting it. <u>Sediments were deposited and compacted over time.</u> Magma cooled quickly and hardened, producing a lustrous texture. <p>5. If Rock B is buried deep underground due to tectonic movement, what will most likely happen over millions of years?</p> <ol style="list-style-type: none"> It will remain unchanged It will break into smaller sediments <u>It will transform into metamorphic rock</u> It will melt and become magma immediately
<p>VI. REFLECTION (Feedback and Continuous Improvement)</p>	<p><i>This section presents the key highlights and challenges encountered by both teachers and learners throughout the unit. It also includes the teacher's adjustments to improve instruction.</i></p>
<p>VII. USE OF GENERATIVE AI</p>	<p>In preparing this Learning Exemplar (LE), the author(s) used ChatGPT to organize ideas and check basic grammar. Moreover, CoPilot was used to synthesize the author's content to produce a textual passage. The author(s) reviewed and finalized the writing of the content. The author(s) take full responsibility for the content of this LE.</p>

Lesson Title/Topic	Characteristics, Formation, and Profile of the Types of Soil in the Philippines	Lesson Exemplar	14
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I. OBJECTIVES	
A. Content Standard	The learners learn that various environmental factors influence the characteristics of soil.
B. Performance Standard	By the end of the quarter, learners identify, describe, and classify a range of minerals, rocks, and soils using appropriate scientific techniques. They explain the formation and economic significance of the Philippines' earth materials and energy sources, emphasizing the importance of sustainable mineral resource management. Learners differentiate renewable and non-renewable energy sources and develop campaigns focused on energy conservation and sustainability.
C. Learning Competencies	<i>The learners:</i> Describe the characteristics, formation, and profile of the types of soil in the Philippines, in particular, what is found in the locality.
II. REFERENCES and MATERIALS	<ul style="list-style-type: none"> Ias, Pmf. "Soil Types: Sandy, Clayey & Loamy Soil Profile (Soil Horizon)." PMF IAS, February 28, 2018. https://www.pmfias.com/soil-profile-soil-horizon-soil-types-sandy-clayey-loamy/. Peekaboo Kidz. "Layers of Soil - the Dr. Binocs Show Best Learning Videos for Kids Peekaboo Kidz," December 8, 2017. https://www.youtube.com/watch?v=bgqea0E2eAY. Soil Science Society of America. "Soil Types Soils 4 Teachers," n.d. https://www.soils4teachers.org/soil-types/. Soil Science Society of America. "Soil Horizons Soils 4 Teachers," n.d. https://www.soils4teachers.org/soil-horizons/. Soil Science Society of America. "Characteristics of Different Soils," n.d. https://ahdb.org.uk/knowledge-library/characteristics-of-different-soils. Soil Science Society of America. "Formation Soils 4 Teachers," n.d. https://www.soils4teachers.org/formation/.
III. CONTENT	Characteristics, Formation, and Profile of the Types of Soil in the Philippines
IV. OBJECTIVES	At the end of the sessions in this lesson exemplar, Grade 12 learners are expected to: <ol style="list-style-type: none"> 1. Identify the characteristics, formation, and profiles of the types of soil in the Philippines, in particular those found in the locality. 2. Describe the characteristics, formation, and profile of the types of soil in the Philippines, in particular, what is found in the locality.
V. PROCEDURES	ANNOTATIONS

<p>A. Activating Prior Knowledge</p>	<p>SESSION 1 1. Activating Prior Knowledge</p> <p>Activity 1: SOIL OF THE EARTH! (The Apple as Earth Demo)</p> <p>Objective: <i>To recognize that soil is only a very thin layer of the Earth and understand its importance for supporting life and plant growth.</i></p> <p>Materials:</p> <ul style="list-style-type: none"> • 1 apple (per student or per pair if materials are limited) • plastic knife • plate or tissue <p>Procedures:</p> <ol style="list-style-type: none"> 1. Ask the learners to prepare their apple while you demonstrate the steps in front of the class. 2. Show the apple and explain that the apple represents the Earth. 3. Instruct the learners to cut the apple into four equal parts, following your demonstration. Explain that three-fourths of the Earth is covered by water, while only one-fourth is land. 4. Ask learners to set aside three slices and keep one to represent the land portion of Earth. 5. Tell the learners to cut the remaining slice into four parts again, following you. Explain that much of the land is covered by mountains, deserts, forests, and cities, leaving only a small portion suitable for growing food. 6. Instruct the learners to carefully slice a very thin layer of peel from the remaining piece. Explain that this thin layer represents the soil where plants grow. 7. Ask learners to observe the thin peel and compare it to the whole apple. <p>Guide Questions:</p> <ol style="list-style-type: none"> 1. Why do you think the soil layer is so thin compared to the rest of the Earth? 2. What would happen to plants and food production if this thin layer of soil were removed or damaged? 	<p>Activity 1: SOIL OF THE EARTH! (The Apple as Earth Demo)</p> <p>Instruction to the Teacher: <i>The teacher will demonstrate the apple activity, guiding learners through the steps and reminding them about knife safety. Learners may perform the activity individually, in pairs, or simply observe the demonstration if materials are limited. The teacher will facilitate the discussion using the guide questions to help learners reflect on the thinness and importance of the soil layer.</i></p> <p>Application of the IDF: <i>This activity applies the Instructional Design Framework (IDF) by activating prior knowledge through a concrete demonstration. It helps learners visualize that soil is only a thin layer of the Earth while highlighting its importance in supporting life, preparing them for deeper discussion in the succeeding activities.</i></p> <p>Note:</p> <ul style="list-style-type: none"> • Before starting the demonstration, present
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3. Based on this, why do you think soil is considered an important natural resource?

Say: From this demonstration, we can see that the soil layer on Earth is very thin compared to the entire planet. Even though it is a small part of the Earth, it plays a very important role in supporting life, providing a place for plants to grow and for us to produce food. Because soil is limited and essential, it is important for us to understand its characteristics, how it forms, and the different types we can find in our surroundings. In the next activity, we will explore the soils in our locality more closely and learn why knowing about soil is important for everyday life, agriculture, and caring for our environment.

2. Establishing the Purpose of the Lesson

Activity 2: DIG IT!

Materials:

- Soil samples: (sandy, silty, clayey, loam)

Note: Do not label the soil.

Procedures:

1. Group the class into small groups.
2. Provide each group with different soil samples.
3. Ask learners to observe each soil sample and record their observations on the table below.

Type of Soil	OBSERVATIONS
Soil 1	
Soil 2	
Soil 3	
Soil 4	

4. Ask learners to present their observations and answers in the guide questions.

Guide Questions:

1. What differences did you observe among the soil samples?
2. Based on your observations, which soil do you think would be good for growing plants? Why?

safety reminders, especially regarding knife handling.

- You may choose to demonstrate it yourself while the students observe.
- To contextualize the activity, you may use other fruits in the locality that share the same description as an apple, like guava, katmon, and the like.

Note: The next activity will help learners understand the learning goals and recognize the relevance and real-life applications of the new lesson. Learners will explore different soil samples to connect their previous knowledge to the present lesson.

Activity 2: DIG IT!

Instruction to the Teacher:

The teacher will divide the class into small groups and provide each group with unlabeled soil samples. Learners will observe the texture and characteristics of

	<p>3. Why do you think soils are different from one another? 4. Where in your community do you think these soils might be found?</p> <p>Note: After their presentation, encourage learners to show curiosity and emphasize that the answers to the guide questions will be discussed in the succeeding sessions.</p> <p><i>Say: Thank you for your observations and presentations! From the activity, we observed that soil samples have different characteristics. Some feel rough, some are smooth, and others feel sticky. These differences tell us that soils are not the same everywhere, depending on one's locality. You also raised interesting ideas about where these soils might be found and which ones are good for growing plants. However, there are still many questions that we need to explore. Why do these soils have different characteristics? How are these different types of soil formed? And what does the inside of the soil look like beneath the surface? In the next sessions, we will investigate these questions further. We will learn about the different types of soil found in our locality, the factors and processes involved in their formation, and the layers that make up the soil profile.</i></p> <p>Note: Present the lesson and the learning objectives.</p>	<p><i>the soils and record their observations. The teacher will facilitate the sharing of responses and guide the discussion using the guide questions to stimulate curiosity about soil differences.</i></p> <p>Application of the IDF: <i>This activity applies the Instructional Design Framework (IDF) by establishing the purpose of the lesson. Through hands-on observation, learners recognize that soils have different characteristics and begin to connect these observations to real-life situations in their community.</i></p>
<p>B. Instituting New Knowledge</p>	<p>SESSION 2 1. Presenting Examples</p> <p>Note: You may start by presenting the characteristics of the soil types in the locality to introduce the new concept (concept 1). Activity 3 is the continuation of Activity 2, only this time, it is more in-depth and specific. The activity will allow learners to identify and describe the characteristics of each soil type before you formally explain the concepts.</p> <p>Activity 3: UN-EARTHING SOIL'S SECRETS! Objective: <i>To identify and describe the characteristics of different types of soil.</i> Materials:</p>	<p>Activity 3: UN-EARTHING SOIL'S SECRETS!</p> <p>Instruction to the Teacher: <i>The teacher will guide the learners in performing a hands-on investigation of different soil samples. Learners will observe and test the soils by examining particle size, texture, and water retention through simple procedures. The teacher will facilitate group presentations,</i></p>

	<ul style="list-style-type: none"> • soil samples (loamy, sandy, clayey, silty) • clear plastic cups or small containers • water droppers or spoons • ruler • hand lens/magnifying glass (optional) • observation worksheet <p>Procedures:</p> <ol style="list-style-type: none"> 1. Group the class into four groups. 2. Provide each group with each of the soil samples. 3. Ask the learners to observe each soil sample carefully. They should determine particle size, texture (gritty, smooth, or sticky), and moisture retention. 4. Let the learners perform a simple water test. <ul style="list-style-type: none"> • <u>Determining Particle Size</u> <ol style="list-style-type: none"> 1. Place a small amount of dry soil sample (about 1–2 teaspoons) on a plate or in a clear cup. 2. Observe the particles carefully and compare each with the others. 3. Use a hand lens or magnifying glass if needed to see fine differences. You may also use the ruler to validate your comparison. • <u>Determining Texture</u> <ol style="list-style-type: none"> 1. Take a small pinch of soil and add a few drops of water at a time. 2. Rub the soil gently between your fingers. Is it gritty? Smooth? Sticky? Balanced texture? 3. Observe how the soil sticks together or crumbles. • <u>Determining Water Retention</u> <p>Setup:</p> <ol style="list-style-type: none"> 1. Use a clear cup with a small hole at the bottom. 2. Each cup should have a pre-determined amount of soil (e.g., 50 g) to ensure consistency. 3. Use a pre-determined amount of water (e.g., 20 mL) for each test. <p>Steps:</p> <ol style="list-style-type: none"> 1. Place one soil sample inside the cup. 2. Slowly pour the pre-measured amount of water into the soil. 3. Observe whether water passes through the hole. Does it pass quickly, moderately, slowly, or barely? 5. Record their observations on the table below: 	<p><i>validate the learners' observations, and clarify the characteristics of sandy, silty, clayey, and loamy soils. In the following session, learners will repeat the activity using soil samples collected from their community to connect the lesson with real-life contexts.</i></p> <p>Application of the IDF: <i>This activity applies the Instructional Design Framework (IDF) by engaging learners in inquiry-based exploration. Through observation, testing, and analysis, learners actively construct their understanding of soil characteristics. The activity also promotes contextualized learning as students examine soil samples from their localities, helping them relate scientific concepts to their environments and everyday experiences.</i></p>
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Soil samples	Particle Size	Texture	Water Retention	Possible Soil Type
Soil A				
Soil B				
Soil C				
Soil D				

6. After completing the observations, ask each group to name the possible type of soil, present their findings, and answer the given guide questions.

Guide Questions:

1. Which soil has the largest particles?
2. Which soil sample feels smooth or gritty?
3. Which soil sample becomes sticky when wet?
4. Which soil seems to absorb water quickly?
5. Which soil appears to be a mixture of different particles?
6. Based on your observations, how would you describe the characteristics of each type of soil?

Note: You may provide the students the table below after they conduct all the tests to guide them in completing the table provided to them. After the presentation of the groups, process their answers and provide feedback.

Say: Thank you for your observations and presentations! You did a great job examining the different soil samples and describing their characteristics based on what you saw and felt. Let us now look at the table summarizing the characteristics of the different types of soil.

Type of Soil	Particle Size	Texture	Water reaction
Sandy	Largest particles (0.06 – 2 mm)	Gritty with large air spaces between them	Water drains quickly
Silty	Medium-sized particles (.002 - .06 mm)	Smooth and soft to the touch	Holds more moisture than sand

	Clayey	Smallest particles (less than .002 mm)	Sticky when wet, hard when dry	Water moves slowly
	Loam	Varied particle sizes since it is a balanced mixture of sand, silt, and clay (roughly 40% sand, 40% silt, and 20% clay)	Balanced texture	Good water retention
<p>Source: Bennett, A. (2024). <i>Characteristics of different soils</i> AHDB. Ahdb.org.uk. https://ahdb.org.uk/knowledge-library/characteristics-of-different-soils</p> <p>Note: End the session by reminding students to bring soil samples from their community to use in the activity the next day.</p> <p>SESSION 3</p> <p>Note: Repeat Activity 3 in the previous session. This time, the students will use the soil samples they collected in their community. You may group students by residence/address, since they likely have the same soil samples.</p> <p>After the activity, ask the following processing questions:</p> <ol style="list-style-type: none"> 1. Based on your observations, which type of soil do you think your sample represents? 2. Did other groups observe similar characteristics in their samples? 3. Considering all the soil samples presented, which do you think is the most common type of soil found in your locality? 4. What are the main characteristics of this common soil type? 5. How would you describe this soil in terms of particle size, texture, and water retention? <p><i>Say: Thank you for your observations and presentations. By examining soil samples from your community, you identified their characteristics</i></p>				

based on particle size, texture, and water retention. From the results shared by each group, we noticed that many samples showed similar properties, which helped us identify the most common soil type in our locality. Understanding these characteristics is important because soil type in an area affects plant growth, agriculture, and how water moves through the land.

SESSION 4

2. Discussing New Concept

Activity 4: GROUND-BREAKING!

Objective: To identify and describe the factors involved in the formation of different types of soil found in the locality.

Materials:

- Printed pictures/illustrations of the following:
 - ✓ Solid rock (representing the parent material)
 - ✓ Broken/cracked rock
 - ✓ Small rock fragments
 - ✓ Soil in a pot with plants growing
 - ✓ Hourglass (representing time)
 - ✓ A side-by-side image of a rainy forest and a dry desert (representing climate)
 - ✓ An image of a hill showing thin soil at the top and thicker soil accumulating at the bottom (representing relief)
 - ✓ An image of plant roots, earthworms, and microorganisms in the soil.

Procedures:

1. Group the class into small groups.
2. Distribute the printed pictures to each group in mixed order.

Task 1: Arrange the Soil Formation Sequence

1. Ask learners to arrange the pictures showing how soil forms from rock to fully developed soil.
2. Encourage discussion within the group about the order and why they arranged it that way.

Task 2: Identify the Factors of Soil Formation

1. After arranging the sequence, ask learners to examine the remaining pictures and identify them.

Activity 4: GROUND-BREAKING!

Instruction to the Teacher:

The teacher will distribute the mixed pictures to each group and facilitate the activities on soil formation. Learners will first arrange the pictures to show the sequence of soil development, then identify and explain the factors of soil formation. The teacher will guide the discussion using the provided questions, clarify misconceptions, and ensure each group presents their sequence and explanations clearly.

Application of the IDF:

This activity applies the Instructional Design Framework (IDF) by introducing and developing the new concept of soil formation through sequencing and analysis. It promotes

	<p>2. Prompt them to identify what each picture represents first, then describe how it contributes to soil formation.</p> <p><u>Task 3: Group Presentation</u></p> <ol style="list-style-type: none"> 1. Each group presents: <ol style="list-style-type: none"> a. The sequence of soil formation b. What each picture of the factor represents c. How the factor influences soil formation <p>Guide Questions:</p> <p>Task 1</p> <ol style="list-style-type: none"> 1. What do you think this picture shows? 2. What details help you identify it? <p>Task 2</p> <ol style="list-style-type: none"> 1. How might each factor contribute to soil formation? 2. How does each influence how quickly soil forms or the type of soil? 3. How might each factor interact with other factors over time? <p>Task 3</p> <ol style="list-style-type: none"> 4. Looking at all the pictures together, what pattern or sequence do you notice in soil formation? 5. Which factors seem to work together to create different types of soil in an area? 6. How do these factors explain why soils differ from one place to another? <p>Say: <i>Excellent work, everyone! From arranging the pictures and analyzing the factors, you've seen how soil forms from rocks and how climate, organisms, relief, parent material, and time all interact to shape soil. These processes do not just create soil; over time, they form distinct layers within the soil, each with unique properties. In our next lesson, we will explore the soil profile, examining its layers and learning how they reveal the soil's history, composition, and suitability for plants.</i></p> <p>Source: "Formation Soils 4 Teachers," n.d. https://www.soils4teachers.org/formation/.</p> <p>Note: Check Attachment 1 for the suggested answers to the guide questions via this link:</p>	<p><i>collaborative learning and critical thinking as students examine how parent material, climate, organisms, relief, and time interact to form soil, preparing them for the next lesson on soil profile.</i></p>
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	<p>https://drive.google.com/file/d/19dFPHe7pmHddoXm-Qe8lCR0ydpwUGdJ1/view?usp=sharing</p> <p>SESSION 5</p> <p>3. Developing Mastery</p> <p>Activity 5: HORIZON HUNTERS!</p> <p>Objective: <i>Identify and describe the soil profile of different types of soil found in the locality.</i></p> <p>Materials:</p> <ul style="list-style-type: none"> • Option 1: Soil profile video • Option 2: Soil profile infographic/diagram • Option 3: Text handout describing soil horizons <p>Note: Please check Attachment 2 to access the materials via this link: https://drive.google.com/file/d/1IxK7NB48C0zd0y0jJ-PT02tIM-Ona0Z/view?usp=drive_link. The materials are deliberately varied to provide multiple means of representation in line with the Universal Design for Learning (UDL).</p> <p>Procedures:</p> <ol style="list-style-type: none"> 1. Students self-select which material they prefer (video, infographic, or text). 2. Groups study their material and complete the observation worksheet: record horizon, color, texture, organic matter, and notes. 3. Students discuss differences between layers and any unique observations. 4. Each group presents findings to the class. The teacher facilitates a discussion to compare representations and introduce horizon terminology (O, A, E, B, C). 5. The class identifies key characteristics of soil profiles and relates observations to soils in their localities. <p>Guide Questions:</p> <ol style="list-style-type: none"> 1. How many layers (horizons) can you identify? 2. Which layer has the most organic matter? 3. Which layer contains mostly minerals or parent material? 	<p>Activity 5: HORIZON HUNTERS!</p> <p>Instruction to the Teacher: <i>The teacher will allow students to self-select their learning material (video, infographic, or text) and guide them in analyzing their assigned resource. Learners will complete the observation worksheet and discuss their findings within their groups. The teacher will facilitate presentations, compare the different representations, and introduce the correct soil horizon terminology (O, A, E, B, C, and R), ensuring understanding of each layer's characteristics and function.</i></p> <p>Application of the IDF: <i>This activity applies the Instructional Design Framework (IDF) by developing mastery of the lesson through varied instructional materials aligned with Universal Design for Learning (UDL). It strengthens understanding of soil profiles</i></p>
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	<p>4. How do the layers differ in color, texture, and content? 5. How might these layers affect plant growth or water movement? 6. Based on your material and discussion, how would you describe the soil profile of your community (based on their findings in SESSION 3)?</p> <p><i>Say: Great work, everyone! From your observations and discussions, we can see that soil consists of distinct layers, or horizons, each with its own characteristics. The O horizon contains mostly organic matter like decomposing leaves, the A horizon is rich in minerals mixed with organic material, and the B horizon collects minerals leached from above. Some soils also have an E horizon that is lighter due to leaching, while the C horizon represents the parent material, and the R horizon is the underlying bedrock. Each layer plays an important role in supporting plants, retaining water, and cycling nutrients. By comparing different materials and relating them to soil samples in our locality, we can see that soil profiles vary depending on how the soil formed, yet every layer contributes to the soil's health and fertility.</i></p> <p>(Soil Horizons Soils 4 Teachers," n.d. https://www.soils4teachers.org/soil-horizons/.)</p>	<p><i>by allowing learners to analyze, compare, and describe soil horizons, reinforcing key concepts and deepening their comprehension of soil structure and its importance.</i></p>
<p>C. Demonstrating Knowledge and Skills</p>	<p>SESSION 6: 1. Finding Practical Application GRASP Activity: MISSION: SOIL POSSIBLE! Objective: <i>To create a 3D soil horizon model showing O, A, B, and C layers, and describe each layer's composition, function, and formation.</i></p> <p>G – Goal: Construct a 3D soil profile using materials and label each layer with composition, function, and formation process.</p> <p>R – Role: You are Soil Scientists tasked with investigating and representing the layers beneath the surface in a clear, educational model.</p> <p>A – Audience: Classmates and the teacher, who will evaluate the accuracy, clarity, and real-world relevance of your model.</p> <p>S – Situation: You are helping farmers and students understand soil horizons.</p>	<p>Instruction to the Teacher: <i>The teacher will introduce and explain the GRASP task clearly, ensuring students understand the goal, roles, situation, and expected product. Learners will work in groups to create a 3D soil horizon model using the provided materials. The teacher will guide, monitor progress, clarify questions, and ensure that each model includes correct layer representation (O, A, B, C) with proper labels showing composition, function, and formation. After completion,</i></p>

Create a model using materials to illustrate the different layers and explain how each supports plant growth and soil health.

P – Product / Performance:

- 3D model of soil horizons (O, A, B, C)
- Labels for each layer with composition, function, and formation

Materials: Containers/boxes, sand, clay, soil, compost, pebbles, leaves, glue (optional), labels, markers

Procedures:

1. Observe real soil samples to understand textures and colors.
2. Decide which materials represent each layer:
 - O – Organic matter (leaves, compost)
 - A – Topsoil (fertile soil)
 - B – Subsoil (clay, minerals)
 - C – Weathered rock (pebbles, coarse sand)
3. Build the model layer by layer.
4. Label each layer with composition, function, and formation process.
5. Present and explain your model to classmates.

Rubric:

Criteria	Excellent	Good	Satisfactory	Needs Improvement
Accuracy of layers	All 4 correct	3 correct	2 correct	1 or none correct
Material representation	Realistic and clear	Mostly realistic	Somewhat realistic	Not realistic
Explanation/ labels	Detailed & clear	Mostly clear	Basic explanation	Missing/unclear
Creativity & presentation	Neat & visually appealing	Clear & neat	Basic	Messy/incomplete
Real-world connection	Strong link	Some link	Minimal link	No link

2. Making Generalization

Note: Choose any of the options below to generalize the lesson.

groups will present and explain their models based on the rubric.

Application of the IDF:

This activity applies the Instructional Design Framework (IDF) by providing a practical learning experience through performance-based output. Learners demonstrate understanding of soil horizons by constructing and explaining a real-world model, integrating knowledge of soil composition, function, and formation while strengthening critical thinking, creativity, and real-life connections.

Option 1:**KWLA Chart (Know – Want – Learned – Apply)**

Instructions for Students:

1. **K (Know):** Write what you already know about soil types, formation, and layers in the Philippines and in your locality.
2. **W (Want to know):** Write questions or things you want to learn about soil (e.g., why some soils retain water more than others).
3. **L (Learned):** After the lesson and activities, write key facts, observations, or concepts you learned.
4. **A (Apply):** Think about how you can use this knowledge in real life (farming, gardening, landscaping, environmental projects).

Teacher Guidance:

- Collect and review the KWLA charts at the end for formative assessment.
- Encourage specific, evidence-based answers in the “Learned” and “Apply” columns.
- Prompt SHS students to think critically: “How does this help in actual farming or environmental planning?”

Option 2:**Think-Pair-Share**

Materials: Notebook/worksheet, pen

Steps:

1. Think (3 min): Ask students to individually list soil types they have seen and note differences in color, texture, and fertility.
2. Pair (4 min): They will share their observations with a partner and discuss which soils are best for farming, gardening, or other uses.
3. Share (5 min): Each pair presents one key insight; the teacher records patterns under Soil Types, Formation Factors, and Soil Layers.

Note: Before closing the lesson, revisit the APPLE-AS-EARTH activity to help learners connect the concept of Earth’s thin soil layer with soil types, formation, and horizons discussed in the lesson. Ask learners to reflect on how the activity illustrates the importance, the limited nature, and the role of soil in supporting life, and use this reflection to reinforce their understanding as a final synthesis.

	<p>Ask this:</p> <p>1. How do soil types, soil layers, soil formation, and soil erosion together help explain why soil is limited and important, as shown in the APPLE-AS-EARTH activity?</p>	
<p>V. ASSESSMENT (Assessing Learnings)</p>	<p>Summative Assessment – Soil Types, Formation, and Profile</p> <p>Option 1: Paper and Pencil Test</p> <p>Test I. Knowledge Check (1 point each)</p> <p>Instruction: Read each item carefully and choose the letter of the best answer.</p> <ol style="list-style-type: none"> Which soil type has the largest particles and drains water quickly? a. Clayey b. Loamy c. Sandy d. Silty Which soil type feels smooth and holds more moisture than sand? a. Clayey b. Loamy c. Sandy d. Silty Which soil type becomes sticky when wet and hard when dry? a. Sandy b. Clayey c. Loamy d. Silty Which soil type has a balanced mixture of sand, silt, and clay? a. Loam b. Clayey c. Sandy d. Silty Which soil horizon contains mostly organic matter, like decomposing leaves? a. O Horizon b. A Horizon c. B Horizon d. C Horizon Which horizon is rich in minerals leached from above and forms subsoil? a. O Horizon b. A Horizon c. B Horizon d. C Horizon Which horizon contains the topsoil with a mixture of minerals and organic matter? a. O Horizon b. A Horizon c. B Horizon d. C Horizon Which horizon is the unweathered parent material? a. O Horizon b. A Horizon c. B Horizon d. C Horizon Which factor influences the speed of soil formation by providing moisture and temperature? a. Relief b. Climate c. Organisms d. Parent Material Which factor enriches soil by breaking down rocks and adding organic matter? a. Climate b. Organisms c. Relief d. Parent Material <p>Test II. Understanding Check (1 point each)</p> <ol style="list-style-type: none"> Why does clayey soil absorb water slowly? a. Contains mostly sand b. Has no organic matter c. Large particles prevent water retention d. Small particles are tightly packed Which soil horizon would most affect plant root growth? a. O Horizon b. A Horizon c. B Horizon d. C Horizon How does the relief (landscape) affect soil accumulation? a. Soil color changes only 	

- b. Soil is uniform everywhere
 - c. Soil does not form on slopes
 - d. Soil is deeper at the bottom of slopes**
14. Why is loamy soil ideal for farming?
- a. It drains too quickly
 - b. It is sticky when wet
 - c. It has a balanced texture and nutrient content**
 - d. It contains only sand that has bigger particles
15. What role does the O horizon play in soil?
- a. It stores minerals from the parent material
 - b. It provides organic matter and nutrients**
 - c. It forms bedrock underlying surface soil and loose materials
 - d. It prevents water movement, hence sustaining water retention
16. Why do soils differ from one place to another?
- a. Due to the same climate everywhere
 - b. Due to the same environmental patterns
 - c. Due to differences of types of landforms present
 - d. Due to differences in climate and other factors**
17. How might older soils differ from younger soils?
- a. Older soils have fewer available minerals
 - b. Older soils cannot support plant growth
 - c. Older soils are less developed with fewer layers
 - d. Older soils are more developed with distinct layers**
18. How does the B horizon get its minerals?
- a. Minerals leached from upper horizons**
 - b. Minerals from the underlying bedrock
 - c. Minerals from decomposed organic matter
 - d. Minerals added by rainfall and water movement
19. Why is the A horizon important for plants?
- a. It contains mostly rocks and coarse material
 - b. It is rich in minerals and organic matter**
 - c. It prevents water from reaching lower layers
 - d. It consists mainly of the underlying bedrock
20. How do organisms influence soil formation?
- a. They have little or no effect on soil
 - b. They only change the color of the soil
 - c. They only move soil particles downhill
 - d. They break down rocks and add organic matter**

Option 2: Authentic Assessment :**Soil Exhibit – “Soil Safari!”**

Instruction:

1. Divide the class into small groups and assign each group the task of collecting soil samples from their localities (e.g., sandy, clayey, silty, loamy).
2. Instruct each group to prepare a display for each soil sample showing:
 - Soil profile (layers/horizons: O, A, E, B, C)
 - Color, texture, organic matter, water retention, and other distinguishing characteristics
 - Factors influencing soil formation (climate, organisms, relief, parent material, time)
3. Guide students to create clear, informative labels for each soil type and profile.
4. Have each group present their soil exhibit to the class or invited spectators and explain:
 - How the soil was formed
 - Its characteristics
 - Its horizon profile and function
5. During the presentations, prompt students to answer questions from classmates and spectators. Encourage discussion and connections to local soil conditions.
6. Use the provided rubric to evaluate soil identification, description, presentation, visual clarity, and connection to the local environment.

Criteria	Excellent (10)	Good (8)	Satisfactory (6)	Needs Improvement (4)
Soil Identification (Objective 1)	Correctly identifies all collected soil types and their origins	Identifies most soil types accurately	Some soil types are correctly identified	Many soil types are misidentified or missing
Soil Description (Objective 2)	Thoroughly describes all characteristics, horizons, and formation factors	Describes most characteristics and horizons accurately	Partial descriptions; some missing details	Limited or inaccurate descriptions
Exhibit Presentation	Clear, engaging, confident; explains all soil profiles to spectators	Mostly clear and confident; minor omissions	Basic presentation; lacks clarity	Poor explanation; unengaging
Visual & Informative Display	Display is neat, organized, and visually appealing; all labels and information are clear	Mostly organized; minor missing labels	Some organization labels are incomplete	Disorganized; labels unclear or missing
Connection to Local Context	Accurate, insightful links between soil and the local environment	Mostly accurate	Limited connection	No connection or incorrect

VI. REFLECTION

This section presents the key highlights and challenges encountered by both teachers and learners throughout the unit. It also includes the teacher's adjustments to improve instruction.

VII. USE OF GENERATIVE AI

In preparing this Learning Exemplar (LE), the author used ChatGPT (GPT-5 Mini) to refine ideas in crafting learning activities and guide questions, including checking grammar and improving sentence structure. The author reviewed and finalized the content. The author takes full responsibility for the content of this LE.

Lesson Title/Topic	Human Activities that Affect the Soil	Lesson Exemplar	15
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I. OBJECTIVES		
A. Content Standard	The learners learn that various environmental factors influence the characteristics of soil.	
B. Performance Standard	By the end of the quarter, learners identify, describe, and classify a range of minerals, rocks, and soils using appropriate scientific techniques. They explain the formation and economic significance of the Philippines' earth materials and energy sources, emphasizing the importance of sustainable mineral resource management. Learners differentiate renewable and non-renewable energy sources and develop campaigns focused on energy conservation and sustainability.	
C. Learning Competencies	<i>The learners:</i> Identify human activities that affect the soil.	
II. REFERENCES and MATERIALS	<ul style="list-style-type: none"> • Bryner, Jeanna. "Philippines' Mayon Volcano Shoots Out Lava Fountains, Violent Eruption Imminent." <i>Live Science</i>, January 24, 2018. https://www.livescience.com/61487-mayon-volcano-imminent-eruption.html. • Buxbaum, Marisa. "Chemical Fertilizer Issues & Bull; Insteading." <i>Insteading</i>, October 5, 2020. https://insteading.com/blog/chemical-fertilizers/. • Gilberto Lauengco, "Saving the Dying Soil Beneath Us," <i>Philippine News Agency</i>, June 28, 2023, https://www.pna.gov.ph/index.php/opinion/pieces/711-saving-the-dying-soil-beneath-us • Ralls, Eric. "What Is Rain?" <i>Earth.Com</i>, August 6, 2024. https://www.earth.com/earthpedia-articles/rain/. 	
	Soil Science Society of America. "Human Soil Interactions Soils 4 Teachers," n.d. https://www.soils4teachers.org/human-soil-interactions/ .	
III. CONTENT	Human Activities that Affect the Soil	
IV. OBJECTIVES	At the end of the sessions in this lesson exemplar, Grade 12 learners are expected to: <ol style="list-style-type: none"> 1. Identify human activities that affect the soil. 	
V. PROCEDURES	ANNOTATIONS	
A. Activating Prior Knowledge	Activity 1: Soil Mystery Box Objective: <i>To review concepts of soil characteristics, soil formation, and soil profile.</i> Materials:	Activity 1: Soil Mystery Box Instruction to the Teacher: <i>The teacher will prepare the Mystery Box with relevant soil-related pictures and facilitate</i>

	<ul style="list-style-type: none"> • A box containing pictures related to soil (e.g., sandy soil, clay soil, loamy soil, weathering of rocks, soil layers O–A–B–C, plant roots in soil, organic matter, rainfall affecting soil formation) (These can be accessed in Lesson 7 exemplar). • Music player/TV/Multimedia projector • Pictures printed or cut out <p>Procedure:</p> <ol style="list-style-type: none"> 1. Prepare a Mystery Box containing pictures related to soil characteristics, soil formation, and soil profile. 2. Students form a circle in the classroom. 3. While the music plays, the Mystery Box will be passed from one student to another. 4. When the music stops, the student holding the box will pick one picture from inside. 5. Using knowledge from the previous lesson, the student will describe and explain the key elements shown in the picture 6. You may ask follow-up questions to help clarify or deepen the explanation. 7. The activity continues until several students have participated. <p>Processing Questions:</p> <ul style="list-style-type: none"> • What characteristics help us identify different types of soil? • How does soil form over time? • Why is it important to understand the different layers of the soil profile? <p>Note: Make this activity short and engaging. After activating students' schema, proceed to the next part.</p> <p>2. Establishing the Purpose of the Lesson</p> <p>Activity 2: READING FOR INSIGHT: SOIL IN FOCUS!</p> <p>Objective: <i>To analyze a column article and recognize the role humans play in taking care of soil.</i></p> <p>Materials:</p> <ul style="list-style-type: none"> • Printed copy of the column article “Saving the Dying Soil Beneath Us” by Atty. Gilberto Lauengco, J.D. of the Philippine News Agency 	<p><i>the activity by guiding the music-based passing process. The teacher will ensure active participation, manage time, and ask follow-up questions to clarify and deepen students' explanations.</i></p> <p>Application of the IDF: <i>This activity applies the Instructional Design Framework (IDF) by activating prior knowledge, as students recall concepts about soil characteristics, formation, and soil profile. It promotes learner engagement through an interactive strategy and serves as formative assessment, allowing the teacher to check understanding before proceeding to the next lesson.</i></p> <p><i>Using knowledge from the previous lesson, the student will describe and explain the key elements shown in the picture</i></p> <p>Activity 2: READING FOR INSIGHT: SOIL IN FOCUS!</p> <p>Instruction to the Teacher: <i>The teacher will distribute the article “Saving the Dying Soil Beneath Us” to each student,</i></p>
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	<ul style="list-style-type: none"> • Pen or pencil <p>Note: Access Attachment 1 containing the article here: https://drive.google.com/file/d/1YL07nTv9T5-NUd11-Q3ZSDx0xxQFjRbT/view?usp=sharing</p> <p>Procedure:</p> <ol style="list-style-type: none"> 1. Distribute a copy of the news article to each student. 2. Ask the students to read the article silently and carefully. 3. After reading, instruct them to answer the guide questions individually. 4. Discuss the answers as a class to highlight the key ideas presented in the article. <p>Guide Questions:</p> <ol style="list-style-type: none"> 1. What major problem about soil is presented in the article? 2. Why is healthy soil important for agriculture and food security? 3. What activities or practices mentioned in the article contribute to the decline of soil health? 4. What possible effects could occur if soil continues to degrade or lose its fertility? 5. Based on the article, why is it important for us to understand the different ways soil can be damaged? <p><i>Say: From the article and your responses, we can see that soil is essential to agriculture, food production, and environmental sustainability, yet it is currently facing serious threats from various human activities and environmental processes. These problems show that soil can lose its fertility, quality, and stability over time if it is not properly managed. Because of this, it is important for us to understand how soil becomes damaged and what processes contribute to its decline. In this lesson, we will examine the different ways soil can be degraded and how these processes affect the environment and our food security. The lesson is divided into three parts: first, human activities that cause soil volume loss; second, activities and processes that reduce soil quality; and third, processes that induce climatic or ecosystem transformations.</i></p>	<p><i>guide them in silent reading, and facilitate discussion using the provided guide questions. The teacher will ensure that learners understand the key ideas and connect their responses to the lesson focus. After the discussion, the teacher will clearly introduce the new lesson and learning objective.</i></p> <p>Application of the IDF: <i>This activity applies the Instructional Design Framework (IDF) by establishing the purpose of the lesson. Through reading and analysis, students recognize the importance of soil and the human activities that affect it. The activity builds relevance, promotes critical thinking, and helps learners transition from their prior understanding to the new topic of soil degradation and its classifications.</i></p>
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	Note: Introduce the new lesson and the learning objective.	
B. Instituting New Knowledge	<p>1. Presenting Examples</p> <p>Activity 3: SOIL OR SPOIL?</p> <p>Objective: <i>Identify human activities that affect soil.</i></p> <p>Materials:</p> <ul style="list-style-type: none"> • A collage of 8 pictures (6 human activities related to soil degradation and 2 unrelated, but only added to spark discussion) • Board or manila paper • Marker <p>Note: Note: You may use the photos in Attachment 2 found in this link: https://drive.google.com/file/d/1_7hmvVdaJ42w_fRqqppn6s3aIfY2peDP/view?usp=sharing</p> <p>Procedure:</p> <ol style="list-style-type: none"> 1. Divide the class into small groups. 2. Provide each group with a collage of images depicting various human activities and environmental conditions. 3. Instruct the groups to examine the collage carefully and identify which images show human activities that affect the soil. 4. Each group will answer the guide questions based on their observations. 5. After the discussion, groups will present their answers to the class. <p>Guide Questions:</p> <ol style="list-style-type: none"> 1. Which pictures in the collage show activities or situations that affect the soil? 2. What human activity can you identify in each of these pictures? 3. Which pictures do you think do not affect the soil? Why? 4. Based on the pictures you selected, what can you say about how human activities influence soil conditions? <p>Note: It is acceptable if learners are unable to identify all six human activities. What is important is that they can identify examples of activities that affect the soil, since this activity only serves as a preview of the lesson and focuses on presenting examples. They have not yet</p>	<p>Activity 3: SOIL OR SPOIL?</p> <p>Instruction to the Teacher: <i>The teacher will divide the class into small groups and distribute the collage to each group. The teacher will instruct learners to carefully examine the pictures, identify which images show human activities that affect the soil, and answer the guide questions. The teacher will facilitate group discussions, monitor participation, record responses on the board, and manage the presentation of answers. Correct answers will be confirmed after all groups have presented.</i></p> <p>Application of the IDF: <i>This activity applies the Instructional Design Framework (IDF) by presenting examples of the lesson concept. It allows learners to observe real-life situations and identify human activities that affect soil without yet discussing detailed classifications. The activity serves as a springboard for deeper learning, transitioning from example recognition to the</i></p>

	<p>named it. Use it as a springboard to introduce each human activity in the succeeding sessions.</p> <p><i>Say: Very good! You identified several human activities that can affect soil. But have you ever wondered how these activities damage the soil? In the next part of our lesson, we will explore this further. Understanding these activities will help us see how soil can gradually lose volume and quality, and even transform entire ecosystems. Let us now dig deeper into these processes.</i></p> <p>2. Discussing New Concept</p> <p>Activity 4: WHAT ON EARTH IS HAPPENING?</p> <p>Objective: <i>Identify human activities and processes that affect soil.</i></p> <p>Materials:</p> <ul style="list-style-type: none"> • Six posters showing pictures of the following: erosion, deforestation, surface mining, acidification, salinization, and desertification • Guide questions are posted at each station • Activity sheet or notebook for recording answers <p>Note: You may use the photos in Attachment 2 found in this link: https://drive.google.com/file/d/1_7hmvVdaJ42w_fRqqppn6s3alfY2peDP/view?usp=sharing</p> <p>Procedure:</p> <ol style="list-style-type: none"> 1. Reveal the six pictures from the previous collage and inform the class that each picture represents a different human activity or process that affects soil. 2. Six stations are arranged around the classroom. Each station contains one poster showing a specific activity or process affecting soil. 3. Divide the class into six groups and assign each group to a starting station. 4. At each station, students will carefully observe the picture and answer the provided guide questions. 	<p><i>upcoming discussion of the three categories of soil degradation.</i></p> <p>Activity 4: WHAT ON EARTH IS HAPPENING?</p> <p><i>Instruction to the Teacher:</i> <i>The teacher will reveal the six pictures and organize the class into six groups, assigning each group to a different station. The teacher will guide students as they rotate, ensure they carefully observe each poster, answer the guide questions, and collaboratively identify the correct human activity or process. After all rotations, the teacher will facilitate a brief class review to confirm the correct answers before moving to the discussion of concepts.</i></p> <p><i>Application of the IDF:</i> <i>This activity applies the Instructional Design Framework (IDF) in the</i></p>
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	<ol style="list-style-type: none"> Based on their observations and discussion, the group will identify and write the name of the activity shown in the picture. After a few minutes, groups rotate to the next station until they have visited all stations. After the rotation, the class will review and confirm the correct names of the activities before proceeding to the discussion. <p>Guide Questions per Station</p> <p>Station 1</p> <ol style="list-style-type: none"> What is happening to the soil in the picture? What human activities might cause the soil to become exposed? What do you think this process is called? <p><i>(Expected answer: Erosion)</i></p> <p>Station 2</p> <ol style="list-style-type: none"> What do you observe about the trees in the area? What activity might humans be doing in this place? How might removing trees affect the soil on the ground? What do you think this activity is called? <p><i>(Expected answer: Deforestation)</i></p> <p>Station 3</p> <ol style="list-style-type: none"> What activity is taking place in this area? What is happening to the land surface and soil? Why do you think people dig or remove materials from the ground? What do you think this activity is called? <p><i>(Expected answer: Mining)</i></p> <p>Station 4</p> <ol style="list-style-type: none"> What human activity is illustrated in the picture? What do farmers use chemical fertilizers in farming? How might these substances change the soil's condition over time? What do you think this process is called? <p><i>(Expected answer: Acidification)</i></p> <p>Station 5</p> <ol style="list-style-type: none"> What do you notice on the surface of the soil in the picture? 	<p>development phase, where learners construct new understanding through guided inquiry. The station rotation strategy promotes active engagement, collaboration, and critical thinking as students analyze each example. It directly supports concept development by leading learners to identify and name the human activities and processes that affect soil, preparing them for deeper discussion and generalization in the next part of the lesson.</p>
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	<p>2. What might happen when too much salt builds up in the soil?</p> <p>3. What farming practice might cause salt to accumulate in the soil?</p> <p>4. What do you think this process is called?</p> <p><i>(Expected answer: Salinization)</i></p> <p>Station 6</p> <p>1. What do you observe about the land and vegetation in the picture?</p> <p>2. Does the land appear fertile or dry and barren?</p> <p>3. What might happen if land continues to lose vegetation and soil quality?</p> <p>4. What do you think this process is called?</p> <p><i>(Expected answer: Desertification)</i></p> <p>Note: Please access Attachment 3 for the suggested answers to the guide questions and the concepts for generalization via this link: https://drive.google.com/file/d/1bNzYrJsGTUerbbVAT9Swj8UJF2ICSykR/view?usp=sharing</p> <p>3. Developing Mastery</p> <p>Activity 5: THE SOIL SITUATION</p> <p>Objective: <i>Identify human activities or processes that affect the soil by analyzing case-based scenarios in the Philippines.</i></p> <p>Procedure:</p> <ol style="list-style-type: none"> 1. Divide the class into six groups. 2. Each group will receive one case scenario describing a situation happening in the Philippines. 3. Groups will carefully read and analyze the case. 4. Using their understanding from the previous activity, they will identify the human activity or process affecting the soil. 5. Groups will share their answers and briefly explain their reasoning. <p>Case Scenarios</p> <p>Case 1: Erosion</p> <p>Farmers in the mountainous areas of the Cordillera region have cleared large portions of vegetation on steep slopes to expand their vegetable farms. During the rainy season, strong rainfall washes large amounts</p>	<p>Activity 5: THE SOIL SITUATION</p> <p>Instruction to the Teacher:</p> <p><i>The teacher will divide the class into six groups and distribute one Philippine-based case scenario to each group. The teacher will instruct students to read and analyze the case carefully, answer the guide questions, and identify the human activity or soil process involved. After the group discussion, the teacher will facilitate the sharing of answers, clarify</i></p>
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	<p>of soil downhill, leaving the land less fertile and causing sediments to accumulate in nearby rivers (https://essc.org.ph/content/cordilleras-forests-green-water-and-watersheds).</p> <p>Guide Questions:</p> <ol style="list-style-type: none"> 1. What problem is happening to the soil in this situation? 2. What human activity contributed to this problem? 3. What soil-related process is illustrated in this case? 4. How might this situation affect the environment and people if it continues over time? <i>(optional for HOTS integration)</i> <p>Case 2: Deforestation</p> <p>In parts of the Sierra Madre mountain range, the longest mountain range in the Philippines, large areas of forest have been cleared to make way for farming and settlements. Over time, the removal of trees has left the soil exposed to heavy rains and strong winds, making the land more vulnerable to soil loss (https://www.facebook.com/sciencekonek).</p> <p>Guide Questions:</p> <ol style="list-style-type: none"> 1. What human activity is happening in the area? 2. What role do trees play in protecting the soil? 3. What might happen to the soil when trees are removed? 4. What activity affecting soil is shown in this case? 5. How would continued deforestation affect the environment and people living in the area? <i>(optional for HOTS integration)</i> <p>Case 3: Surface Mining</p> <p>In the Caraga region of Mindanao, the mining capital of the Philippines, open-pit mining operations extract minerals such as nickel from the ground. Large sections of land are excavated, removing the topsoil and leaving large pits and exposed rock surfaces. Communities nearby are concerned about the damage to the landscape and environment (https://www.scribd.com).</p> <p>Guide Questions:</p> <ol style="list-style-type: none"> 1. What activity is being conducted in the area? 2. What happens to the topsoil during this process? 3. How does this activity change the landscape? 4. What human activity affecting soil is described in this case? 5. How might surface mining affect the long-term productivity of the land? <i>(optional for HOTS integration)</i> 	<p><i>misconceptions if needed, and process the responses to ensure correct identification.</i></p> <p>Application of the IDF: <i>This activity applies the Instructional Design Framework (IDF) by strengthening mastery through contextualized learning. It allows students to apply previously learned concepts to real-life Philippine situations, reinforcing their understanding of soil-related human activities and processes. The activity promotes analytical thinking and prepares learners for deeper understanding while maintaining a focus on identification as the lesson's core objective.</i></p> <p><i>Optional HOTS questions are included, although they do not directly align with the learning competency since it focuses only on lower-order skills (identifying).</i></p>
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Case 4: Acidification

Many rice farmers in Central Luzon, where the “Rice Granary of the Philippines” (Nueva Ecija) is located, use large amounts of chemical fertilizers to increase crop yield. Over time, some farmers have noticed that their soil becomes less productive and requires even more fertilizer to maintain production (<https://edepot.wur.nl/79848#:~:text=Page%201,had%20come%20from%20technicians>).

Guide Questions:

1. What farming practice is described in the case?
2. How might excessive fertilizer use affect the soil?
3. What change may happen to the soil’s pH level?
4. What soil process is illustrated in this situation?
5. What could happen to crop yield and soil health if the practice continues over time? *(optional for HOTS integration)*

Case 5: Salinization

In some coastal farming areas in the Visayas, farmers rely heavily on irrigation and groundwater for their crops. Over time, saltwater from nearby coastal areas seeps into the soil, leaving white salt deposits on the surface and making it difficult for crops to grow (<https://www.bswm.da.gov.ph/wp-content/uploads/Salinity-2020-Technical-Report-Cebu.pdf>).

Guide Questions:

1. What problem do farmers observe in their soil?
2. What might be causing the salt buildup in the soil?
3. How does salt affect plant growth?
4. What soil-related process is happening in this case?
5. What long-term effects might salinization have on farming and food production in the area? *(optional for HOTS integration)*

Case 6: Desertification

In some grassland areas of Mindanao, continuous land clearing, overgrazing by livestock, and repeated soil erosion have gradually reduced vegetation cover. Over time, the land becomes dry and less productive, making it difficult for farmers to grow crops (<https://www.unccd.int/sites/default/files/naps/philippines-eng2004.pdf>).

Guide Questions:

	<ol style="list-style-type: none"> 1. What changes are happening to the land in this situation? 2. What human activities may have contributed to this condition? 3. What happens when land continues to lose vegetation and soil quality? 4. What process affecting soil is illustrated in this case? 5. How might desertification affect the livelihood of farmers and the local community in the long term? <i>(optional for HOTS integration)</i> <p>Note: Process the students' responses to the guide questions.</p> <p><i>Say: Very good! From the cases you analyzed, we can see that different human activities and practices in the Philippines can significantly affect the condition of our soil. Activities such as forest clearing, mining, excessive fertilizer use, improper irrigation, and poor land management can lead to various forms of soil degradation. These situations show that soil problems are not just theoretical concepts but real environmental issues that communities experience. Understanding these activities helps us recognize how human actions can influence soil health and why proper soil management is important for sustainable agriculture and environmental protection.</i></p>	
C. Demonstrating Knowledge and Skills	<p>1. Finding Practical Application</p> <p>Activity 6: LET'S UN-'EARTH' IT TOGETHER!</p> <p>Objective: <i>Identify human activities that affect the soil through creative group presentations.</i></p> <p>Materials:</p> <ul style="list-style-type: none"> • Assigned activity cards (erosion, deforestation, mining, acidification, salinization, desertification) • Art materials/paper/markers • Device for slide presentation (for Group 6) <p>Procedure:</p> <ol style="list-style-type: none"> 1. Divide the class into six groups. 2. Assign each group one creative task: <ul style="list-style-type: none"> • Group 1: Role Playing • Group 2: Speech Making • Group 3: Announcement Writing 	<p>Activity 6: LET'S UN-'EARTH' IT TOGETHER!</p> <p>Application of the IDF: <i>This activity applies the Instructional Design Framework (IDF) through the application phase, where learners demonstrate understanding by creatively representing human activities that affect soil. It reinforces mastery of concepts while maintaining focus on identification. The collaborative, performance-based approach promotes</i></p>

	<ul style="list-style-type: none"> • Group 4: Jingle Making • Group 5: Poster Making • Group 6: Slide Deck Making <ol style="list-style-type: none"> 3. The teacher will assign each group one human activity related to soil degradation. 4. Groups will prepare their outputs based on the following limits: <ul style="list-style-type: none"> • Role Play – Maximum of 3 minutes • Speech – 2 paragraphs only • Announcement – 1 announcement only • Jingle – 3 stanzas only • Poster – Creative visual representation • Slide Deck – Maximum of 3 slides 5. The presentation and outputs must contain descriptions of each human activity, emphasizing which human activities and processes contributed to it. 6. Important Rule: <ul style="list-style-type: none"> • The name of the assigned human activity must NOT be mentioned in the presentation. • Groups must keep their assigned activity a secret. • The group whose presentation is correctly identified by the fewest groups will receive additional points. 7. During presentations, the other groups will: <ul style="list-style-type: none"> • Observe and listen carefully. • Identify the human activity being demonstrated and write it in their answer sheets. 8. After all the presentations, the teacher will confirm the answer. <p>2. Making Generalization</p> <p>Activity 7: Exit Ticket – SOIL TAKEAWAYS!</p> <p>Objective: <i>To summarize and generalize learning about human activities that affect the soil.</i></p> <p>Materials:</p> <ul style="list-style-type: none"> • Small strips of paper • Pen/ballpen <p>Procedure:</p>	<p><i>engagement and deeper learning, while the structured confirmation of answers ensures alignment with the lesson objective.</i></p> <p>Note: The teacher will facilitate and monitor the activity, ensure that groups follow the given guidelines and time limits, and record the identified answers on the board. The correct answers will be revealed only after all groups have presented. A rubric may be used to guide assessment of participation and performance; however, the main objective of the activity is to identify human activities affecting the soil. The activity is considered successful when the groups correctly identify the presented human activities.</p> <p>Activity 7: Exit Ticket – SOIL TAKEAWAYS!</p> <p>Application of the IDF: <i>This activity applies the Instructional Design Framework (IDF) during the generalization phase, in which learners synthesize and</i></p>
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	<ol style="list-style-type: none"> 1. The teacher distributes one piece of paper to each student. 2. Students will individually write and/or draw five (5) things they learned from all the lessons and activities. 3. Answers may include concepts, examples, or key ideas about human activities affecting soil. 4. After writing, the teacher will randomly call students to share their answers with the class. 5. The teacher will briefly highlight common responses to reinforce key concepts. 6. The activity will serve as preparation for the summative assessment. 	<i>summarize their understanding of human activities that affect soil.</i>
VI. ASSESSMENT <i>(Assessing Learnings)</i>	<p>SUMMATIVE ASSESSMENT</p> <p>Option 1</p> <p>Instructions: Read each statement carefully and identify the human activity described in the question that affects soil.</p> <p>Statements:</p> <ol style="list-style-type: none"> 1. Farmers remove vegetation from sloping land, exposing the soil to heavy rainfall that washes away fertile topsoil. <i>Answer: Erosion</i> 2. Continuous irrigation without proper drainage results in the buildup of salts in agricultural land. <i>Answer: Salinization</i> 3. Due to overgrazing, land clearing, and improper land management, productive areas in dry regions gradually lose vegetation and become barren. <i>Answer: Desertification</i> 4. Companies conduct surface excavation to extract minerals, removing the topsoil and significantly changing the natural landscape. <i>Answer: Mining</i> 5. Logging and land clearing remove trees that normally protect and stabilize the soil, leaving it vulnerable to environmental damage. <i>Answer: Deforestation</i> 6. Strong winds and flowing water detach and transport soil particles, especially in areas where humans have cleared plants and trees. <i>Answer: Erosion</i> 7. Farmers apply excessive chemical fertilizers that cause essential nutrients to leach away, increasing the soil's acidity over time. <i>Answer: Acidification</i> 	

8. Communities permanently cut down large areas of forest for farming, housing, or commercial development, reducing tree cover to very low levels.
Answer: Deforestation
9. The overuse of certain agricultural chemicals reduces soil pH, making it more acidic and less productive.
Answer: Acidification
10. Large-scale land operations strip away the fertile upper layer of soil to access valuable resources beneath the surface.
Answer: Mining
11. In coastal farming areas, improper irrigation practices can cause salt accumulation in the soil, affecting crop growth.
Answer: Salinization
12. Long-term human activities, such as deforestation and land misuse, in arid regions can transform fertile land into desert-like conditions.
Answer: Desertification

Option 2

Directions: Read each pair of statements carefully. Choose the correct answer from Options A–F. Each option contains the correct pair of human activities.

Options:

- A.** Statement 1 is **Erosion**; Statement 2 is **Salinization**
- B.** Statement 1 is **Desertification**; Statement 2 is **Deforestation**
- C.** Statement 1 is **Erosion**; Statement 2 is **Mining**
- D.** Statement 1 is **Acidification**; Statement 2 is **Mining**
- E.** Statement 1 is **Desertification**; Statement 2 is **Deforestation**
- F.** Statement 1 is **Salinization**; Statement 2 is **Acidification**

1.

Statement 1: The decrease in soil pH occurs due to nutrient leaching and excessive fertilizer use.

Statement 2: Large-scale land excavation removes the topsoil to extract minerals beneath the ground.

2.

Statement 1: Salt accumulates in the soil due to improper irrigation or coastal intrusion.

Statement 2: Strong wind and heavy rainfall detach and transport soil particles, especially in areas where vegetation has been removed.

	<p>3. Statement 1: Forest areas are permanently cleared for farming and development, reducing tree cover. Statement 2: Productive land in dry regions gradually loses vegetation and becomes barren due to long-term degradation.</p> <p>4. Statement 1: The buildup of salts in agricultural soil affects plant growth and soil structure. Statement 2: Excessive use of chemical fertilizers causes the soil to become more acidic over time.</p> <p>5. Statement 1: Land is excavated to extract valuable minerals, significantly changing the natural landscape. Statement 2: The wearing away of topsoil occurs due to wind or water, especially when vegetation is removed.</p> <p>6. Statement 1: Long-term land misuse in arid areas transforms fertile land into desert-like conditions. Statement 2: Trees are permanently cut down, leaving soil exposed and vulnerable to environmental damage.</p> <p>Answers: <i>D-A-B-F-C-E</i></p> <p>Note: This assessment may be turned into a Quiz Bee game to make it more interactive. However, please ensure that the objective remains focused only on identifying the human activities affecting the soil. Avoid going beyond identification.</p>
VII. REFLECTION	<i>This section presents the key highlights and challenges encountered by both teachers and learners throughout the unit. It also includes the teacher's adjustments to improve instruction.</i>
VIII. USE OF GENERATIVE AI	In preparing this Learning Exemplar (LE), the author used ChatGPT (GPT-5 Mini) to refine ideas in crafting learning activities and guide questions, including checking grammar and improving sentence structure. The author reviewed and finalized the content. The author takes full responsibility for the content of this LE.

Lesson Title/Topic	Rocks and Soils	Lesson Exemplar	16
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I. OBJECTIVES	
A. Content Standard	The learners learn that various environmental factors influence the characteristics of soil.
B. Performance Standard	By the end of the quarter, learners identify, describe, and classify a range of minerals, rocks, and soils using appropriate scientific techniques. They explain the formation and economic significance of the Philippines' earth materials and energy sources, emphasizing the importance of sustainable mineral resource management. Learners differentiate renewable and nonrenewable energy sources and develop campaigns focused on energy conservation and sustainability.
C. Learning Competencies	The learners provide sustainable ways to conserve and protect soil resources;
II. REFERENCES and MATERIALS	<ul style="list-style-type: none"> • <i>UN/ISDR (2004). Land Use, Disaster Risk & Rewards. Cape Town, South Africa UN/ISDR Africa Educational Series, Volume 1, Issue 4. https://www.unisdr.org/files/8543_landuseschool1.pdf</i> • https://tinyurl.com/3cyrtres • https://stock.adobe.com/ph/search?k=mining&asset_id=706883052 • https://commons.wikimedia.org/wiki/File:Crop-rotation.JPG • https://tinyurl.com/bud8bsvz • https://commons.wikimedia.org/wiki/File:Batad_Rice_Terraces.jpg • https://commons.wikimedia.org/wiki/File:Agroforestry_in_Masaka._VI_Agroforestry.jpg • https://tinyurl.com/2usyd8az • https://agrisearchindia.com/en/blog/what_is_organic_mulching • https://commons.wikimedia.org/wiki/File:Erosion_Netzwerk027.jpg • https://tinyurl.com/2cx4ck7n • https://education.nationalgeographic.org/resource/deforestation/ • https://www.agcanada.com/2017/05/steve-kenyon-overgrazing-is-a-matter-of-timing

	<ul style="list-style-type: none"> • https://www.change.org/p/improper-waste-disposal-in-clemente-borja-memorial-highschool
III. CONTENT	Rocks and Soils
IV. OBJECTIVES	<div> <div>1. Identify common soil-related problems in the community such as soil erosion, deforestation, overgrazing, mining, and improper waste disposal.</div> <div>2. Discuss in groups the causes and effects of these soil-related problems on Food Security & Agriculture, Ecosystem Health and Biodiversity, Water quality & Hydrology, & Community Safety and Infrastructure?</div> <div>3. Explain the different sustainable soil conservation methods such as Crop rotation, Contour plowing, Terracing, Agroforestry, Organic farming, Mulching, Reforestation, Proper waste management and relate these methods to local agricultural and environmental practices.</div> <div>4. Using information from secondary sources or surveys, provide and present locally sustainable farming and land management practices to conserve soil and maintain soil health within the school or local community.</div> </div>
IV. PROCEDURES	ANNOTATIONS
A. Activating Prior Knowledge	<div> <div> DAY 1 Activating Prior Knowledge <i>Before the start of the new lesson, the teacher conducts routine activities to help the students ready for the new lesson.</i> Option 1: DECODING SOIL-RELATED PROBLEMS <i>Conduct a simple interactive activity to check students' prior knowledge through unlocking words that are related to soil</i> </div> <div> <i>As you begin the lesson, consider conducting a simple activity to ignite students' interest in the lesson. You can use Option 1 or 2 to help students build connections to the lesson.</i> Option 1 is decoding words that are related to soil problems. Try to </div> </div>

problems. This activity may be done through any of the following activities below:

1	2	3	4	5	6	7	8	9	10	11	12	13
A	B	C	D	E	F	G	H	I	J	K	L	M
14	15	16	17	18	19	20	21	22	23	24	25	26
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

Procedure:

1. Instruct your students that each number code below represents a vocabulary word related to soil problems. Use the alphabetical value of each letter (A=1, B=2, ..., Z=26) to decode each word.

Example: Code: **19-3-9-5-14-3-5** Decoded word: **SCIENCE**

2. In your class, call volunteers to decode each word related to soil-related problems.

19	15	9	12	5	18	15	19	9	15	14
13		9		14		9		14		7

4	5	6	15	18	5	19	20	1	20	9	15	14

15	22	5	18	7	18	1	26	9	14	7

9	13	16	18	15	16	5	18	23	1	19	20	5	4	9	19	16	15	19	1	12

Option 2: CROSSWORD PUZZLE

Procedure:

- Group your class into 4 or 5 groups.
- Instruct your students to search for words that can be formed by the scrambled letters inside the box below. There 5

unlock these words through this interactive activity.

Say: Before we start our new lesson, we will begin with a short decoding activity. Each number code represents a vocabulary word related to soil problems. The numbers correspond to the alphabetical value of each letter, where A = 1, B = 2, C = 3,.. Z = 26.

For example, if the code is 19 – 3 – 9 – 5 – 14 – 3 – 5, the decoded word is SCIENCE.

What: Students will analyze the codes and decode each number to its corresponding letter in the alphabet to form a meaningful word related to soil problems.

Do: Flash the codes on the screen and encourage your students to raise their hands before they give their answer. Then, call a volunteer to give his/her answer.

13	9	14	9	14	7															
M	I	N	I	N	G															
19	15	9	12	5	18	15	19	9	15	14										
S	O	I	L	E	R	O	S	I	O	N										
9	13	16	18	15	16	5	18	23	1	19	20	5	4	9	19	16	15	19	1	12
I	M	P	R	O	P	E	R	W	A	S	T	E	D	I	S	P	O	S	A	L
15	22	5	18	7	18	1	26	9	14	7										
O	V	E	R	G	R	A	Z	I	N	G										
4	5	6	15	18	5	19	20	1	20	9	15	14								
D	E	F	O	R	E	S	T	A	T	I	O	N								

Link to the activity:

<https://tinyurl.com/5fr6j8zv>

Option 2: CROSSWORD PUZZLE

words that your students must find inside the box. Clue: All words are related to soil problems.

E	R	I	Q	D	Q	L	Z	Y	A	Y	T	X	S	W
F	D	L	Y	R	Y	R	U	H	G	O	K	O	M	Y
Z	A	Y	T	J	J	S	E	V	R	M	I	M	X	M
J	G	W	L	E	R	J	E	B	L	L	O	M	W	X
H	Q	N	B	U	S	P	Y	K	E	N	N	H	M	X
N	R	N	I	C	Z	O	T	R	K	B	E	D	K	E
F	A	C	C	N	H	P	O	K	M	N	E	S	A	R
C	G	N	N	F	A	S	P	N	R	D	N	S	G	Q
U	N	R	F	R	I	R	J	Y	C	L	Q	B	B	H
L	I	P	X	O	T	N	G	E	X	H	L	R	W	V
L	N	N	N	L	V	O	V	R	U	E	E	W	H	P
P	I	N	O	I	T	A	T	S	E	R	O	F	E	D
M	M	J	M	J	C	P	Y	R	C	V	Q	M	Y	B
H	U	W	A	S	T	E	D	I	S	P	O	S	A	L
I	N	W	L	R	D	V	M	J	V	Y	T	X	B	O

Point of discussion: After the students decoded the words, unlock and discuss the meaning of the word/s.

Establishing the Purpose of the Lesson

Option 1: Picture Identification

Procedure:

1. Present pictures of the 5 soil-related problems on the screen
2. Let your students describe each picture first, then let them identify what is the picture all about based on the words they decoded.



1. Soil Erosion



2. Deforestation



3. Overgrazing

Say: Before we start with our new lesson, I will divide you into five groups. Each group will look at a box containing scrambled letters. Your task is to search and form words from the scrambled letters found inside the box.

There are five words hidden in the box, and all of these words are related to soil problems.

What: Students will work collaboratively to analyze the scrambled letters to identify five words related to soil problems.

Do: Divide the class into 5 groups and ask students the 5 word they have found inside the box

E	R	I	Q	D	Q	L	Z	Y	A	Y	T	X	S	W
F	D	L	Y	R	Y	R	U	H	G	O	K	O	M	Y
Z	A	Y	T	J	J	S	E	V	R	M	I	M	X	M
J	G	W	L	E	R	J	E	B	L	L	O	M	W	X
H	Q	N	B	U	S	P	Y	K	E	N	N	H	M	X
N	R	N	I	C	Z	O	T	R	K	B	E	D	K	E
F	A	C	C	N	H	P	O	K	M	N	E	S	A	R
C	G	N	N	F	A	S	P	N	R	D	N	S	G	Q
U	N	R	F	R	I	R	J	Y	C	L	Q	B	B	H
L	I	P	X	O	T	N	G	E	X	H	L	R	W	V
L	N	N	N	L	V	O	V	R	U	E	E	W	H	P
P	I	N	O	I	T	A	T	S	E	R	O	F	E	D
M	M	J	M	J	C	P	Y	R	C	V	Q	M	Y	B
H	U	W	A	S	T	E	D	I	S	P	O	S	A	L
I	N	W	L	R	D	V	M	J	V	Y	T	X	B	O

This activity is designed to help students reflect and relate to the topic. It also promote collaboration and self-exploration.

Link to the activity:

<https://tinyurl.com/3v4bw7p5>

After the students learned the soil-related problems, present pictures of Soil Erosion, Deforestation, Overgrazing, Mining, and Improper

	<div> </div> <div> </div> <p>4. Mining 5. Improper Waste Disposal</p> <p>Based on the activity the learners did earlier, allow the learners to reflect on the following questions.</p> <p>Guide Questions:</p> <ol style="list-style-type: none"> 1. What are the picture all about? Describe each picture. 2. How do the soil-related issues we explored in the activity affect our community and the larger society? 3. Why is it important for us to study and understand these environmental issues, especially in relation to soil and land use? 4. In what ways might these soil problems become a threat to our well-being, livelihoods, and future as a society? <p>Note to teacher: <i>If no available internet connection in your school, you can opt to draw each pictures of the soil-related problems.</i></p>	<p><i>Waste Disposal. Let your students engage with the topic by analyzing and describing the pictures.</i></p> <p>Say: <i>Now that you have learned the words related to soil problems, I will present pictures of these soil-related problems, then you analyze and briefly describe what you observe on the pictures.</i></p> <p>What: <i>Students analyze and describe the pictures.</i></p> <p>Do: <i>Present the pictures in the class and call volunteers who are raising their hands to share their observations.</i></p> <p><i>After conducting the activity, guide the students to explore the topic leading to establishing the purpose of the lesson. Using the guide questions, allow your students to think critically on the relevance of this topic and why there is a need to discuss the soil-related problems. Link to the activity: https://tinyurl.com/432z6a4u</i></p>
<p>B. Instituting New Knowledge</p>	<p><u>DAY 2</u></p> <p>1.Presenting Examples</p> <p>Option 1: Case Scenario</p> <p><i>Now that we’ve explored the different soil-related problems— such as Soil Erosion, Mining, Deforestation, Overgrazing, & Improper Waste Disposal—let’s take a moment to explore the causes and</i></p>	<p><i>Before doing this activity, conduct a short review on the 5 soil-related problems discussed yesterday. After that, assign a case scenario to the class to let them explore on their own the causes and effects of these soil-related problems.</i></p> <p>Option 1: Case Scenario</p>

effects of these soil-related problems to our existence and to the environment.

Procedure:

1. *Divide the class into 5 groups.*
2. *In each group, assign a case scenario for them to read.*

Group 1- Soil Erosion,

In a small upland farming community, most families depend on planting corn and vegetables on sloping land. For many years, farmers practiced traditional methods without considering soil conservation techniques. During the rainy season, the area often experiences strong typhoons that bring heavy rainfall. At first, the farmers believed the rain was beneficial for their crops. However, they slowly began to notice changes in the quality of their soil. The once dark and fertile topsoil started to disappear. Crops became weaker and less productive over time. This situation marked the beginning of a serious soil-related problem in the community.

As the rains continued, large portions of the topsoil were washed downhill into nearby rivers. The exposed land became rocky and dry, making it difficult for plants to grow. Farmers noticed that even with fertilizers, crop yield continued to decrease. In addition, the river became muddy due to the accumulated sediments from the farms. This affected fish populations and water quality for nearby households. Some farmers attempted to plow deeper, but this only worsened the problem. Without proper vegetation or barriers, the soil had no protection against erosion. The lack of knowledge about contour farming and terracing contributed to the worsening condition.

Eventually, the community realized that soil erosion was the main cause of their declining agricultural productivity. Local leaders and agricultural experts introduced soil conservation practices such as planting cover crops and building terraces. Over time, these efforts helped reduce soil loss and improve land quality. The case highlights the importance of sustainable farming practices in protecting soil resources. It also shows how natural events, when combined with improper land use, can lead to environmental degradation. Addressing soil erosion is essential not only for farmers but also for food security and ecosystem stability. The community learned that

Group 3- Overgrazing

In a rural village known for livestock farming, raising cattle and goats was the primary source of income. Farmers allowed their animals to graze freely on open grasslands. At first, the land provided enough grass to sustain the growing number of animals. However, as more families increased their livestock, the demand for grazing land also grew. No clear system was established to manage grazing areas. Over time, the once green pasture began to show signs of degradation. The problem slowly developed into overgrazing.

With too many animals feeding on the same land, grass had no time to regrow. The soil became exposed and dry, making it vulnerable to erosion. Without plant roots to hold the soil together, wind and rain easily carried it away. The land gradually turned barren, reducing its ability to support livestock. Farmers noticed that their animals were becoming weaker due to lack of food. Some were forced to buy expensive feeds, increasing their expenses. The situation created tension among farmers competing for limited resources.

Recognizing the problem, the community worked together to implement controlled grazing practices. They divided the land into sections and rotated grazing to allow grass to recover. Some farmers also planted additional forage crops to support their livestock. Over time, the land slowly regained its productivity. This case demonstrates the importance of proper resource management in agriculture. Overgrazing can lead to long-term environmental damage if not addressed. Sustainable practices are necessary to maintain both the land and the livelihood of farmers. Cooperation among community members is key to solving such issues.

Group 2- Deforestation

In a forest-rich region in Caraga, logging activities increased due to the high demand for timber and agricultural land. Many trees were cut down to make space for farming and settlements. At first, this brought economic benefits to the community, including jobs and additional income. However, the continuous removal of trees began to affect the natural balance of the environment. Wildlife started to disappear as their habitats were destroyed. The forest, once dense and thriving, became sparse and fragmented. The effects of deforestation gradually became more noticeable.

Without trees to absorb rainwater, the area became prone to flooding during heavy rains. Soil erosion also increased, as tree roots were no longer there to hold the soil in place. Rivers became muddy, affecting water quality and aquatic life. The loss of trees also contributed to higher temperatures in the area. Farmers experienced reduced crop yields due to poor soil conditions. In addition, the loss of biodiversity disrupted the ecosystem. Many species of plants and animals were either displaced or became endangered.

In response, environmental groups and local authorities initiated reforestation programs. Community members were encouraged to plant trees and protect existing forests. Laws were enforced to regulate logging activities and prevent illegal cutting. Over time, these efforts helped restore some parts of the forest. This case highlights the importance of forests in maintaining ecological balance. Deforestation has far-reaching effects on climate, soil, and biodiversity. Protecting forests is essential for sustainable development and environmental preservation. The community learned that conserving natural resources is vital for their future.

Group 4- Mining

In a mountainous province rich in mineral resources, a mining company began operations after receiving government approval. The project promised employment opportunities and economic growth for the local community. Many residents were hopeful that mining would improve their standard of living. At first, roads were built, and jobs were offered to local workers. However, not everyone agreed with the project, especially environmental groups and indigenous communities. Concerns about the long-term effects of mining started to arise. Despite these concerns, operations continued at full scale.

As mining activities intensified, large areas of land were cleared to access mineral deposits. Forests were cut down, and heavy equipment was used to dig deep into the *الارض*. Toxic chemicals used in processing minerals began to contaminate nearby water sources. Residents noticed that their drinking water had become unsafe, and fish in rivers started to die. Dust from mining operations affected air quality, causing health problems among villagers. Farmlands near the mining site also became less productive due to soil contamination. While some people benefited economically, many suffered from environmental and health issues.

Over time, the negative impacts of mining outweighed its economic benefits for many residents. The community began to demand stricter environmental regulations and rehabilitation programs. This case illustrates the importance of responsible mining practices and proper environmental management. It also shows that economic development should not come at the expense of people's health and the environment. Sustainable mining requires balancing profit with environmental protection. Governments, companies, and communities must work together to minimize harm. The experience taught the community the value of protecting natural resources for future generations.

Say: To deepen your understanding on the soil-related problems, I will group you into 5 groups, you will read a case scenario on these soil-related problems that will be assigned to your group. Group 1 will read a case scenario on Soil Erosion, Group 2 Deforestation, Group 3 Overgrazing, Group 4 Mining, and Group 5 Improper Waste Disposal. After you read the scenario answer the guide questions and choose 2 representatives to present your answer.

What: Students will read the case scenario and collaboratively answer the guide questions.

Do: Divide the class into 5 and distribute the reading materials.

After each group presents their answer, guide your students on their answer and elaborate their answers further.

Link to the activity:

<https://tinyurl.com/4k2nu52p>

This activity aims to develop students critical thinking and and develop sound reasoning on the causes and effects of these soil-related problems.

Option 2: Video Reflection

Group 5- Improper Waste Disposal

In a rapidly growing urban community, waste management became a major concern. With an increasing population, the amount of garbage produced daily also rose. Unfortunately, many residents lacked proper knowledge and discipline in disposing of their waste. Instead of using designated bins, people threw garbage in empty lots, canals, and rivers. Local authorities struggled to enforce waste management rules effectively. Over time, the accumulation of waste began to affect the cleanliness of the area. The problem became more visible during the rainy season.

Clogged drainage systems caused by improperly disposed waste led to frequent flooding. During heavy rains, water could not flow properly, resulting in flooded streets and homes. The stagnant water became a breeding ground for mosquitoes, increasing the risk of diseases such as dengue. The unpleasant smell of rotting garbage also affected the quality of life in the community. Plastic waste in rivers harmed aquatic life and polluted water sources. Despite occasional clean-up drives, the problem persisted due to lack of consistent effort. Many residents continued their harmful practices out of habit or convenience.

Eventually, the local government launched an intensive campaign on proper waste segregation and disposal. Educational programs were conducted in schools and communities to raise awareness. Stricter penalties were also implemented for violators. Gradually, residents began to take responsibility for their waste. This case highlights the importance of discipline and community cooperation in maintaining a clean environment. Improper waste disposal not only affects cleanliness but also poses serious health and environmental risks. Sustainable waste management is essential for a safe and healthy community. Everyone plays a role in solving this problem.

Guide questions:

1. Identify the causes and effects of the soil-related problem assigned to your group. What are those?
2. How does the soil-related problem assigned in your group affect a) Food Security & Agriculture, b) Ecosystem Health and Biodiversity, c) Water Quality & Hydrology, & d) Community Safety and Infrastructure?
3. If these soil-related problems continue to occur, what are the possible long-term impacts they might have on humans?

Link of sample rubrics to this activity:

<https://tinyurl.com/bdnrv39u>

Option 2: Video Reflection

Procedure:

If time is limited, the teacher may use a shorter video titled “How Soil Pollution Affects Agriculture and Ecosystems: Causes, Effects and Sustainable Solutions”

Link:

<https://www.youtube.com/watch?v=LnSMquLBtdk>

Students may pair up or form 3 member each group and share their reflections with a classmate to promote peer connection and communication.

After watching the video, ask students to reflect on the guide questions.

Encourage your students to write a short reflection or discuss in small groups. Then, invite volunteers to share their thoughts to the whole class. This activity aims to make the lesson relevant.

Day 3: Option 1 Mix & Match

After learning its causes and effects, gather insights from your students how we can address these soil-related problems. Allow your students to explore the different sustainable soil conservation methods such as Crop rotation, Contour plowing, Terracing, Agroforestry, Organic farming, Mulching, Reforestation,

	<ol style="list-style-type: none"> 1. Group your class into small group of 2-3 members per group. 2. Show a video on “How Soil Pollution Affects Agriculture and Ecosystems: Causes, Effects and Sustainable Solutions” to your students using this link https://www.youtube.com/watch?v=LnSMquLBtdk 3. In each group, let your students discuss the causes and effects of the soil-related problems to a) Food Security & Agriculture, b) Ecosystem Health and Biodiversity. And guide them to brainstorm the possible effects of these soil pollution to a) Water quality & Hydrology, & b) Community Safety and Infrastructure? <p>Guide Questions:</p> <ol style="list-style-type: none"> 1. What do you think are the causes of these soil-related problems such as Soil Erosion, Deforestation, Mining, Overgrazing, and Improper Waste Disposal? 2. How does soil-related problems affect Food Security & Agriculture, Ecosystem Health and Biodiversity? Do you think it has also an impact on a) Water Quality & Hydrology, & b) Community Safety and Infrastructure? <p>DAY 3</p> <p>2.Discussing New Concept</p> <p><i>In this part, gather insights from your students how we can address these soil-related problems after learning its causes and effects. Allow your students to explore the different sustainable soil conservation methods such as Crop rotation, Contour plowing, Terracing, Agroforestry, Organic farming, Mulching, Reforestation, Proper waste management and relate these methods to local agricultural and environmental practices.</i></p> <p>Option 1: Mix & Match</p> <p>Procedure:</p>	<p><i>Proper waste management and relate these methods to local agricultural and environmental practices.</i></p> <p>Say: <i>Now that you learned the causes and effect of these soil-related problems, let’s apply what you have learned. I will divide the class into 5 groups and I will give you two sets of cards containing Soil-related problems and Sustainable soil practices</i></p> <p>What: <i>Students collaborate in groups to analyze soil-related problems and match them with appropriate sustainable soil conservation practices. Students justify their answers and present their explanations to the class.</i></p> <p>Do: <i>Divide the class into 5 groups and distribute two set of cards. Facilitate group presentations, where students explain their matches and how the practices help address issues related to agriculture, water quality, ecosystem protection, and community safety. Then, provide feedback and summarize the correct matches after the presentations.</i></p> <p>Option 2: Jigsaw Exploration</p> <p>Say: <i>To deepen your understanding on these soil-related problems, we will have an activity</i></p>
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1. Divide the class into 5 groups.
 2. Provide each group with two sets of cards containing (Soil-related Problems & Sustainable Soil Practices) and Manila Paper.
 3. **Soil-related problems:** soil erosion, deforestation, overgrazing, mining, improper waste disposal. **Sustainable soil practices:** crop rotation, contour plowing, terracing, agroforestry, organic farming, mulching, reforestation, proper waste management.
 4. Ask students to analyze and match which conservation method/s can best address each soil problem.
 5. Groups present their matches to the class and explain how the method helps solve the problem, especially in terms of agriculture, water quality, ecosystem protection, and community safety.
- Note to teacher:** In this activity, you may use the pictures used in Option 2 Jigsaw Exploration for sustainable soil practices, and Option 1 Picture Identification for soil-related problems.
- Link to the activity:** <https://tinyurl.com/345hhsyt>

Option 2: Jigsaw Exploration

Procedure:

1. Divide the class into 8 with 5 members and assign each group with one soil conservation method:

G-1: Crop Rotation



G-2: Contour plowing



G-3: Terracing



called Jigsaw Exploration to understand the different soil conservation methods. First, I will divide you into groups with eight members each. Each group will be assigned with one soil conservation method. After your discussions, we will rearrange the groups so that each new group has one representative from each expert group. Your task is to teach your assigned soil conservation method to your new group members.

What: Students collaborate in expert groups to analyze and understand an assigned soil conservation method. They then share and teach this knowledge to members of new groups, allowing all students to learn about different soil conservation practices.

Do: Divide the class into groups of eight members. Assign one soil conservation method to each group. Ask each representative to explain their soil conservation method to the new group members. Facilitate sharing and provide clarifications or additional explanations if necessary.

This activity promotes active, collaborative, and inquiry-based learning. Instead of simply receiving information, students analyze, discuss, and teach concepts to their peers, which

G-4: Agroforestry

G-5: Organic farming

G-6: Mulching



G-7: Reforestation



G-8: Proper Waste Disposal

2. Provide each group with a short description, diagram, or example of their assigned method.
3. Rearrange the class into new groups so that each new group has at least one representative from the expert groups. Each student explains their assigned soil conservation method to their new group.

Guide Questions:

1. What is the soil conservation method assigned to your group? Describe that particular soil conservation method.
2. How does it help prevent soil-related problems?
3. What soil-related problem (Soil Erosion, Mining, Overgrazing, Deforestation, and Improper Waste Disposal) does it address?
4. How can this practice be applied in our local farms or community?

3. Developing Mastery

deepens their understanding of soil conservation practices. This also develops critical thinking, communication, and collaboration skills. By connecting soil conservation methods to local farms and community practices, students apply scientific knowledge to real-life environmental issues, helping them appreciate the importance of sustainable soil management for agriculture, ecosystem protection, and community safety.

*In **developing students mastery** of the topic, select at least 1 of these activities.*

Option 1: Soil Conservation Scenario Challenge.

Say: *Now that you learned the different soil conservation method, we will have another group activity where you will analyze a community scenario related to soil problems to develop your mastery of the lesson. I will divide the class into five groups, and each group will receive a scenario involving issues such as soil erosion, deforestation, overgrazing, mining, or improper waste disposal.*

What: *Students work collaboratively in groups to analyze a real-life community scenario involving soil-related problems. They will identify the problem,*

Option 1: Soil Conservation Scenario Challenge

Procedure:

1. Divide the class into 5 groups.
2. Provide each group with a community scenario involving soil-related problems such as soil erosion, deforestation, overgrazing, mining, or improper waste disposal.



Soil Erosion



Deforestation



Overgrazing



Mining



Improper Waste Disposal

3. Each group analyzes the scenario
4. Groups present their solutions and explain how the methods improve Food Security & Agriculture, Ecosystem Health and Biodiversity, Water quality & Hydrology, & Community Safety and Infrastructure?

Guide Questions:

1. What is the soil-related problem in the scenario?
2. What are the possible causes of these soil-related

analyze its causes, propose appropriate soil conservation methods, and explain how these solutions contribute to environmental sustainability and community well-being.

Do: *Divide the class into five groups and provide each group with a community scenario involving a soil-related problem. Students analyze their scenario, answer the guide questions about the soil problem, its causes, and possible conservation methods. Each group then presents their solutions to the class, explaining how the proposed soil conservation methods improve food security, ecosystem health, water quality, and community safety. After that, facilitates the discussion and ask probing questions and provides feedback to reinforce key learning points.*

Option 2: Soil Conservation Method Role-Play

Say: *To enhance your understanding of the lesson, we will have a fun group activity where each group will be assigned a **soil conservation method**. Your task is to prepare a **short role-play or demonstration** showing how the method works, which soil problem it addresses, and its benefits to agriculture and the environment. After your presentation, the rest of*

	<p>problems?</p> <ol style="list-style-type: none"> 3. Which soil conservation methods can solve the problem? 4. Why is this method effective for this problem? 5. Can this method be applied in our local community? 6. What benefits might farmers or the environment gain from it? <p>Option 2: Soil Conservation Method Role-Play</p> <p>Procedure:</p> <ol style="list-style-type: none"> 1. Assign each group a soil conservation method (e.g., crop rotation, terracing, mulching, etc). 2. Students prepare a short role-play or demonstration showing: how the method works, which soil problem it addresses, its benefits to a) Food Security & Agriculture, b) Ecosystem Health and Biodiversity, c) Water quality & Hydrology, & d) Community Safety and Infrastructure. 3. Provide them roles to portray such as Farmer, Mayor, Barangay Captain, & etc. 4. Groups perform their role-play in front of the class. 5. After each presentation, classmates identify: the conservation method shown, and the soil problem it solves. 	<p><i>the class will identify the conservation method demonstrated and the soil problem it solves.</i></p> <p>What: Students collaborate in groups to create and perform a role-play illustrating a soil conservation method. Classmates observe and identify the method and the soil problem it addresses.</p> <p>Do: Assign each group a soil conservation method and instructs] them to prepare a short role-play highlighting how the method works, the soil problem it addresses, and its benefits to agriculture and the environment. After each presentation, students will identify the conservation method and the soil problem it solves.</p> <p><i>This activity connects learning to real-world soil conservation practices, making the content meaningful for students. It is reflective and responsive as students actively demonstrate understanding, evaluate solutions, and engage with peers.</i></p>
<p>C. Demonstrating Knowledge and Skills</p>	<p><u>DAY 4:</u></p> <p>1. Finding Practical Application</p> <p>Option1: Community Soil Survey</p> <p>Procedure:</p> <ol style="list-style-type: none"> 1. Divide students into small groups. 2. Assign each group to observe or interview local farmers, gardeners, or community members about current soil management 	<p>Say: Today, we are going to apply what you have learned from our previous lessons, we will work in small groups to observe or interview local farmers, gardeners, or community members about their current soil management practices. Your goal is to gather information on existing practices, soil problems, and any current conservation</p>

	<p>practices. They should gather information such as: existing farming practices (e.g., planting, grazing, waste disposal), soil problems observed (erosion, degradation, contamination), current conservation efforts (if any).</p> <p>3. Students analyze their survey results and identify gaps where soil conservation can be improved.</p> <p>4. Each group prepares a short presentation proposing locally feasible solutions, relating the sustainable soil conservation methods learned in class (e.g., mulching, contour plowing, agroforestry)</p> <p>Link to the worksheet with application of Design Thinking Approach: https://tinyurl.com/5e5xekhu</p> <p>Option 2: Sustainable Farm Model Procedure:</p> <ol style="list-style-type: none"> In small groups, ask students to design a plan or model for a sustainable farm or garden within the school or local community. The design should include: <ol style="list-style-type: none"> Areas prone to soil erosion or poor fertility Selected soil conservation methods suitable for each area (e.g., terracing for slopes, agroforestry along boundaries, mulching in gardens) Strategies for water conservation and proper waste management Each group will create a visual map or model of their farm/garden and prepare a brief oral presentation explaining: <ol style="list-style-type: none"> How each method contributes to soil health Why the method is appropriate for the local environment How it benefits agriculture, water quality, and the ecosystem as a whole? <p>2. Making Generalization</p>	<p><i>efforts, then propose locally feasible solutions based on what you have learned in our class.</i></p> <p>What: Students collect and analyze information on local soil management practices, identify gaps in soil conservation, and create presentation proposing sustainable methods to use such as mulching, contour plowing, or agroforestry.</p> <p>Do: Divide students into small groups and instruct them to conduct observations or interviews with local farmers or community members, analyze the collected data to identify soil problems and gaps in conservation, and prepare a short presentation proposing practical solutions using sustainable soil conservation methods using the worksheet provided to them.</p> <p><i>This activity connects classroom learning to real local practices, making solutions meaningful and context-specific. Students critically evaluate current soil management and propose actionable improvements that address community needs.</i></p> <p>Option 2: Sustainable Farm Model Say: This time we are going to apply everything you have learned from our previous discussions. You</p>
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	<p>Option 1: SOIL CONSERVATION METHOD PRESENTATION</p> <p>Procedure:</p> <p>1. Divide students into two or three groups, each representing different perspectives:</p> <p>Group 1: Focus on agriculture and food security</p> <p>Group 2: Focus on ecosystem and biodiversity</p> <p>Group 3: Focus on community safety and water safety.</p> <p>2. Provide a soil-related problem scenario, e.g., erosion on a sloping farm or deforestation near a watershed.</p> <p>3. Each group researches and presents which soil conservation method(s) they believe are best to address the problem from their assigned perspective.</p> <p>4. Group presents their choices, highlighting advantages and limitations, while considering practicality for the local community.</p> <p>5. After the debate, facilitates a class discussion to synthesize the findings and highlight how multiple conservation methods can work together.</p>	<p>are going to design a sustainable farm or garden in the school or local community, showing areas prone to soil problems and selecting suitable soil conservation, water, and waste management strategies. You will create a visual map or model and explain how your methods support soil health, agriculture, water quality, and the ecosystem.</p> <p>What: Students collaborate to plan and model a sustainable farm or garden, integrating soil conservation, water management, and waste strategies, and prepare a brief presentation explaining their choices.</p> <p>Do: Ask students to work in small group to design a sustainable farm or garden, create a visual map or model highlighting soil conservation methods and environmental strategies, and present their plan in the class.</p> <p>This activity applies classroom knowledge to real-world local contexts. Students critically design solutions that improve soil and environmental health while addressing community needs.</p>
<p>V. ASSESSMENT (Assessing Learnings)</p>	<p>I. Encircle the letter of the correct answer.</p> <p>1. After a strong typhoon, farmers noticed that the topsoil from their sloping farms had been washed into the nearby river, leaving the land less fertile for planting. Which soil-related problem is illustrated in this situation?</p> <p>A. Mining B. Soil erosion C. Overgrazing D. Improper waste disposal</p>	

2. In a rural community, large areas of forest were cleared to create space for farms and housing. Over time, wildlife disappeared and the soil became dry and less productive. What soil-related problem is described?

- A. Overgrazing B. Mining C. Deforestation D. Soil erosion

3. A grassland area where livestock continuously graze has gradually lost most of its vegetation. What is the most likely cause of the soil problem in this area?

- A. Excessive mining B. Overgrazing by livestock C. Heavy rainfall D. Tree planting

4. Soil erosion carries large amounts of sediments into rivers and lakes. How does this affect water quality and hydrology?

- A. It improves water clarity. B. It increases soil fertility in farms.
C. It makes water muddy and harms aquatic life. D. It prevents flooding.

5. A mining site leaves large open pits and unstable soil surfaces in a community. Which effect is most likely to threaten community safety and infrastructure?

- A. Increased biodiversity B. Landslides and damage to roads and houses
C. Improved irrigation systems D. Increased agricultural production

6. A farmer plants corn one season and legumes the next season to maintain soil nutrients and reduce pests. Which sustainable soil conservation practice is being used?

- A. Crop rotation B. Reforestation C. Mulching D. Contour plowing

7. Farmers living in mountainous areas create step-like levels on slopes to prevent soil from being washed away by rainwater. What soil conservation method is this?

- A. Organic farming B. Terracing C. Agroforestry D. Crop rotation

8. In some communities, farmers plant trees together with crops to improve soil fertility and prevent erosion while also producing fruits and timber. Which method is being applied?

- A. Contour plowing B. Agroforestry C. Mulching D. Reforestation

9. Students conducted a survey in their community and discovered that garbage is often dumped near agricultural fields. Which practice would best help protect soil health?

- A. Burning waste regularly B. Dumping waste in rivers
C. Practicing proper waste segregation and disposal D. Ignoring the waste problem

10. After reviewing information from agricultural studies, students found that planting cover crops and applying compost improves soil fertility. What is the main purpose of recommending this practice to farmers?

- A. To increase soil pollution B. To maintain soil health and support sustainable farming
C. To reduce plant growth D. To remove nutrients from the soil

(Part I. Answer Key 1. B 2. C 3. B 4. C 5. B 6. A 7. B 8. B 9. C 10. B)

II. Essay

Pointing System:

	<ul style="list-style-type: none"> • 3 pts – The answer is accurate, complete, and clearly demonstrates understanding of the physics principle using appropriate science terms or examples. • 2 pt – The answer is partially correct, related to the question, and shows basic understanding, but lacks depth or clarity. • 1 pt – The answer is incorrect, incomplete, or not related to the question. • 0 pt – No answer provided <ol style="list-style-type: none"> 1. Identify two common soil-related problems in your community. Explain their possible causes and effects on agriculture and food security. 2. Choose one soil-related problem (e.g., soil erosion, deforestation, overgrazing, mining, or improper waste disposal). Explain how this problem can affect Food Security & Agriculture, Ecosystem Health and Biodiversity, Water quality & Hydrology, & Community Safety and Infrastructure? 3. Using information from secondary sources or community observations, propose two sustainable farming or land management practices that can help conserve soil in your school or local community. Explain how these practices improve soil health and environmental sustainability.
VI. REFLECTION	<p>Teachers are encouraged to record relevant observations or any critical teaching events that influence on the attainment of the lesson objectives. You can also note tasks that will be continued the next day or additional activities needed. Entries on this section are the teacher's reflection on the implementation of the entire lesson which will serve as inputs for the LAC sessions.</p>
VII. USE OF GENERATIVE AI	<p>In preparing this Learning Exemplar (LE), the author(s) used Chatgpt & Google AI in order to check grammar and improve word phrasing and providing additional sources. The author(s) reviewed and finalized the writing of the content. The author(s) take(s) full responsibility for the content of this LE.</p>

Lesson Title/Topic	Energy Sources	Lesson Exemplar	17
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I. OBJECTIVES	
A. Content Standard	The learners learn that the differences between renewable and non-renewable energy sources are key to making sustainable energy choices and reducing environmental impacts.
B. Performance Standard	By the end of the quarter, learners describe the origin of the solar system and Earth's historical evolution. They relate Earth's unique position in the solar system to its composition, structure, and the dynamic nature of its outer layers. Learners explain how scientists determine the nature of Earth's interior. They also collaboratively create detailed models and scientific analyses and use evidence-based findings to illustrate the nature and composition of the Earth.
C. Learning Competencies	The learners distinguish between renewable and non-renewable energy sources based on their characteristics, availability, use, and environmental impact
II. REFERENCES and MATERIALS (Selecting Resources and Materials)	<p>Admin. 2022a. "Difference Between Renewable and Non-renewable Resources." BYJUS. October 20, 2022. https://byjus.com/biology/difference-between-renewable-and-non-renewable-resources/.</p> <p>"Non-Renewable Energy - Knowledge Bank - Solar Schools." n.d. https://solarschools.net/knowledge-bank/non-renewable-energy.</p> <p>United Nations. n.d. "What Is Renewable Energy? United Nations." https://www.un.org/en/climatechange/what-is-renewable-energy.</p> <p>U.S. Energy Information Administration. n.d. "What Is Energy? Sources of Energy." US Energy Information Administration. Accessed March 14, 2026. https://www.eia.gov/energyexplained/what-is-energy/sources-of-energy.php.</p>
III. CONTENT (Sequencing Content)	Energy Sources
IV. OBJECTIVES (Setting Clear Objectives and Analyzing the Tasks)	<ol style="list-style-type: none"> 1. Describe renewable and non-renewable energy sources; 2. Cite examples of renewable and non-renewable energy sources; and 3. Compare and contrast renewable and non-renewable energy sources using a chart that highlights their characteristics, availability, household and industrial applications, and environmental impact.

IV. PROCEDURES

ANNOTATIONS

A. Activating Prior Knowledge

Day 1:

1. Activating Prior Knowledge

Option A: The Great Energy "Source-to-Socket" Hunt

Objective: To identify energy-consuming items in the classroom and community and "trace" them back to their raw power sources to understand sustainability.

Part 1: The 3-Minute Speed List

- Give students exactly 3 minutes to list as many energy-consuming items as possible. They must look in three "zones":
 1. Zone 1 – Personal Zone: Items inside their bag or personal belongings
 2. Zone 2 – Classroom Zone: Items found inside the classroom
 3. Zone 3 – Community Zone: Items seen on their way to school

Zone 1 (inside your bag)	Zone 2 (classroom)	Zone 3 (community)
(example: calculator)	(example: electric fan)	(example: motorcycle)
1.	1.	1.
2.	2.	2.
3.	3.	3.
4.	4.	4.
5.	5.	5.

(Note: Students may add as many items as they can within the time limit.)

Part 2: The Source Trace

Have students review their list and classify each item based on its primary energy source: Group A – items powered by electricity, and Group B – items powered by fuel.

Group A (Items powered by electricity from power grid)	Group B (Items powered by fuel)

This activity aims to spark curiosity and encourage students to observe their everyday surroundings through a scientific lens.

Say:

"Class, for the next three minutes, you will be Energy Detectives! List as many items as you can that use energy. Look in three zones: your bag (Zone 1), this classroom (Zone 2), and your community (Zone 3). Ready? Go!"

After the listing phase, instruct students to classify the items into two groups: Group A, items that operate using electricity, and Group B, items that run on liquid fuels such as gasoline or diesel.

After the activity, facilitate a class reflection using the guide questions. You may

(Teacher Tip: Clarify that even if electricity comes from mixed sources, students should focus on how the device is commonly powered.)

Guide Questions for Reflection

1. Looking at the items you listed, what types of energy sources do you think are used to power them?
2. Which items in your list rely on electricity from the power grid, and which rely on liquid fuels such as gasoline or diesel?
3. Where do you think the electricity from the wall outlet originally comes from? What natural resources might be used to generate it?

Option B: Conduct a “2 Pics 1 Word – Energy Edition” activity in which students determine the word or concept depicted in the images. Ask volunteers to guess the word or concept represented.

<p>Image 1:</p>  <p>Answer: Solar</p>	<p>Image 2:</p>  <p>Answer: Wind</p>
<p>Image 3:</p>  <p>Answer: Hydroelectric</p>	<p>Image 4:</p>  <p>Answer: Nuclear</p>
<p>Image 5:</p>  <p>Answer: Geothermal</p>	<p>Image 6:</p>  <p>Answer: Petroleum</p>

After the game, ask the students the following questions:

1. Were you able to identify all the energy sources? Can you name them?
2. Which of these energy sources are present in your community or used to power your homes?
3. Which sources provide energy for vehicles or charge your cellphones?

invite a few volunteers to share their responses.

Show a slide presentation or prepare printed images for the "2 Pics 1 Word" game. Flash each image pair for 10-15 seconds. Validate all reasonable guesses and write the correct concept/s on the board. Once all five concepts are revealed, transition to the reflection question. Give learners 1-2 minutes of silent thinking time, then call on volunteers to answer the questions.

Link for the “2 Pics 1 Word – Energy Edition” Activity Slide Presentation:
<https://tinyurl.com/2Pics1WordSlidePDF>

	<p>4. Which of these energy sources are renewable? Which are non-renewable?</p> <p>2. Establishing the Purpose of the Lesson</p> <p>Based on the previous activity, guide learners to reflect on the lesson's goal and relevance through a <i>Think–Pair–Share</i> activity.</p> <p><i>Step 1 – Think:</i></p> <p>Have students write their answers to the reflection questions in their notebooks. Encourage them to express their ideas freely using the prompts as guides.</p> <p>Reflection Questions:</p> <ol style="list-style-type: none"> 1. Which energy sources do you know, and where have you seen or used them? <ul style="list-style-type: none"> ○ I know that energy can come from... ○ One energy source I have seen or used is... ○ In our home/community, we use... for... 2. Why is it important to identify different energy sources, their features, and applications? <ul style="list-style-type: none"> ○ It is important to identify energy sources because... ○ We need to understand energy sources so that we can... 3. How does knowing the key features of energy sources help in managing them effectively? <ul style="list-style-type: none"> ○ Knowing the features of energy sources helps us to... ○ This knowledge allows us to choose... ○ It helps in managing energy because... <p><i>Step 2 – Pair:</i> Let students discuss their answers with a partner, comparing ideas and examples.</p> <p><i>Step 3 – Share:</i> Allow pairs to share their insights with the class.</p>	<p>The goal is to move students beyond simply identifying energy sources and guide them toward understanding the importance of recognizing their features, impacts, and applications, as this is the main purpose of the lesson. Ask learners to write the reflection questions in their notebooks and provide sentence starters to help them effectively formulate their ideas and build confidence during sharing.</p> <p>Have students pair up and discuss their answers and ideas with a classmate. Then, invite a few volunteers to share their insights with the whole class. Manage time effectively and consolidate their ideas before proceeding to the next phase of the lesson.</p>
<p>B. Instituting New Knowledge</p>	<p>1. Presenting Examples</p> <p><i>Activity: Exploring Energy Sources and Classification</i></p> <p>Objective: Students will identify and classify energy sources as renewable or non-renewable by analyzing visual clues and explaining their reasoning.</p>	<p>In this part of the lesson, the teacher engages students in analyzing pictures of different energy sources, grouping them as renewable or non-renewable, and</p>

	<p>Materials Needed:</p> <ul style="list-style-type: none"> • Manila paper (with two labeled columns: Renewable and Non-Renewable) • Printed pictures of various energy sources (e.g., solar panels, wind turbines, hydroelectric dam, coal plant, petroleum, natural gas, nuclear plant, geothermal) • Tape or glue for pasting pictures • Markers <p>Instructions:</p> <ol style="list-style-type: none"> 1. Divide the class into five groups (adjust based on class size). 2. Provide each group with a set of energy source pictures (without labels). 3. Task: <ul style="list-style-type: none"> ○ Sort the pictures into renewable and non-renewable energy sources. ○ Arrange the pictures on the table, discuss as a group, then paste them in the correct columns on the Manila paper. 4. Presentation: <ul style="list-style-type: none"> ○ Assign a reporter to present the group's output and explain their classification. 5. Class Discussion: <ul style="list-style-type: none"> ○ Facilitate a discussion using these guide questions: <ul style="list-style-type: none"> ▪ <i>What criteria did you use to classify the energy sources?</i> ▪ <i>How would you define renewable and non-renewable?</i> ▪ <i>Which sources are renewable, and which are non-renewable?</i> ▪ <i>Which were easy or difficult to classify? Why?</i> ▪ <i>What helped you decide how to group them?</i> <p><u>Day 2</u></p> <p>2. Discussing New Concept</p> <p>Start Day 2 by connecting it to the previous day's lesson. Ask students to recall the energy sources they explored and how they classified them as renewable or non-renewable. After a brief recap, proceed with activities that guide students in identifying the key features of renewable and non-renewable energy sources.</p>	<p><i>identifying their applications in households and industries.</i></p> <p><i>After the activity, the teacher facilitates group presentations and a brief discussion to clarify ideas and address misconceptions. The teacher then asks the groups to explain their reasoning for classifying the energy sources as renewable or non-renewable.</i></p> <p><i>Based on the previous activity, ask students to recall the two main groups of energy sources and identify which are renewable and which are non-renewable. Then</i></p>
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Activity: Exploring Renewable and Non-Renewable Energy Sources
 Objective: Students will analyze renewable and non-renewable energy sources by examining their characteristics, availability, household and industrial applications, and environmental impact.

Activity Steps:

1. Grouping and Materials

- Divide the class into five groups.
- Provide each group with information snippets, felt-tip pens (e.g., Pentel pens), manila paper and masking tape.
- Display a comparison chart on the board to serve as a reference framework:

Feature	Renewable Energy Sources	Non-Renewable Energy Sources
Characteristics		
Availability		
Household Applications		
Industrial Applications		
Environmental Impact		

2. Assigning a feature

- Assign each group a feature from the comparison chart:
 - Group 1: Characteristics
 - Group 2: Availability
 - Group 3: Household Applications
 - Group 4: Industrial Applications
 - Group 5: Environmental Impact
- Distribute info snippets to each group so they can extract accurate details regarding their assigned feature.
- Allow 10 minutes for groups to review the materials and gather their key points.

prompt them to explain how they determined whether an energy source is renewable or non-renewable.

After the recap, guide students through the activity by clearly explaining the procedures, providing the necessary materials, and allocating sufficient time for each part of the task. Facilitate the learning process by encouraging active participation, guiding discussions, and allowing students to process their ideas. After the activity, provide time for reflection so learners can connect their experiences with the key concepts learned.

Download the information snippets from the link below and distribute it to the assigned groups as a reference for the activity:
<https://tinyurl.com/ArticleEnergySources>

Group 1- Characteristics of Renewable and Non-Renewable Resources

The way we generate power depends on the unique traits of our natural resources. Some energy sources are naturally replenished on a human timescale, ensuring they are available for generations to come. These options are generally cleaner, producing far fewer pollutants, though they are often intermittent (weather-dependent) because they rely on the sun or wind. On the other hand, traditional fuels exist in a finite supply because they are formed from organic matter that takes millions of years to form. These resources are valued for their high energy density, meaning a small amount of fuel produces a large amount of power, and they are reliable because they provide constant 'baseload' power to the grid 24 hours a day.

Group 2- Availability of Renewable and Non-Renewable Resources

The way we access energy depends on whether a resource is naturally replaced or trapped in the ground. Some sources, like the Sun, wind, and water, are considered virtually inexhaustible because they will not run out even after millions of years of use. However, these are geographically dependent, meaning their potential varies by location, such as more solar being available in deserts than in rainy regions. In contrast, other resources are depleted over time because we consume them much faster than nature can replace them. These fuels are not found everywhere but are concentrated in specific geological locations, such as coal seams and oil fields, which requires us to find and extract them from deep within the Earth.

Group 3- Household Applications of Renewable and Non-Renewable Resources

Modern homes rely on a variety of energy systems for comfort and daily tasks. Many homeowners are now switching to sustainable options, such as installing rooftop solar panels to generate their own electricity or using solar water heaters for warm showers. Some larger properties might even use small-scale wind turbines or geothermal heat pumps to regulate indoor temperatures. Despite these green advancements, many households still depend on traditional fuels, such as natural gas for cooking or heating and gasoline for cars. Additionally, most homes are connected to grid electricity, which is often coal or gas-derived, meaning the power for our lights and appliances often starts at a large fossil fuel plant.

Group 4- Industrial Applications of Renewable and Non-Renewable Resources

The global industry is currently undergoing a massive shift in how it powers its facilities. Many companies are moving toward sustainable solutions, with a growing use in 'green' hydrogen production to replace carbon-heavy fuels. Large-scale operations are also adopting bio-power for factories and building their own corporate solar farms to ensure a steady supply of clean electricity. Despite these changes, several sectors still rely on non-renewable sources for high-heat processes like those used in steel and cement manufacturing. Fossil fuels also remain critical as petrochemical feedstocks for making plastics and chemicals. Because of these intense requirements, much of today's heavy manufacturing still depends on the high energy density provided by coal, oil, and natural gas.

Group 5- Environmental Impact of Renewable and Non-Renewable Resources

The environmental impact of our energy choices depends on whether we prioritize long-term atmospheric health or immediate land-use efficiency. Non-renewable resources are the primary contributors to global climate change because burning them releases massive amounts of greenhouse gases and pollutants that degrade air quality and cause acid rain. Furthermore, extracting these fuels often leads to habitat destruction and the risk of toxic spills. In contrast, renewable resources are significantly cleaner, producing virtually no emissions during operation and helping to mitigate the warming of our planet. However, they are not entirely footprint-free; building the necessary infrastructure requires the mining of rare minerals and can lead to localized ecological shifts, such as disrupted bird migrations or altered river ecosystems. While all energy production has a cost, transitioning to renewables shifts the burden from permanent global damage to manageable environmental trade-offs.

3. Completing the Comparison Chart

- Instruct groups to write their extracted information on the manila paper, following the format shown in the comparison chart on the board.

4. Presentation of Outputs

- Have each group present and explain their findings to the class.
- Facilitate a short Q&A session where the teacher or classmates can ask follow-up questions.
- Evaluate groups based on content accuracy, clarity of presentation, and quality of reasoning.

5. Class Discussion and Reflection

- Once all outputs have been posted, facilitate a class discussion and guide students in reflecting on their findings.

Guide Questions:

- 1. What feature was assigned to your group, and what key differences did you observe between renewable and non-renewable energy sources based on this feature?*
- 2. How do renewable and non-renewable energy sources differ in terms of their applications in households and industries?*
- 3. What patterns can you identify in the advantages and limitations of renewable and non-renewable energy sources, especially in terms of availability and environmental impact?*
- 4. If you were to recommend an energy source for long-term use in your community or country, which would you choose and why?*

This activity engages

3. Developing Mastery

Activity: Energy Source Application Scenarios

Objective: Students will apply their understanding of renewable and non-renewable energy sources by determining the most suitable energy source for specific household and industrial scenarios.

Activity Steps:

1. Prepare 5 short scenarios on cards or the board.
2. Divide students into their previous groups. Each group receives a scenario card.

Group 1: A densely populated district in Quezon City has residents with limited rooftop space. Some buildings have open rooftops; others are shaded by taller structures. Residents want to reduce electricity costs and rely less on the grid.

Group 2: A small port facility on a coastal island in Palawan requires a reliable power supply to run cranes, warehouses, and security systems. Wind is strong at times but calm on other days, and fuel from the mainland is limited and expensive.

Group 3: A village in the Cordillera mountains is near a small river and experiences heavy rainfall for part of the year. Households currently rely on kerosene lamps. Transporting fuel is costly.

Group 4: A boutique resort in Batangas is near geothermal activity but also has access to solar energy during the day. The resort needs electricity for hot water, lighting, and air conditioning, but demand fluctuates with tourist seasons.

Group 5: Medium-scale factories in Metro Manila require reliable 24/7 power. Nearby options include natural gas pipelines, limited solar exposure, and occasional strong winds. Environmental regulations are strict.

3. Task:

- Students shall identify the most appropriate energy source(s) for the scenario. Have them justify their choice based on characteristics, availability, applications, and environmental impact.
4. Groups present their answers briefly to the class (2–3 minutes per group).

learners in applying their understanding of renewable and non-renewable energy sources through real-world scenarios. Students analyze contextual situations, evaluate available energy options, and justify their choices based on key factors such as availability, efficiency, cost, and environmental impact. The task promotes critical thinking, collaboration, and evidence-based decision-making. The teacher facilitates discussion, clarifies misconceptions, and guides learners in connecting theoretical concepts to practical energy solutions in different settings.

Distribute scenarios to groups, guide students to choose and justify the most suitable energy source, roam around to prompt thinking, and facilitate brief presentations and reflection using guiding

	<p>Reflection Guide Questions:</p> <ol style="list-style-type: none"> 1. <i>Why did your group choose this particular energy source for your scenario? Which features or characteristics influenced your decision?</i> 2. <i>How does the chosen energy source meet the needs of households or industries in the scenario?</i> 3. <i>Could another energy source have worked in this scenario? Why or why not?</i> 4. <i>How do environmental factors or constraints in the scenario affect the choice of energy source?</i> 5. <i>What are the advantages and limitations of the energy source you selected in this context?</i> 6. <i>What lessons from this activity can help you make better decisions about energy use in real-life situations?</i> 	<p>questions.</p>
<p>C. Demonstrating Knowledge and Skills</p>	<p><u>Day 3</u></p> <p>1. Finding Practical Application</p> <p><i>Activity: “Energy Decision-Making: Evaluating Real-World Energy Challenges”</i></p> <p>Objective: Students will apply their understanding of renewable and non-renewable energy sources by analyzing real-world energy issues and making informed decisions based on environmental, economic, and societal considerations.</p> <p>Procedure:</p> <ol style="list-style-type: none"> 1. Divide the class into two groups. <ul style="list-style-type: none"> o Group 1 will analyze Nuclear Energy Dilemma. o Group 2 will analyze Petroleum Supply Challenges. <div style="border: 1px solid black; padding: 10px; margin-top: 10px;"> <p><i>Group 1 – Nuclear Energy Dilemma</i></p> <p>The Philippine government is considering expanding its nuclear energy program to meet the growing electricity demands in Metro Manila and nearby regions. Nuclear power plants can produce large amounts of electricity with relatively low greenhouse gas emissions. However, there are concerns about potential radioactive waste, long-term environmental hazards, and the health risks associated with accidents. Your task is to decide whether the country should continue investing in nuclear energy or scale it back. Justify your decision considering energy demand, environmental impact, safety, and economic feasibility.</p> <p>Decision Question: <i>Should the country continue using nuclear energy despite the environmental and health risks? Why or why not?</i></p> </div>	<p>Guide students in applying their understanding of renewable and non-renewable energy sources by analyzing real-world scenarios. Divide the class into two groups and assign each group a scenario to examine, while reminding students that they will formulate their responses individually. Allow them time to read and analyze the situation, then instruct them to decide whether the energy source should continue to be used, reduced, or replaced, and to justify their decision based on environmental, economic, and societal</p>

Group 2 – Petroleum Supply Challenges

The Philippine government is considering its heavy reliance on petroleum to meet the growing transportation and electricity demands in Metro Manila and nearby regions. Petroleum can produce large amounts of energy with high energy density, utilizing a well-established infrastructure for easy distribution. However, recent conflicts in the Middle East have disrupted supply chains, causing sharp price hikes, and there are deep concerns about heavy greenhouse gas emissions and non-renewable resource depletion. Your task is to decide whether the country should continue investing in petroleum or scale it back. Justify your decision considering energy demand, environmental impact, supply security, and economic feasibility.

Decision Question: *Should the country continue relying on petroleum despite supply uncertainties, or switch to alternative energy sources? Explain your reasoning.*

2. Although students are assigned to groups, they will analyze the scenario individually and prepare their own responses.
3. Give students a few minutes to read and analyze their assigned scenario. Ask them to determine whether the energy source should continue to be used, reduced, or replaced, and to justify their reasoning.
4. After the analysis period, call on several students from each group to share their opinions and explanations with the class.
5. Facilitate a brief class discussion to compare viewpoints and highlight the factors that influence energy decisions.

2. Making Generalization

Activity: Energy in Focus: Discovering Connections Among Energy Sources

Objective: Students will synthesize their learning by identifying patterns, relationships, and key principles between renewable and non-renewable energy sources. They will identify key features and visually organize their insights using a concept map.

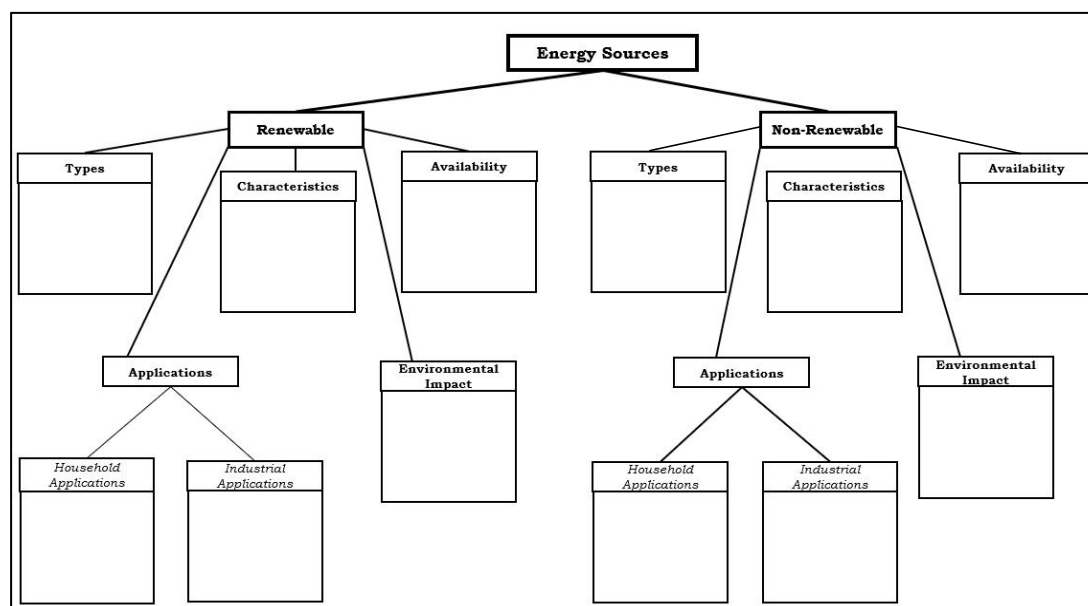
Materials Needed: manila paper, markers, paper strips, reference (completed comparison chart from the previous day)

considerations. After the analysis period, invite several students from each group to share their viewpoints. Facilitate a brief discussion by highlighting similarities and differences in their responses and by emphasizing the factors that influence real-world energy decisions.

Guide students in synthesizing their learning by reviewing the outputs from the previous activity and explaining that the goal is to identify connections and patterns among energy sources. Introduce the concept

Activity Steps:

1. Revisiting previous output – Allow the students to review the outputs and comparison chart from the previous activity.
2. Clarifying the purpose – Explain that the goal of the activity is to synthesize their learning by identifying connections, patterns, and overarching principles related to energy sources.
3. Introducing the concept map – Introduce the concept map as a visual tool for organizing and connecting ideas.
4. Constructing the concept map – Instruct students to create a concept map with the central theme “Energy Sources – Renewable vs. Non-Renewable.” From the central idea, branch out into the two main categories: Renewable and Non-Renewable energy sources. From these main categories, further branch out to include their types, characteristics, availability, household applications, industrial applications, and environmental impact.
5. Completing the concept map – Students will individually complete the concept map using the provided worksheet format. Guide them to connect related ideas between renewable and non-renewable sources, including their types and key features.



map as a visual tool for organizing ideas and relationships. Instruct students to create a concept map centered on “Energy Sources – Renewable vs. Non-Renewable,” branching out to include types, characteristics, availability, household applications, industrial applications, and environmental impact. Provide guidance as students complete their concept maps individually, ensuring that they link related ideas and identify key similarities and differences between energy sources. The concept map format is found in the LAS.

Afterward, invite selected students to share their outputs and encourage peers to provide feedback or add insights. Conclude the activity by facilitating a discussion using the guided generalization questions to help

	<div><div><div>6. Reflection on Patterns and Differences – Allow students to review their concept maps and reflect on the patterns, differences, and key features they observed.</div><div>7. Sharing of Outputs – Invite 3–5 volunteers to present their completed concept maps to the class.</div><div>8. Peer Feedback – Encourage other students to provide feedback or share additional connections they noticed.</div><div>9. Teacher-Facilitated Discussion – Guide the discussion to highlight key patterns, contrasts, and principles of energy sources.</div><div>10. Reflection and Generalization – Using the same worksheet, ask students to answer the provided reflection and generalization questions.</div></div><div>Guided Generalization Questions:</div><div><div>1. <i>What patterns or connections do you notice between renewable and non-renewable energy sources in terms of their types and availability?</i></div><div>2. <i>How do renewable and non-renewable energy sources differ in terms of their characteristics?</i></div><div>3. <i>How do these energy sources differ in their use in households and industries??</i></div><div>4. <i>What advantages and limitations can you identify for each type of energy source in terms of availability, efficiency, and environmental impact?</i></div><div>5. <i>Based on your concept map, what general principle can you conclude about the responsible and sustainable use of energy resources?</i></div></div></div> <td><div><i>students derive key principles about the responsible and sustainable use of energy resources.</i></div></td>	<div><i>students derive key principles about the responsible and sustainable use of energy resources.</i></div>
<div><div>V. ASSESSMENT</div><div>(Assessing Learnings)</div></div>	<div><div><div>Day 4</div><div>Test I: Read the statements below and choose the letter of the correct answer.</div><div><div>1. Energy sources can be grouped based on whether nature can replenish them quickly. Which statement best describes a renewable energy source?</div><div><div>A. An energy source that requires drilling for extraction</div><div>B. An energy source that forms in underground rock layers</div><div>C. An energy source that produces the highest temperature for industry</div><div>D. An energy source that is replenished naturally within a human timescale</div></div><div>2. Geothermal energy is defined as thermal energy stored within the Earth’s crust. What describes the reliability of geothermal energy?</div><div><div>A. It can only be used during daylight hours.</div><div>B. It is only accessible through the use of photovoltaic cells.</div><div>C. It is a 24/7 source of energy that is not weather-dependent.</div></div></div></div></div>	

- D. It is highly dependent on weather conditions like wind and rain.
3. Many countries rely on fuels formed from ancient plants and animals buried for millions of years. Which characteristic best describes non-renewable energy sources?
- A. They are weather-dependent.
 - B. They are naturally replenished each year
 - C. They produce energy without combustion
 - D. They exist in limited quantities and take millions of years to form**
4. Ocean energy uses the kinetic and thermal energy of seawater. Which description applies to the current state of ocean energy technology?
- A. It is the most mature and widely used renewable source.
 - B. It is an emerging field with many prototype devices.**
 - C. It is the cheapest form of electricity available today.
 - D. It is a non-renewable source found in deep-sea reservoirs.
5. A city planner is looking for "Photovoltaic (PV) Systems" to power streetlights. PV systems are an example of which energy source?
- A. Solar Energy**
 - B. Wind Energy
 - C. Ocean Energy
 - D. Geothermal Energy
6. Certain fuels are used in nuclear power plants. Which material is commonly used as fuel in nuclear energy generation?
- A. Coal
 - B. Uranium**
 - C. Methane
 - D. Biomass
7. A homeowner installs rooftop solar panels to generate electricity for lighting and appliances. What is the primary benefit of using solar energy in households?
- A. It requires coal combustion
 - C. It provides a renewable source of electricity**
 - B. It increases fossil fuel consumption
 - D. It produces high greenhouse gas emissions
8. Offshore wind turbines are typically larger and taller than onshore turbines. Why is this design more suitable for offshore wind energy generation?
- A. To lower the cost of construction materials
 - B. To reduce dependence on land-based electricity
 - C. To improve visibility for nearby sea vessels
 - D. To capture stronger and steadier winds at sea**
9. Small-scale hydropower is mentioned as being "especially suitable" for certain areas. In which context is this specific application most useful?
- A. In desert regions with no rainfall.
 - B. In remote locations and small communities.**
 - C. In the middle of the ocean for deep-sea mining.
 - D. In large metropolitan cities with high-rise buildings.

Lesson Title/Topic	Energy Sources	Lesson Exemplar	18
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I. OBJECTIVES	
A. Content Standard	The learners learn that the differences between renewable and non-renewable energy sources are key to making sustainable energy choices and reducing environmental impacts.
B. Performance Standard	By the end of the quarter, learners describe the origin of the solar system and Earth's historical evolution. They relate Earth's unique position in the solar system to its composition, structure, and the dynamic nature of its outer layers. Learners explain how scientists determine the nature of Earth's interior. They also collaboratively create detailed models and scientific analyses and use evidence-based findings to illustrate the nature and composition of the Earth.
C. Learning Competencies	The learners use secondary sources to make a proposal for conserving energy sources to promote economic and environmental sustainability.
II. REFERENCES and MATERIALS (Selecting Resources and Materials)	<p>"Addressing Republic Act 11285: Energy-saving Fan Technology for Increased Efficiency." n.d. https://www.ebmpapst.com/sq/en/newsroom/blog/republic-act-11285-philippines-energy-saving-fan-technology-for-increased-efficiency.html#:~:text=RA%2011285%20was%20signed%20into,effect%20on%20May%2011%2C%202019.</p> <p>Electric, Kazar's. 2022. "Disadvantages of Non-Renewable Energy." Kazar's Electric. March 21, 2022. https://www.kazarselectric.com/disadvantages-of-non-renewable-energy/#:~:text=They%20Pollute%20the%20Environment,climate%20change%20and%20respiratory%20problems.</p> <p>"Energy Conservation Earth Science." n.d. https://courses.lumenlearning.com/earthscienceck12/chapter/energy-conservation/.</p> <p>"Energy Efficiency and Conservation Act (Republic Act No. 11285 of 2018) ESCAP Policy Documents Management." n.d. https://policy.asiapacificenergy.org/node/2973#:~:text=Overall%20Summary:,energy%20efficiency%20and%20conservation%20projects.</p> <p>Euenergyweek. 2014. "Energy Let's Save It!" https://www.youtube.com/watch?v=y9e9z2KoGnI.</p> <p>IGS Energy. 2020. "Energy Conservation Vs. Energy Efficiency." https://www.youtube.com/watch?v=lqJ3ckBncyY.</p> <p>"Nonrenewable Energy." n.d. https://education.nationalgeographic.org/resource/non-renewable-energy/.</p> <p>Osobajo, Oluyomi A., Afolabi Otitoju, Martha Ajibola Otitoju, and Adekunle Oke. 2020. "The Impact of Energy Consumption and Economic Growth on Carbon Dioxide Emissions." <i>Sustainability</i> 12 (19): 7965. https://doi.org/10.3390/su12197965.</p>

	<p>“Philippines - Energy.” 2024. International Trade Administration Trade.Gov. January 23, 2024. https://www.trade.gov/country-commercial-guides/philippines-energy-0#:~:text=Overview,different%20types%20of%20energy%20sources. Vidyarthi, Anurag, Niharika Varshney, and Rajesh Upadhyay. 2021. “A Study Of The Effects Of Non-Renewable Energy Sources On The Environment.” Ilkogretim Online - Elementary Education Online 20 (2). https://doi.org/10.17051/ilkonline.2021.02.318.</p>	
III. CONTENT <i>(Sequencing Content)</i>	Energy Sources	
	<ol style="list-style-type: none"> 1. Identify practices related to energy consumption and conservation based on information obtained from secondary sources; 2. Use data and information from secondary sources to explain the economic and environmental effects of energy consumption; 3. Identify effective conservation strategies that promote economic and environmental sustainability based on information gathered from secondary sources; and 4. Develop a proposal to conserve energy sources and enhance economic and environmental sustainability, integrating insights from secondary sources. 	
IV. PROCEDURES		ANNOTATIONS
A. Activating Prior Knowledge	<p>Day 1: 1. Activating Prior Knowledge Option A: <i>Activity: Red Light, Green Light</i> Have the students play the activity. You can either download the slide presentation and display it on a TV or projector screen, or read the statements aloud, depending on the resources available. Instructions:</p> <ol style="list-style-type: none"> 1. Students will play an activity called Red Light, Green Light. <ul style="list-style-type: none"> o Green Light: The statement is TRUE — stand up. o Red Light: The statement is FALSE — sit down. 2. A series of statements related to the topic will be either read aloud or shown on the screen. 3. Students stand up if they think the statement is TRUE (Green Light) or sit down if they think the statement is FALSE (Red Light). <p>Statements:</p>	<p><i>This activity aims to activate students’ prior knowledge about energy consumption and conservation. Through the Red Light, Green Light game, students quickly evaluate statements, enabling the teacher to identify their current understanding and potential misconceptions.</i></p> <p><i>Encourage quick responses to maintain</i></p>

	<ol style="list-style-type: none"> At present, the residential sector is the largest consumer of electricity in the Philippines. <i>Answer: Green Light</i> Leaving electronics plugged in when not in use does not affect energy consumption <i>Answer: Red Light; Reason: Leaving electronics plugged in causes “vampire power” consumption, increasing electricity use.</i> Using LED bulbs instead of incandescent or CFL bulbs reduces both electricity costs and CO₂ emissions. <i>Answer: Green Light</i> Setting air conditioning units to very low temperatures is the most energy-efficient practice. <i>Answer: Red Light; Reason: Setting ACs too low increases energy consumption; efficient settings are around 24–25°C.</i> Collecting rainwater and using it for irrigation does not help reduce energy consumption. <i>Answer: Red Light; Reason: Rainwater harvesting reduces energy needed for large-scale water treatment and pumping, saving energy.</i> <p>2. Establishing the Purpose of the Lesson <i>Option A: Energy: Let’s Save It!</i> Objective: After the introduction of key terms in the previous activity, students will understand the lesson’s learning goals, relevance, and real-life applications by viewing and reflecting on the selected video(s). Suggested videos can be accessed here: https://www.youtube.com/watch?v=y9e9z2KoGnI or https://www.youtube.com/watch?v=lqJ3ckBncyY Materials: <ul style="list-style-type: none"> Laptop, projector, or TV Audio speaker Notebook for students to jot down answers Procedure: <ol style="list-style-type: none"> Introduction: Tell the class they will watch a short video about energy and its importance in conservation. Ask them to consider how the content relates to their daily life and why it matters. Video Viewing: Play the video(s). Encourage students to take notes on key points, examples, and any ideas that surprise or interest them. </p>	<p><i>engagement. Briefly clarify incorrect answers when necessary, but avoid long discussions, as the concepts will be explored more deeply later in the lesson. This activity also serves as a diagnostic tool to guide the teacher in emphasizing key ideas in the succeeding discussion.</i></p> <p><i>You may download a copy of the Red Light, Green Light PDF & Slide Presentation at this link: https://tinyurl.com/RedLightGreenLightActiv</i></p> <p><i>The activity is designed to help you engage your students at the start of the lesson by connecting energy concepts to their everyday lives. Showing the video(s) provides a visual and relatable way for them to understand why conserving energy is important and the rationale behind the</i></p>
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	<p>3. Guided Discussion: Facilitate a discussion to help students connect the video content to lesson goals, relevance, and real-life applications.</p> <p>Guide Questions – Understanding the Lesson Goals:</p> <ol style="list-style-type: none"> 1. <i>What are the main ideas about energy highlighted in the video?</i> 2. <i>Can you identify at least two examples from the video that relate to your household or school?</i> 3. <i>What simple actions from the video can you personally take that can be applied at home?</i> 4. <i>After watching the video, why do you think learning about energy conservation is important for everyone?</i> 	<p><i>lesson. Use the guided questions to prompt reflection and discussion, encouraging students to identify examples from their homes or school and simple actions they can take. This will help them recognize the lesson's relevance and establish a clear purpose for their learning.</i></p>
<p>B. Instituting New Knowledge</p>	<p>1. Presenting Examples</p> <p><i>Activity 1: Energy Detective – Situation Analysis</i></p> <p>Objective: Students will identify practices related to energy consumption and conservation based on information from secondary sources.</p> <p>Materials:</p> <ul style="list-style-type: none"> • Energy Situation Cards • Whiteboard or Manila paper <p>Procedure:</p> <ol style="list-style-type: none"> 1. Divide the class into five groups. Each group receives an Energy Situation Card describing everyday energy use in different settings. <p><i>Card 1 – Home Energy Use</i></p> <p>A family uses several electrical appliances daily in their home, including air conditioning, lighting, and small devices that are often plugged in. Their daily routine sometimes includes leaving rooms unoccupied while appliances continue running, especially during busy mornings and evenings. At the same time, they have recently begun switching to LED bulbs and are becoming more mindful of unplugging some devices when not in use, depending on who is at home and the time of day.</p>	<p><i>This activity engages learners in identifying energy consumption and conservation practices from real-life situations in home, school, workplace, transport, and community settings. Through group work, students analyze each situation, classify behaviors as energy-wasting or energy-saving, and share their findings with the class. The teacher then synthesizes responses to highlight common patterns and reinforce understanding of</i></p>

	<p><i>Card 2 – School Classroom</i></p> <p>A typical classroom uses various equipment such as projectors, computers, electric fans, and lighting systems throughout the school day. Depending on the schedule, some devices remain running during short breaks or when students move to other activities. However, teachers also encourage the use of natural ventilation when possible, and students sometimes remember to turn off lights when leaving, although this is not always consistently done.</p> <p><i>Card 3 – Office Workplace</i></p> <p>An office environment operates with multiple electronic systems, including computers, printers, and lighting, which are used continuously during working hours. In some instances, equipment remains powered on during lunch breaks or when employees are away from their desks for meetings. However, certain departments have started encouraging staff to reduce unnecessary energy use by adjusting equipment settings and being more mindful of shutdown routines at the end of the day.</p> <p><i>Card 4 – Transportation System</i></p> <p>In an urban area, daily transportation relies heavily on diesel-powered buses, jeepneys, and private vehicles, especially during peak hours, which contributes to continuous fuel consumption and traffic delays. At the same time, some commuters occasionally choose alternative options such as walking short distances, cycling, or sharing rides with others, depending on convenience, weather conditions, and travel needs.</p> <p><i>Card 5 – Community Facility</i></p> <p>A community center hosts various activities throughout the week, requiring the use of lighting, electric fans, and water systems at different times of the day. Some areas of the facility remain powered even when not fully occupied, especially during events with shifting schedules. In other instances, the center has adopted certain practices such as scheduled lighting control and partial use of renewable energy sources to support its operations.</p> <p>2. Task: Students read the situation and identify practices that show:</p> <ul style="list-style-type: none"> • Which practices waste energy? • Which practices conserve energy? <p>3. Sharing: Groups present their identified practices to the class.</p>	<p><i>responsible energy use.</i></p> <p><i>Clearly explain and model one example before group work. Roam around to guide learners and ensure active participation. Encourage evidence-based answers from the situation cards. During sharing, ask follow-up questions to deepen thinking. Summarize responses on the board to highlight patterns.</i></p>
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	<p>4. Synthesis: After the presentation, the teacher asks students to list all identified practices on the board and group them into:</p> <ul style="list-style-type: none"> • Energy Consumption Practices • Energy Conservation Practices <p>Guide Questions:</p> <ul style="list-style-type: none"> • <i>What energy-consuming and energy-conserving practices did you identify in the situations?</i> • <i>What patterns do you notice about energy use across home, school, workplace, transport, and community settings?</i> • <i>Which identified practices are most effective in reducing energy use, and why do you consider them effective?</i> • <i>If these energy-consuming practices continue, what possible effects could they have on economy and the environment?</i> <p><i>Transition: After the activity, learners will examine the economic and environmental effects of energy consumption using secondary sources.</i></p> <p>Day 2: 2. Discussing New Concept <i>Activity: Energy Impacts Case Study – Economy and Environment</i> Objective: Students will analyze real-life energy scenarios to explain both the economic and environmental effects of energy consumption. Materials:</p> <ul style="list-style-type: none"> • Printed case scenarios (one per group) • Manila paper or whiteboard • Markers or pens <p>Procedure:</p> <ol style="list-style-type: none"> 1. Group Formation: Divide the class into five groups. Each group receives a case scenario on real-world energy use (e.g., household, school, industry, transport, or commercial establishment). Download a copy of the scenarios in this link: https://tinyurl.com/ScenarioEffectsEnergyconsump 2. Case Analysis: Each group analyzes their scenario and identifies: <ul style="list-style-type: none"> • Economic Effects: <ul style="list-style-type: none"> ○ Costs of energy use (e.g., high electricity rates, fuel expenses) ○ Financial burden on households, businesses, or communities 	<p><i>This activity engages learners in group analysis of real-life energy scenarios to identify both economic and environmental effects of energy use. Students examine costs and impacts then share and compare their findings to recognize patterns across different contexts.</i></p> <p><i>Model one example before group work</i></p>
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	<ul style="list-style-type: none"> • Environmental Effects: <ul style="list-style-type: none"> ◦ Pollution (e.g., air pollution, greenhouse gas emissions) ◦ Environmental damage (e.g., ecosystem disruption, climate-related impacts) • Key Issue: <ul style="list-style-type: none"> ◦ The main problem caused by energy consumption or misuse <p>3. Presentation: Groups present their analysis using Manila paper or a whiteboard, highlighting:</p> <ul style="list-style-type: none"> • The key economic effects • The key environmental effects • The primary issue identified in the scenario <p>4. Class Discussion and Generalization: The teacher facilitates a synthesis of ideas across all groups.</p> <p>Guide Questions:</p> <ul style="list-style-type: none"> • <i>What are the economic and environmental effects of energy consumption in your scenario?</i> • <i>How does energy use contribute to financial costs and environmental problems?</i> • <i>Which practices or conditions worsen these impacts?</i> • <i>Why is it important to understand both the economic and environmental effects of energy use?</i> <p>3. Developing Mastery</p> <p><i>Activity: Energy in Action: Exploring Real-Life Use and Conservation</i></p> <p>Objective: Students will become familiar with real-life energy consumption and conservation practices based on credible secondary sources and relate them to their own daily lives.</p> <p>Materials:</p> <ul style="list-style-type: none"> • Printed copies of the “Practices on Energy Consumption and Conservation” list for each student (download a copy of the material in this link: https://tinyurl.com/Energyconsumptionconservation) • Manila paper or board to record key points <p>Procedure:</p> <ol style="list-style-type: none"> 1. Distribute printed copies of the energy practices to all students. <table border="1"> <thead> <tr> <th>Area of Focus</th><th>Practices on Energy Consumption and Conservation</th><th>Source</th></tr> </thead> <tbody> <tr> <td>Daily Habits</td><td>Turning off lights and appliances when not in use helps reduce electricity use and lower energy bills.</td><td>EIA – Efficiency & Conservation</td></tr> </tbody> </table>	Area of Focus	Practices on Energy Consumption and Conservation	Source	Daily Habits	Turning off lights and appliances when not in use helps reduce electricity use and lower energy bills.	EIA – Efficiency & Conservation	<p><i>begins. Roam around the classroom to guide participation and keep groups on task. Prompt learners to support answers with evidence from the scenario. Use follow-up questions during presentations to deepen analysis and connect ideas across groups. Keep discussion grounded in real-life experiences.</i></p> <p><i>This activity engages learners in examining credible secondary-source information on real-life energy consumption and conservation practices and relating these to their daily experiences. Students review and discuss examples from various contexts such as households, transportation, technology use, and</i></p>
Area of Focus	Practices on Energy Consumption and Conservation	Source						
Daily Habits	Turning off lights and appliances when not in use helps reduce electricity use and lower energy bills.	EIA – Efficiency & Conservation						

		Replacing incandescent bulbs with LED bulbs saves electricity because LEDs use less energy and last longer.	IEA – Saving Energy	<i>community initiatives, then share insights and personal practices. The teacher facilitates the discussion to highlight common energy-saving behaviors and reinforce their impact on cost reduction and environmental protection.</i> <i>Guide learners in interpreting the material by emphasizing key ideas before discussion. Encourage the sharing of real-life experiences to make learning more relatable. During sharing, highlight accurate practices from credible sources. Lead the class in summarizing key energy-saving patterns on the board.</i>
		Walking, cycling, or using public transport for short trips reduces fuel consumption, saves money, and cuts air pollution.	IEA – Saving Energy	
	Household/ Building Efficiency	Using programmable thermostats and energy-efficient lighting reduces overall electricity consumption.	EIA – Efficiency & Conservation	
		Insulating windows and draft-proofing homes reduces heating and cooling energy use.	IEA – Saving Energy	
		Conducting a home energy audit helps households identify ways to reduce energy waste.	EIA – Efficiency & Conservation	
	Technology & Renewable Solutions	Installing solar panels reduces electricity costs and decreases dependence on non-renewable energy sources.	MEED – Sustainable Energy	
		Energy management systems allow real-time monitoring and optimization of electricity use, improving efficiency.	MEED – Sustainable Energy	
		Upgrading appliances to energy-efficient models (e.g., smart refrigerators, inverter A/Cs) lowers electricity consumption.	DOE Philippines – Energy Efficiency	
	Government & Community Actions	Government offices set thermostats to 24°C to save energy and reduce costs.	PIA Philippines – DOE	
		Cities install LED streetlights and solar panels on public buildings to cut energy use and electricity bills.	OECD – Clean Energy Roadmap Philippines	
		Government-led energy awareness campaigns encourage citizens to adopt conservation habits.	PIA Philippines – DOE	
	Broader Sustainability Practices	Reducing energy use lowers demand on electricity systems and decreases greenhouse gas emissions.	EIA – Efficiency & Conservation	
		Energy savings through efficiency measures reduce household or city electricity bills and support economic stability.	IEA – Saving Energy	
		Combining small behavior changes (turning off unused devices) with efficient technologies gives the greatest energy savings.	IEA – Saving Energy	
	2. Call on volunteers to explain specific practices and share personal experiences. Emphasize that these examples are drawn from credible sources such as the U.S. Energy Information Administration, International Energy Agency, Department of Energy Philippines, MEED, and the Organization for Economic Co-operation and Development.			
3. Facilitate a discussion on how these practices are applied in students’ own homes, schools, or communities. Encourage students to share personal experiences.				
4. Record common practices on the board to highlight patterns of energy conservation and identify areas where habits could improve.				
Guide Questions:				
• Which of these practices do you already do at home?				

	<ul style="list-style-type: none"> • Which practices could you adopt to save energy and reduce costs? • How do these actions benefit the environment and your household economy? • How can you personally apply one of these conservation strategies in your own school or household? • Why is it important to follow the said strategies for energy conservation? 	
C. Demonstrating Knowledge and Skills	<p><u>Days 3 & 4</u></p> <p>1. Finding Practical Application</p> <p><i>Activity: “Energy Conservation Proposal”</i></p> <ul style="list-style-type: none"> • Objective: Students will develop a proposal for conserving energy sources to promote economic and environmental sustainability, using insights from secondary sources. • Procedure (2 Days) <ol style="list-style-type: none"> 1. The class will be divided into five groups. Each group will be assigned one energy-related situation. 2. Groups will carefully analyze their assigned situation and identify the key energy problems involved. 3. Students will conduct guided research using credible secondary sources (e.g., government websites, scientific articles, and energy reports) to support possible solutions. 4. Each group will begin drafting a proposal using the provided Energy Proposal Template in the LAS. <p>Proposal should include:</p> <ul style="list-style-type: none"> • Introduction (context of the situation) • Problem Statement (key energy issues and their economic and environmental impacts) • Proposed Solution(s) (evidence-based strategies for energy conservation) • References (APA 7th Edition format) <p>Day 2 – Presentation and Reflection</p> <ol style="list-style-type: none"> 1. Each group presents their proposal to the class (5–7 minutes per group). 2. After each presentation, allow 2–3 minutes for class questions or feedback. 3. The teacher facilitates a discussion on how each proposal addresses economic and environmental sustainability, highlighting key lessons. <ul style="list-style-type: none"> • Specific Instructions: 	<p><i>This activity allows students to apply their learning by developing practical, real-world solutions for energy conservation. Teachers should guide students in analyzing their assigned scenarios, identifying key energy issues, and linking solutions to both economic and environmental benefits. Encourage learners to use credible secondary sources to support their proposals and ensure solutions are realistic and actionable. Teachers should roam around during group work, providing prompts or clarifications, and help students stay focused on the objectives of sustainability and energy efficiency.</i></p> <p><i>During presentations, teachers should</i></p>

	<p>GRASPS Model</p> <p>G – Goal: To develop a clear, realistic, and evidence-based proposal that addresses energy consumption issues and promotes sustainable energy use.</p> <p>R – Role: You are energy consultants tasked with advising a community, school, industry, or organization on how to reduce energy waste and improve energy efficiency.</p> <p>A – Audience: Your proposal will be presented to your classmates and teacher, who will act as stakeholders or decision-makers evaluating the feasibility and impact of your solutions.</p> <p>S – Situation/Scenario: Each group will analyze a real-world energy-related situation. Using secondary sources, you will identify problems and propose practical and sustainable solutions.</p> <p>Scenarios:</p> <p><i>Group 1 – Residential Energy Challenge</i></p> <p>A group of boarding houses is experiencing rising electricity bills due to outdated appliances and inconsistent energy-use practices among tenants. The owner must decide whether to invest in energy-efficient upgrades or focus on stricter energy-use policies to reduce costs while maintaining tenant comfort and affordability.</p> <p><i>Group 2 – School Energy Management</i></p> <p>A public school faces high electricity costs caused by old lighting systems, continuously operating classroom equipment, and inefficient cooling systems. School administrators are considering whether to upgrade facilities, install renewable energy systems, or implement stronger energy monitoring practices.</p> <p><i>Group 3 – Industrial Energy Efficiency</i></p> <p>A food processing company is expanding production but continues to use energy-intensive, outdated machinery. Management is evaluating options such as upgrading to energy-efficient equipment, integrating renewable energy sources, or optimizing production schedules to balance cost, efficiency, and environmental responsibility.</p> <p><i>Group 4 – Urban Transport Sustainability</i></p> <p>A city is experiencing rising fuel costs, traffic congestion, and air pollution due to reliance on old diesel-powered public transport. The local government is considering solutions such as shifting to electric vehicles, improving existing engines, or redesigning transport systems to include more sustainable mobility options.</p>	<p><i>facilitate discussion, highlighting the effectiveness, feasibility, and relevance of each group’s proposal. Encourage peers to ask constructive questions and connect each solution to broader impacts on households, schools, industries, and communities.</i></p>
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Group 5 – Community Energy Operations

A community center has increasing electricity expenses due to continuous use of lighting, cooling systems, and water pumps even during low occupancy. Management is exploring options such as installing solar energy systems, using automated energy controls, or combining infrastructure upgrades with energy-saving practices.

P – Product/Performance: Each group will submit and present a written proposal containing:

1. Introduction – Brief description of the assigned situation
2. Problem Statement – Identification of key energy issues and their economic and environmental impacts
3. Proposed Solution(s) – Evidence-based and practical strategies to improve energy efficiency and conservation
4. References – Credible secondary sources cited in APA 7th Edition format

S – Standards/ Criteria for Success: Your proposal and presentation will be evaluated based on:

- Clarity and organization: Introduction, Problem, Proposed Solution
- Use of secondary sources to support claims
- Feasibility and practicality of proposed solutions
- Relevance to economic and environmental sustainability
- Presentation skills: Engagement, clarity, teamwork

Use the rubric provided

Rubric for Energy Conservation Proposal				
Criteria	Excellent (4)	Good (3)	Fair (2)	Needs Improvement (1)
Clarity & Organization	Proposal is well-structured with clear Introduction, Problem, and Solution	Proposal mostly organized; minor gaps in structure	Proposal somewhat organized; some confusion in sections	Proposal poorly organized; hard to follow
Use of Secondary Sources	Uses at least 2 reliable sources to support solutions	Uses 1–2 sources, some may be less reliable	Uses 1 source, not fully relevant	No sources or sources unreliable
Feasibility & Practicality	Solutions are realistic, actionable, and clearly explained	Solutions mostly feasible; minor gaps in explanation	Some solutions feasible but not practical	Solutions unrealistic or unclear
Economic & Environmental Relevance	Clearly explains how solutions impact both economy and environment	Explains either economic or environmental impact	Explains impact vaguely	No clear connection to sustainability
Presentation Skills	Clear, confident, engaging; good teamwork	Clear and confident; minor teamwork issues	Some clarity issues; uneven participation	Hard to follow; poor teamwork or participation

	<p><u>Day 5:</u> 2. Making Generalization <i>Activity: “One-Minute Takeaway” Sharing</i> Objective: Students summarize the key points of the lesson and share them with the class. Procedure:</p> <ol style="list-style-type: none"> 1. Ask each student to think individually about the most important lesson they learned about energy consumption, its effects, and conservation strategies. 2. Students write a 1–2 sentence takeaway in their activity notebook. 3. Ask some volunteers to share their takeaways. 4. Teacher records common themes on the board (practices, effects, strategies, real-life applications). 5. Conclude the activity by highlighting the generalizations: <ul style="list-style-type: none"> ○ Energy choices impact both the economy and the environment. ○ Simple conservation practices can reduce costs and emissions. ○ Using evidence-based strategies ensures sustainability. <p>Guide Questions to Prompt Takeaways:</p> <ul style="list-style-type: none"> • <i>What is one thing you learned about energy use and its effects?</i> • <i>Which energy conservation strategy seems most practical for daily life?</i> • <i>Why is it important to conserve energy in your home, school, or community?</i> 	<p><i>This activity allows students to reflect on and summarize the key lessons about energy consumption, its economic and environmental effects, and practical conservation strategies. By writing and sharing a 1–2-sentence takeaway, students consolidate their understanding, while the teacher highlights common themes and connects them to real-life applications, reinforcing the importance of evidence-based energy conservation practices in daily life.</i></p>
<p>V. ASSESSMENT <i>(Assessing Learnings)</i></p>	<p>Test I: Read each situation carefully and choose the letter of the correct answer.</p> <ol style="list-style-type: none"> 1. A family in Laguna noticed that their electricity bill increased by 25% over the past three months. They found that air conditioners were often left running even when rooms were empty, and several appliances stayed plugged in overnight. What is the most appropriate explanation for the increase in electricity use? <ul style="list-style-type: none"> A. Appliances are left running even when not needed B. Energy-efficient appliances are not yet installed at home C. Lighting is used excessively during daytime hours D. Air circulation in the house is not properly managed 2. A community replaced all streetlights with LED bulbs. After one year, they noticed lower electricity costs and fewer maintenance issues. What explains this outcome? <ul style="list-style-type: none"> A. LEDs use less energy and last longer B. LEDs increase voltage stability in the system 	

- C. LEDs require constant electricity supply
 - D. LEDs produce more heat than traditional bulbs
3. A factory in an industrial zone uses coal-powered machinery for its production processes. Over time, nearby communities report increased respiratory illnesses, declining air quality, and damage to crops and buildings due to acidic deposits. What environmental impact is most directly associated with this situation?
- A. Increased global temperatures due to greenhouse gas buildup
 - B. Air pollution and acid rain from industrial emissions**
 - C. Reduced water supply from excessive industrial water use
 - D. Ocean ecosystem changes caused by excess carbon dioxide
4. A barangay is planning to install solar panels for its public facilities. Although the initial cost is high, long-term projections show reduced electricity expenses and less dependence on the local power grid over the next 10–15 years. What economic principle best supports this decision?
- A. Prioritizing immediate savings over future gains
 - B. Focusing on short-term financial returns
 - C. Choosing lower-cost energy sources with minimal investment
 - D. Investing in long-term savings and efficiency improvements**
5. A household replaces an old refrigerator with a modern inverter-type model. After several months, electricity use decreases while cooling performance remains the same. What principle explains this change?
- A. Appliances operate at full power continuously to maintain cooling
 - B. Energy use increases due to continuous system regulation
 - C. Appliances adjust power use based on cooling demand**
 - D. Energy consumption remains constant regardless of usage
6. A city government replaces diesel jeepneys with electric jeepneys to reduce emissions and improve urban sustainability. What is the most significant environmental benefit of this transition?
- A. Lower greenhouse gas emissions and improved air quality**
 - B. Increased demand on the local electricity supply
 - C. Reduced exhaust pollution with added battery disposal concerns
 - D. Lower fuel use with added infrastructure requirements
7. A mall discovers that air conditioning units are set to 18°C, causing excessive electricity consumption and higher operational costs. Which adjustment would improve energy efficiency without compromising comfort?
- A. Set the temperature to a moderate 24–26°C**
 - B. Run air conditioning continuously at 18°C regardless of occupancy
 - C. Turn off all air conditioning units permanently
 - D. Increase the number of air conditioning units to improve airflow
8. A manufacturing company evaluates two options:

Option 1: Continue using old machines with high energy consumption
Option 2: Upgrade to energy-efficient machines with a higher initial cost

Which factor should most influence the company's decision?

- A. Only the initial purchase cost
- B. Size and space of the new machines
- C. Popularity of the technology
- D. Long-term savings and environmental impact**

9. A household adopts the following practices:

- Uses LED lighting throughout the home
- Unplugs appliances when not in use
- Maximizes natural daylight during the day

What is the combined impact of these practices?

- A. Reduce electricity use in some areas, but increase overall household consumption
- B. Reduce energy consumption and minimize environmental impact**
- C. Reduce reliance on renewable energy while increasing fossil fuel use
- D. Reduce immediate energy costs but increase greenhouse gas emissions

10. A local government launches an energy awareness campaign to encourage residents to practice energy conservation at home and in the community. Why is this strategy important for long-term sustainability?

- A. Promote increased electricity production to meet demand
- B. Achieve short-term reductions in electricity use only
- C. Replace energy technologies with simple daily habits
- D. Encourage long-term behavior change that supports conservation**

Test II. Read the scenario below carefully. Using the data provided and your knowledge of energy conservation from credible secondary sources (e.g., DOE, IEA, Meralco guidelines), answer the questions that follow. Write your answers in clear sentences and provide reasoning for each response.

Scenario: You are a member of the Student Government at Malaya High School. The school's electricity bill has increased by 30% over the last year, now costing PHP 50,000 per month, which is preventing the school from buying new library books and sports equipment. The school has old fluorescent lights that stay on 10 hours a day, non-inverter air conditioners running all day, and computers and photocopiers left on standby overnight. Even though the school is in a sunny, breezy coastal area, it still relies completely on coal-powered electricity.

1. What energy problem is the school facing?
2. What realistic solution can you recommend to conserve energy?
3. How will your solution save money and protect the environment, using insights from at least one credible secondary source?

VI. REFLECTION <i>(Feedback and Continuous Improvement)</i> VII. USE OF GENERATIVE AI	<i>Criteria for assessing learners' responses</i>				
	Criteria	Excellent (4)	Good (3)	Fair (2)	Needs Improvement (1)
	Identification of Energy Problem	Clearly and accurately identifies the main energy issues in the school.	Identifies relevant energy issues but lacks detail or completeness.	Mentions energy issues vaguely or partially.	Fails to identify relevant energy issues.
	Proposed Solution	Suggests a realistic, feasible, and effective solution.	Suggests a solution that is feasible but not fully detailed or innovative.	Suggests a solution that is partially feasible or lacks clarity.	Suggests an unrealistic or irrelevant solution.
	Economic Justification	Clearly explains how the solution will save money with strong reasoning.	Explains economic benefits with some reasoning.	Provides minimal economic reasoning.	Provides little or no explanation of economic benefits.
	Environmental Justification	Clearly explains how the solution will protect the environment with strong reasoning.	Explains environmental benefits with some reasoning.	Provides minimal environmental reasoning.	Provides little or no explanation of environmental benefits.
	Use of Secondary Source	Effectively integrates at least one credible secondary source to support the solution.	Uses a source, but integration or relevance is weak.	References a source, but relevance or credibility is unclear.	No credible source used or source is irrelevant.
	<i>This section presents the key highlights and challenges encountered by both teachers and learners throughout the unit. It also includes the teacher's adjustments to improve instruction.</i>				
	In preparing this Learning Exemplar (LE), the author used ChatGPT and Gemini AI in order to refine the text, improve sentence and question construction, and enhance examples and learning activities. The author reviewed and finalized the content. The author takes full responsibility for the content of this LE.				